
Changes in the sea-ice conditions long the west coast of Svalbard has during the last decades changed and affected conditions ashore. The effect upon the discharge characteristics of small drainage basins close to the seashore are discussed. The area studied is situated on the coastal plain, south of Kapp Linne’ (78°04' N, 13°38' E) with special focus on the anomalous discharge pattern of the Fysvåen Lake catchment area. The drainage of the lake is with increased frequency blocked by ice-cemented storm ridges delaying the spring and snowmelt peak flow. Vast areas are flooded, affecting vegetation and breeding birds of the area. The Lake is then, dramatically tapped during one or two days with heavy flow, after which the discharge pattern returns to normal. This process, is not unique here but rather common along the west coast of Svalbard. These special conditions have a clear influence on the active layer, the permafrost and the vegetation and the bird colonies of the area.

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PHOTOCHEMISTRY MINERALIZES DISSOLVED ORGANIC MATTER (DOM) AND INCREASES DOM BIOAVAILABILITY IN THE ATLANTIC SEA

Direct photomineralization of dissolved organic carbon (DOC) and nitrogen (DON) as well as the stimulation of bacterial growth by photoproduction of labile organic substrates were investigated by simulated solar irradiation experiments using waters from a freshwater-marine gradient in the Baltic Sea. We calculated the annual photomineralization rates of DOC and DON and the annual photoproduction rate of labile organic substrates which supported bacterial growth according to the solar irradiance in the Baltic Sea and the experimentally determined apparent quantum yields for the photochemical reactions. The calculated photomineralization rate of DON was lowest in the regions with terrestrial dominated DON while the photomineralization rate of DON decreased along the freshwater-marine gradient. The calculated photomineralization of DOC and DON over the whole Baltic Sea corresponded to 10% and 6% of annual river loadings in the Baltic Sea, respectively. The bacterial carbon-biomass supported by photoproduced labile substrates corresponded to 6–27% of the direct photomineralization of DOC. Thus, solar-irradiation-induced photochemical reactions provide an important source of labile organic carbon and ammonium to the food webs of the Baltic Sea.

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U.S. FUNDING FOR OCEAN RESEARCH: MATCHING RESOURCES AND REQUIREMENTS

There has been a significant shift in U.S. funding for the ocean sciences over the last twenty years, with an increasing dependence on the National Science Foundation as the primary funding agency. With increased competition for funding as well as increasing costs for oceanographic research facilities (including ships), there are some serious funding challenges ahead. I will discuss how these financial issues combine with fundamental changes in the research and development enterprise to create new stresses as well as new opportunities. Increased emphasis on interdisciplinary research and innovation (in its broadest sense) will require us to rethink how academic research organizations are structured and how individual scientists are rewarded. Development of non-federal funding will help accelerate this process.

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DUAL LAYER FILTRATION SYSTEM FOR CONCENTRATING FECAL INDICATORS AND PATHOGENS FROM MARINE WATERS

The ability to rapidly and effectively concentrate diverse microbes is an essential component for monitoring water quality at recreational beaches. The purpose of this study was to develop a 90 mm diameter 0.45µm pore size dual membrane system, which can simultaneously concentrate both viruses and either bacteria and/or protozoa. The top PVDF membrane was used to filter bacteria/protozoa by physical straining while the bottom HA membrane retained viruses through adsorption. Results indicated that 73%±50% of the test bacteria (E. facialis) and 82±18% of the test virus (M52 coliphage) were recovered. Recoveries of Cryptosporidium and Giardia varied between 80 and 70%. The highest recoveries of poliovirus (Polio 1 CHAT) were obtained with a guanidine hydrochloride elution solution followed by secondary concentration using a commercially available column. Future experiments should focus on measurements utilizing additional bacteria and viruses as well as water with different physical and chemical parameters.

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PATHOGEN AND INDICATOR MICROBE LEVELS AT A RECREATIONAL MARINE BEACH

Swimming in contaminated ocean waters continues to be a rising health concern, especially in beaches where the source of pollution is not known. The purpose of this study was to determine the microbial water quality of a sub tropical beach in Miami-Dade in order to gain insight on the health risk to bathers. Water and sand samples were concentrated and analyzed for fecal indicator microbes (coliiform, E. coli, enterococci, C. perfringens, coliphage, Bacteriodes, polyomavirus) and for pathogens (Vibrio vulnificus, S. aureus, enterovirus, norovirus, hepatitis A virus, Cryptosporidium parvum and Giardia lamblia). Indicator bacteria results were generally below the health standard while pathogens testing positive included Vibrio vulnificus in the sand and water as well as norovirus in two water samples. Giardia lamblia was detected in two water samples at 11 and 51 cysts per liter while Cryptosporidium parvum was detected in two sand samples at 12 and 5 oocysts per 100 grams. Risk associated with the pathogens and the efficiency of using indicator microbes to determine the safety of recreational waters should be evaluated given these findings.

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GLACIAL-INTERGLACIAL VARIABILITY OF THE BENQUELA CURRENT SYSTEM, SW AFRICA (ODP LEG 175, SITE 1084) USING MULTIPLE PALEOCENOGRAPHIC PROXIES

Thirty-two core samples (modern to MIS 8) were used to reconstruct productivity and upwelling intensity at ODP Leg 175, Site 1084. Globigerina bulloides, Globorotalia inflata, and Neogloboquadrina pachyderma (dental and sinistral), were used as paleoceanographic proxies. Preliminary results indicate maximum productivity and/or enhanced preservation corresponding to MIS 2, 4, 6, and 8. The age of our interglacial stage 1 sample suggests that productivity was also high or preservation enhanced during MIS 2, 4, 6, and 8. The age of our interglacial stage 1 sample suggests that productivity was also high or preservation enhanced during MIS 2, 4, 6, and 8.

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STABLE ISOTOPIC AND FTIR INVESTIGATIONS INTO THE INTERACTION BETWEEN ORGANIC MODEL COMPOUNDS AND DOM IN A SUB-ESKIMO ECOSYSTEM

Increased industrialization impacts aquatic ecosystems through the injection of organic pollutants into natural waters. Differences in the chemical characteristics of dissolved organic matter (DOM) can affect the solubility of contaminants in natural waters. In this work we demonstrate that changes in model compound solubility can be used to quantitatively investigate the chemical characteristics of DOM. We present a new technique to measure the solubility enhancement of select model organic pollutants (stryene, dodcenol
The goal of the cookbook is to provide basic recipes for data visualizations and laboratory observations (NEO) image generation and analysis tool developed as part of the ESD Visualization and Analysis Infrastructure (system and the NASA Earth Observation System), Kempler, S.

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MORE will be co-sponsoring a nationwide Teacher Workshop on microbial oceanography real-time data, and the global importance of marine microbes. During summer 2008, C-MORE was established to provide professional development and training opportunities for scientists and educators, and improving public awareness of microbial oceanography. During its inaugural year, C-MORE emphasized K-12 teacher training, which included shipboard experiences for science teachers and mini-grants to incorporate microbial oceanography into their curriculum. C-MORE is also developing partnerships with schools to help teachers create place-based curriculum that teaches students about cutting edge research, application of microbial oceanography into the sinking phase, but no subsequent disaggregation. Unlike haptophytoplankton aggregates, fecal pellets appear to undergo little exchange with surrounding material during transit through the water column, resulting in highly efficient POC export.

The extent to which sinking particlesdisaggregate and exchange with surrounding material affects the efficiency of POC export to the deep sea. In 2003 and 2005, as part of the Mediterranean Sargasso Sea (Medsargasse) Project, we compared the pigment and amino acid compositions of sediment trap and in situ pump samples to assess exchange between sinking and suspended particles. Sinking particles were enriched in fecal pellet indicators and suspended particles in chlorophyll and bacterial degradation products. These compositions remained consistent with depth, suggesting that exchange was limited. Similar results were obtained in 2006 when particles were settling from the SST around the Mediterranean Gyre (SSM). In 2006 and 2007, we investigated the role of mixing and coastal upwelling on particle aggregation and exchange in the northern North Atlantic. We found that mixing and coastal upwelling can result in the disaggregation of sinking particles and the exchange of material into and out of the sinking pool. These processes can have important implications for carbon cycling in the ocean.

The ability of sinking particles to exchange material with the surrounding water is critical for regulating carbon fluxes and nutrient cycling in the ocean. Understanding the mechanisms and rate of particle exchange can provide insights into the biogeochemical processes that govern carbon cycling in the ocean. By examining the compositions of sinking particles and the surrounding water, we can infer the extent to which these particles are affected by mixing and coastal upwelling.

ACKNOWLEDGMENTS

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The patterns of nutrients and phytoplankton biomass (Chl a) are reported and related to the oceanographic conditions in spring, summer, and winter, and in-plume and out-plume regions on the Ishikari Bay, Japan. Nutrients distribution in surface waters was characterized by the general tendency to decrease from spring to winter, and plume to out-plume region. In spring, when the in-sea diffusion of nutrients was highest, total Chl a biomass was at par in plume (2.30 mg m⁻²) and out-plume (2.39 mg m⁻²) region. Marked seasonal differences in size fractions were also observed. When the water column was strongly stratified and nutrient concentrations were low at surface in summer, average total Chl a values were 0.80 mg m⁻² and 0.38 mg m⁻² respectively in plume and out-plume regions. In winter, the intrusion of nutrients into the plume region by intense vertical mixing and riverine inputs produced an increase of the total autotrophic biomass (7.36 mg m⁻²). This study illustrates how changes in environmental gradients of the coastal system in time and space are affected by seawater dilution, vertical mixing, biological activities and light attenuation.

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SPATIO-TEMPORAL ANALYSES OF NUTRIENTS AND PHYTOPLANKTON BIOMASS IN SUB-ARTIC COASTAL ENVIRONMENT OF JAPAN

The concentrations, nature and reactivity of DOM in rivers, estuaries and coastal waters. The concentrations, nature and reactivity of DOM, in turn, are largely determined by source materials, watershed geochemistry, oxidative processes and hydrology. As a result, DOM in North American rivers exhibit a wide range of concentration (<80 to >400 µM C⁻¹) and specific ultra-violet absorbance (0.6 to >5 L *mg C⁻¹ m⁻¹), an optical measurement that is an indicator of aromatic carbon content. Different rivers, therefore, deliver DOM with different reactivities and optical properties to estuaries and coastal regions, thereby influencing the analyses of chromophoric dissolved organic matter (CDOM) in these environments. The processes that control DOM in a given watershed are not well understood, and it is presently difficult to predict the influences of climate change and resource management practices on DOM export to coastal regions. In this paper, insights gained from studies of the factors that control the nature and reactivity of terrestrial derived DOM from diverse freshwater environments will be presented.

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FROM SOURCE TO SEA: VARIATIONS IN BIOGEOCHEMISTRY OF DISSOLVED ORGANIC MATTER DELIVERED TO THE COAST

Terrestrially derived organic matter strongly influences the optical properties and reactivity of dissolved organic matter (DOM) in rivers, estuaries and coastal waters. The concentrations, nature and reactivity of DOM, in turn, are largely determined by source materials, watershed geochemistry, oxidative processes and hydrology. As a result, DOM in North American rivers exhibit a wide range of concentration (<80 to >400 µM C⁻¹) and specific ultra-violet absorbance (0.6 to >5 L *mg C⁻¹ m⁻¹), an optical measurement that is an indicator of aromatic carbon content. Different rivers, therefore, deliver DOM with different reactivities and optical properties to estuaries and coastal regions, thereby influencing the analyses of chromophoric dissolved organic matter (CDOM) in these environments. The processes that control DOM in a given watershed are not well understood, and it is presently difficult to predict the influences of climate change and resource management practices on DOM export to coastal regions. In this paper, insights gained from studies of the factors that control the nature and reactivity of terrestrial derived DOM from diverse freshwater environments will be presented.
The RED SEA OUTFLOW REGULATED BY THE INDIAN MONSOON

To investigate why the Red Sea water overflows less in summer and more in winter, we have developed a locally high-resolution global OGCM with transposed poles in the Arabian peninsula and India. Based on a series of sensitivity experiments with different sets of idealized atmospheric forcing, the present study shows that the summer cessation of the Red Sea outflow is remotely induced by the monsoonal wind over the Indian Ocean, in particular that over the western Arabian Sea. During the southwest monsoon (May–September), thermocline in the Gulf of Aden shoals as a result of coastal Ekman upwelling induced by the predominantly northeastward wind in the Gulf of Aden and the Arabian Sea. Because this shoaling is maximum during the southwest summer monsoon, the Red Sea water is blocked at the Bab-el-Mandeb Strait by upwelling of the intermediate water of the Gulf of Aden in late summer. The simulation also shows the three-dimensional evolution of the Red Sea water tongue at the mid-depths in the Gulf of Aden. While the tongue meanders, the discharged Red Sea outflow water (RSOW) (incoming Indian Ocean intermediate water (IOW)) is always characterized by anticyclonic (cyclonic) vorticity, as suggested from the potential vorticity difference.

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DEVELOPMENT AND EVOLUTION OF OPERATIONAL FORECAST SYSTEMS FOR THE COASTAL AND ESTUARINE ENVIRONMENT IN NOAA’S NATIONAL OCEAN SERVICE

NOAA’s National Ocean Service (NOS) applies hydrodynamic models for the development, transition and implementation of operational forecast systems (OFS) in U.S. estuaries, ports, lakes and the coastal ocean. These systems have applications in the support of marine navigation, emergency response, as well as marine ecological applications. There are currently nine water bodies in which OFSs are functioning (the Chesapeake Bay, the Port of NYC, Galveston Bay, the St Johns River, and the five Great Lakes). OFSs are under development for the Columbia River, Delaware and Tampa Bay, as well as for Cook Inlet, AK and elsewhere. Once evaluated and deemed acceptable by NOS standards, the OFSs are transitioned into the operational environment. The components of an OFS are discussed in terms of a

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BIO-PHYSICS OF SEABIRD OCCURRENCE IN THE NORTHERN CALIFORNIA CURRENT

Using data from Northeast Pacific GLOBEC 2000 and 2002 process cruises, we modeled the biological and physical factors that explain seabird occurrence during the upwelling season off Oregon. Seabirds were derived from ship censuses conducted during the upwelling and data were collected during cruise. Data were treated using a mass function that estimates prey biomass, and the model shows the occurrence pattern for the most abundant species. The model projects for Common Murres and Sooty Shearwaters that the two most abundant and biomass-bearing seabirds in the California Current, in coincidence with the occurrence patterns of Humpback Whales and adult salmon. Results show an increasing association of predators with prey over time, as prey biomass decreases. The question arises whether these predators, along with frontal features, are affecting the spatial occurrence patterns of Humpback Whales and adult salmon. Results show an increasing abundance and biomass-dominating seabirds in the California Current, coincident with the phytoplankton blooms.

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LONG-TERM NITRACAINE SHOALING AND DECREASED WATER COLUMN TRANSPARENCY IN THE SOUTHERN SECTOR OF THE CALIFORNIA CURRENT SYSTEM

We document a reduction in Secchi depth of 0.11 ± 0.01 m per year in the southern California Current System (LTER and CalCOFI region) over the period 1949 – 2004, reflecting a long term decrease in water clarity. This change has been accompanied by a nitracacline shoaling of 0.44 ± 0.10 m per year since 1969 and a parallel increase in mixed layer depth (1949 ± 1984). These changes are thought to be driven by a persistent near-surface nutrient enrichment that has been shown to increase in density stratification in the CCS. Increased stratification has been linked by others to decreased nutrient fluxes, reduced primary production, and reduced water transparency, contrary to our findings. We consider several hypotheses to account for the observed changes in the CCS: (1) variations in nutrient concentrations in the California Undercurrent, which can be important sources for upwelling in this region, (2) other variations related to the North Pacific Gyre Oscillation (NPGO – Di Lorenzo et al., in review), (3) long-term changes in grazing pressure, and (4) variations in nutrients of anthropogenic origins.

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BUILDING A FRAMEWORK FOR THE ECOLOGICALLY SUSTAINABLE DEVELOPMENT OF MARINE LIVING RESOURCES OF THE SULTANATE OF OMAN

The extensive coastline of the Sultanate of Oman has shaped its culture, economy, history and its people for millennia. Today, the coastal marine resources are still of great economic importance and continue to influence the lifestyle of the people of Oman. Marine living resources along the coast of Oman are an endowment of biodiversity, provide food and economic resources and opportunities for tourism and recreation. Unfortunately, the continuous pressure of development threatens this marine environment primarily via overfishing, global climate change, habitat modification, and coastal zone pollution. A continuous monitoring program and research are key steps that will allow us to differentiate between anthropogenic and natural variability. We have been collecting data from three monitro sites, two in the Gulf of Oman and one in the Arabian Sea from 2004 onwards. Data collected includes phytoplankton diversity and hydrographic parameters such as temperature, salinity, nutrients and oxygen that will not only provide us with baseline data necessary for future studies on anthropogenic impacts on this ecosystem but also a better understanding of the seasonal and interannual changes associated with monsoonal forcing. In this paper we address the seasonal monsoonal cycle and its impact on the biology of the coastal waters and use our findings to arrive at conclusions about how variability in phytoplankton and its environment could impact the food chain of this ecosystem.
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PRINCE WILLIAM SOUND SURFACE CIRCULATION INFERRRED FROM A HIGH-FREQUENCY SURFACE-CURRENT MAPPING RADAR AND DRIFTERS
Prince William Sound (PWS) is a semi-enclosed sea linked to the Gulf of Alaska along the south-central coast of Alaska. From June - September 2006, surface currents in the central sound (50 km x 50 km) were observed using both high-frequency radar (HFR) and satellite-tracked drifters. The M2 and the MM species are the dominant tidal constituents with typical speeds of ~5 - 30 cm/s. After de-tiding the data the HF radar and drifter data sets confirm a strong summer-mean cyclonic circulation in the central sound consistent with inferences from hydrography and models. Mean velocities were ~10 - 20 cm/s in the central sound and a maximum of ~50 cm/s in Hinchinbrook Entrance. HFR-measured flow variations were large, but poorly correlated with observed winds from the central sound. This variability is most likely due to wind-forced fluctuations in the Alaska Coastal Current over the adjacent shelf. A comparison between drifter trajectories and HFR-derived virtual drifter trajectories show

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NITROGEN INPUTS TO THE ALTAMAHA RIVER ESTUARY (GEORGIA, USA): A HISTORIC ANALYSIS
The watershed of the Altamaha River, Georgia, is one of the largest in the southeastern U.S., draining 36,718 km2. Between the 1950s and the 2000s the average concentration of NO3 + NO2 in the estuary quadrupled while chlorophyll-a more than tripled. We present nitrogen budgets for 1954 to 2002 that show a 32% increase in inputs to the watershed over the period. All of the increase occurred between 1954 and 1982, and there was actually a net decrease between 1982 and 2002. In keeping with this, the nitrogen load to the estuary has not increased significantly since the 1970s, when standardized water quality sampling began. These results suggest that, even with a fast transit time (generally <1 week), increased nutrient loading from the watershed between 1954 and 2002 translated into an increase in estuarine phytoplankton concentration in this system. Our analysis also suggests that estuarine nitrogen concentration is now more responsive to low inflows than in the past. These observations show the value of considering earlier baseline records when evaluating changes in loading.

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EFFECT OF DEPRESSED SATURATION STATE ON SETTLEMENT, POST-SETTLEMENT SURVIVORSHIP, AND GROWTH OF PORITES ASTREOIDES AND MONTASTREA FAVEOLATA LARVAE
In conjunction with the projected increases in pCO2 of the coming century, coral growth and calcification are expected to decrease significantly. No published studies have investigated the effect of elevated pCO2 on early life history stages of corals. As coral recruitment, post-settlement survivorship, and growth are critical to reef persistence and resilience, it is of timely importance to better understand the repercussions of climate change on such processes. Larvae of Porites astreoides and Montastrea faveolata were collected from reefs in Key Largo, FL and subsequently settled and reared in controlled saturation state seawater. Three treatment levels were obtained (1M HCl additions) based on present (380 ppm) and projected pCO2 scenarios for the years 2065 (500 ppm) and 2100 (720 ppm). The effect of treatment water on settlement and post-settlement growth is being evaluated. Larvae were introduced to their respective treatments and allowed 96 hours to settle onto pre-conditioned limestone tiles. Settlement was confirmed by examination under a dissecting microscope. Settled larvae were placed in flow-through treatment tanks (25°C) and are currently being monitored for differences in survivorship and growth.

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COMMERCe, RESEARCH AND EDUCATION: CONTRIBUTIONS AND CHALLENGES OF MARINE EXTENSION WORK IN NOAA’S SEA GRANT PROGRAM IN PUERTO RICO, MICHIGAN AND NATIONAL OFFICE
The National Sea Grant program represents NOAA’s nationwide university-based program in support of coastal resource use and conservation. This study focuses on a historical and multi-sited ethnography that analyzes two local Sea Grant Programs and their connection to the overarching NOAA national goals from 1980-2000. The project aims to offer insight on how the extension agent position facilitates the resolution of coastal and marine management and tourism issues. The extension agents are staff who have an extensive knowledge of coastal resources, have the role of translating scientific information to coastal stakeholders, and answer the needs of coastal communities to report back to the program. Two local extension programs were examined with 36 in-depth interviews to understand how local programs respond to cultural and regional processes. Preliminary findings suggest that current challenges for Sea Grant agents include maintenance of non-advocacy and mediation roles among stakeholders, their positioning relative to research especially conducting and delivering of science to public, and development of their multi-faceted skills sets essential to extension. This program suggests comprehensive ways for integrated resource management using bottom up approaches.

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CROSS-FRONTAL SURFACE TEMPERATURE AND VELOCITY STRUCTURE IN THE NEW JERSEY MID-SHELF FRONTAL ZONE
The cross-frontal structure of a density front, which occurs during the winter months along the 50m isobath, is examined using remote sensing observations of the New Jersey midshelf region. Shipboard observations show that cooler, fresher, less dense water is located inside the side of the front; however, little is known of the velocity structure in the frontal zone. Surface current fields from HF radar (CODAR) are analyzed along with surface thermal frontal observations to describe the spatial variability of surface flow with regard to the front. Cloud-cleared, Level 2 MODIS Thermal IR sea-surface temperature data from AQUA and TERRA from 2005 through 2007 are processed using an edge-detection algorithm to determine the location and structure of the front. The front coordinates are overlaid on the long-range CODAR velocity field at the time of each respective satellite pass to extract the velocity at the front and in the far-field. The seasonal progression of the temperature and velocity fields are analyzed, and a statistical comparison of along-front velocities versus those in the far-field is performed to determine the presence or absence of a frontal jet.

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INTEGRATING SEASONAL AND CENTENNIAL RATES OF SEDIMENTARY PROCESSES ON THE OUTER CONTINENTAL SHELF AND SLOPE SEAWARD OF THE WAIPAOA RIVER, NEW ZEALAND
The continental margin seaward of the Waipaoa River was examined to determine the rates and products of sedimentary processes in an oceanographically dynamic and geologically active margin. Initial results from short and long lived radionuclides (Be-7 and Pb-210), showed that material was reaching and accumulating within the outer shelf and slope. Radionuclide data from recent summertime and winter cruises provide insight into these processes. Surface Be-7 activities and excess Th-234 seabed inventories suggest that fluidal sediment rapidly reaches the shelf break annually but enhanced delivery of fluidal material occurs during the winter. Sediment is accumulating along the outermost shelf at rates of 0.5-1 cm/year, and transported off-shelf to accumulate in upper submarine canyons and slope gullies at rates up to 3 cm/year; and decreases to 0.1 cm/year in canyon and inter-canyon sites below 1200 m water depth. Hemipelagic sediment delivery is the dominant process along most of the margin. In contrast, sedimentology of cores from the Poverty submarine canyon demonstrates that sediment initially deposited in the canyon head moves down-canyon episodically as discrete mass flows.

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EXTRATROPICAL INFLUENCES ON ENSO: THE SEASONAL FOOTPRINT MECHANISM
Fluctuations in internal atmospheric modes over the North Pacific in winter, especially the North Pacific Oscillation (NPO), impact an SST
Pacific has experienced substantial physical change. How has this affected community dynamics of these complex systems. In the past half century the North structure of their species and/or functional groups. If these structures show pattern in An important aspect of ecosystem communities is the order of numerical dominance circulation of halocline waters in the far northern reaches. from bottle samples collected at target depths of 20, 60, 80, 100, and 120 meters are used to calculate the NO parameter, where NO = 9 x NO - . The first continuous, vertical profiles of nitrate have been obtained from the Arctic Ocean at mid-depth by parametric subharmonic instability. The observations are presented and propagate equatorward but can have either slope, consistent with additional generation with surface (wind) generation at a higher latitude and subsequent propagation toward the North of 29 degrees, they slope predominantly downwards toward the equator, consistent with surface (wind) generation at a higher latitude and subsequent propagation toward the equator (where the local inertial frequency is lower). South of 29 degrees, they still propagate equatorward but can have either slope, consistent with additional generation at mid-depth by parametric subharmonic instability. The observations are presented and implications discussed. The USE OF CONTINUOUS PROFILES OF OXYGEN AND NITRATE TO ASSESS THE SOURCES OF HALOCLINE WATERS IN THE CENTRAL ARCTIC OCEAN The first continuous, vertical profiles of nitrate have been obtained from the Arctic Ocean during the 2007 field season of the North Pole Environmental Observatory. Casts were collected from eleven stations using a Satlantic ISUS (in-situ ultraviolet spectrophotometer) internally recording package. Profiles of dissolved oxygen were also obtained via the simultaneous deployment of a Seabird SBE19 plus CTD equipped with a Seabird SBE 43 O sensor. This data allows the first high-resolution observations of two chemical tracers used to distinguish water-type contributions in this environment. Such resolution is necessary because typical bottle casts through the ice cannot fully capture the various water types ventilating the Arctic halocline. The nitrate and oxygen data are combined to calculate the NO parameter, where NO = 9 x NO - . The NO parameter has been used previously to differentiate among source waters contributing to the halocline of the Arctic Ocean. The vertical profiles of NO, and NO are analyzed to investigate the ventilation of the halocline in the central Arctic. Additional chemical tracers measured from bottle samples collected at target depths of 20, 60, 80, 100, and 120 meters are used to support this analysis. Such analysis should reveal more information regarding the circulation of halocline waters in the far northern reaches. The THE EFFECTS OF PBDE-47 ON THE BENTHIC AMPHIPOD LEPTOCEPHUS PLUMITUSCUROSIS, AND POLYCHAETE STRELJONIO BENEDICTI: A BRIEF OVERVIEW Polybrominated Diphenyl Ethers (PBDEs) are used to reduce the flammability of consumer products. PBDEs enter the environment from decomposing materials such as domestic industrial waste, the incineration of waste, industrial production of PBDEs, and electric equipment use. PBDEs accumulate in marine sediments and pose a threat to wetland ecosystems because they are resistant to degradation and are lipophilic. PBDEs can bioaccumulate into infaunal benthic invertebrates and fishes; at high levels PBDEs cause endocrine disruption, neurotoxicity, and carcinogenic activity. Of the 209 congeners of PBDEs, PBDE-47 is one of the most prominent in studies from around the
The proposed research will investigate 1) the toxicity of PBDE-47 on the survival and reproduction of two benthic invertebrates and 2) the prevalence of PBDEs in natural sediments. In vitro sediment bioassays will be used to assess the LC50, NOEC, and LOEC of the benthic amphipod (L. plumulosus) and polychaete (S. benedicti). GC/MS will be performed on local sediments to determine concentrations and to assess the level of threat in coastal Georgia.

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PHYSICAL CONTROLS ON THE TIMING OF THE SPRING BLOOM IN THE STRAIT OF GEORGIA

The Strait of Georgia is a semi-enclosed coastal sea with a strong estuarine circulation. The growing season starts with a classic spring bloom followed by strong summer productivity. We have coupled a one-dimensional vertical-mixing model that uses a K-Profile parameterization of the boundary layer to a NPFZD-class of biological model with 2 to 12 compartments. Two-dimensional physical processes, such as the estuarine circulation, are parameterized. The model is forced with hourly meteorological data and daily river data. The coupled biophysical model has been successfully used to determine the physical factors that control the arrival time of the spring bloom. The one-dimensional model was used to produce an empirical relationship between wind, cloud-fraction and the timing of the spring bloom. This relationship has been successfully used to predict the bloom in 2006 and 2007. Using historical data, the timing of the spring bloom over the last 30 years has been modelled. We will discuss the interannual variations we see and importance of the climate warming of the Strait to the bloom timing.

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THE AUSTRALIAN INTEGRATED MARINE OBSERVING SYSTEM - FIRST STEPS

In May 2007 the Australian Government funded the first phase of an Integrated Marine Observing System. The IMOS is a nation-wide collaborative program designed to observe the oceans around Australia. IMOS partners comprise of the majority of Australian universities and agencies with capability in ocean and marine research to implement and operate 11 facilities for the collection and distribution of ocean observing data. The facilities are:

1. Argo Australia
2. Enhanced Measurements from Ships of Opportunity (SOOP)
4. Australian National Facility for Ocean Gliders (ANFOG)
5. Autonomous Underwater Vehicle Facility (AUV)
6. Australian National Mooring Network
7. Australian Coastal Ocean Radar Network (ACORN)
8. Australian Acoustic Tagging and Monitoring System (AATAMS)
10. eMarine Information Infrastructure (eMII)
11. Satellite Remote Sensing (SRS)

This paper describes each of the facilities and the challenges associated with observing system capability building in Australia. The unique characteristics of an Australian IMOS are highlighted and discussed.

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ADJUSTMENT IN THE ANTARCTIC CIRCUMPOLAR CURRENT AND THE GLOBAL Pycnocline

In this study we consider an idealized, reduced gravity ocean model, in which the Antarctic Circumpolar Current (ACC) is spun-up from rest. The surface pycnocline is initially flat and shallow. Southern Ocean winds and diapycnal mixing are applied, causing the global pycnocline to deepen and the ACC to spin up. This deepening is arrested by eddy-induced transports and surface buoyancy loss in the Southern Ocean. This method allows us to identify the basic processes which control the adjustment and equilibrium state of the ACC, and the mechanisms by which the changes are communicated to and from the rest of the global ocean. A surprising conclusion is that if diapycnal mixing is important for establishing the global pycnocline (and strength of the Atlantic Meridional Overturning Circulation) then it is also an important driver of the ACC. A predictive theory for the adjustment timescale, equilibrium pycnocline depth and ACC transport is possible for single- and multiple-basin domains. The analytical theory is compared with results from the numerical simulations.

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FLOC BEHAVIOR IN HIGH TURBIDITY WINTER STORM EVENTS ON THE ATCHAFALAYA DELTA INNER SHELE LOUISIANA

Field deployment of bottom tripods (Feb-Apr 2006 and 2007) for the ONR MURI program collected 2 Hz measurements of boundary layer dynamics during cold-front high wave-current events. One pod was deployed with a Sequoia LISST 100C at z = 1.25 m, which measures suspended particulates of 2.5-500 µm size. Size distribution was generally bimodal over all frontal energy periods: a discrete particle mode at 46 µm, and a floc mode at 239 µm. Frequencies were also increasing (3rd mode) at the largest ring angle (mean size 460 µm), indicating larger flocs are present. During the increasing phase of strong currents or swell, and, significantly, even at strong and constant wave-current conditions, floc breakage occurred steadily over periods up to 24h. The latter suggests relatively long periods are necessary for floc size distributions to reach equilibrium with ambient energy. Optical transmission decreased during these periods as a function of both 1) resuspension and 2) breakage of flocs increasing particle numbers and optical scattering. During the strongest pre-frontal phases, turbidities rose at intervals to levels (>1.3 g/l) below the 15% transmission for reliable size data, even with an 80% path reduction. During the 6h post-frontal declining phase, larger flocs (>146 µm) re-formed to become the dominant component in low wave and current stress conditions, and less dominantly, in high swell and low currents.
First results demonstrate that: (1) Ensemble Kalman filtering of VM simulations recover VIRTUAL MISSION FIRST RESULTS SUPPORTING THE WATER HM SATELLITE WATERSHM Participants

Lettenmaier, D.
Alsdorf, D.

organic ligand concentrations were observed. In the virus infected culture, there was no infection. Cu per cell decreased during algal growth in virus free cultures. Viral lyses of increased with time, and was therefore related with algal biomass. Similarly, in the virus decreased with incubation time in both cultures. Particulate Cu in the control cultures Cu were near constant in the control and virus infected cultures. However, labile Cu of Emiliania huxleyi growth, senescence and decay on Cu speciation. Total dissolved Viruses are known to infect a range of phytoplankton species and thus may influence ACHTERBERG, E.
Schroeder, D.
ALSAID, T. T.

components of the marine food web. Microbial community in the Arabian Gulf has not been extensively studied. This study focuses on the bacterioplankton community in the northem waters of Kuwait, which are influenced by Shatt Al Arab River discharge. The results indicate that bacterioplankton community in the northwestern Arabian Gulf have relatively high biomass (average 3.18 x109 bacteria/l) in comparison with bacterial abundance in ocean surface waters, which is generally less than 1 x 109 bacteria/liter. They have high carbon demand (average ratio 1:4) related to local primary production (average 152.89 gC/l/day). The study addresses the subject of temporal and spatial distribution of bacteria plankton in the NW waters of the Arabian Gulf. ALSAID, T. T., UNIVERSITY OF SOUTHAMPTON, SOUTHWATER, United Kingdom, t.alsaid@soton.ac.uk; Schneider, D., MARINE BIOLOGICAL ASSOCIATION, PLYMOUTH, United Kingdom, d.sch@nbsa.ac.uk; TAYLOR, A., The University of North Carolina, Wilmington, WIlmingtont, USA, taylor@uncw.edu; ACHTERBERG, E., UNIVERSITY OF SOUTHAMPTON, SOUTHWATER, United Kingdom, e.achterberg@soton.ac.uk

THE ROLE OF EMILIANIA HUXLEYI SPECIFIC VIRUSES ON COPPER CYCLING Phytoplankton influence the cycling and distribution of Cu in oceanic and coastal waters. Viruses are known to infect a range of phytoplankton species and thus may influence copper speciation in these waters. The objective of our work was to examine the effects of Emiliania huxleyi growth, senescence and decay on Cu speciation. Total dissolved Cu were near constant in the control and virus infected cultures. However, labile Cu decreased with incubation time in both cultures. Particulate Cu in the control cultures increased with time, and was therefore related with algal biomass. Similarly, in the virus infected cultures the particulate Cu increased with time, until the cells crashed due to viral infection. Cu per cell decreased during algal growth in virus free cultures. Viral lyses of Emiliania huxleyi caused a sharp increase in Cu per cell. Ligand production in the control culture decreased the free aqueous Cu concentration ([Cu]aq) with time. The lowest [Cu]aq in the control culture was between 6.73-5.15 x10-1 M, coinciding with the highest organic ligand concentrations. Also in the virus infected culture, [Cu]aq decreased when enhanced organic ligand concentrations were observed. In the virus infected culture, there was no increase in the dissolved Cu fraction in response to the decrease in the particulate Cu. It was hence hypothesized that the virus particles play a direct role in the Cu cycling.

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VIRTUAL MISSION FIRST RESULTS SUPPORTING THE WATER HM SATELLITE CONCEPT

First results demonstrate that: (1) Ensemble Kalman filtering of VM simulations recover water depth and discharge, reducing the discharge RMSE from 23.2% to 10.0% over an 84-day simulation period, relative to a simulation without assimilation. The filter also shows that it can disperse discharge relative errors of 100%, while 16-day and 32-day frequency results in errors of 12.1% and 16.9%, respectively. (2) SRTM measurements of water surfaces along the Mississippi, Missouri, Ohio, and Amazon rivers, as well as smaller tributaries, show height standard deviations of 5 meters or greater (SRTM is the heritage for WATER HM). These large errors require several hundred kilometer reach lengths to estimate slope and hence discharge in the empirical Manning’s method. Nevertheless, discharge estimates are reasonable and can be within 10% of gauged values. (3) River channel widths are key for determining the capability of WATER HM to resolve flow hydraulics. Automated measurements of channels, as classified in NLCD92 (a 30m product from the USGS Land Change Monitoring System), showed detailed coverage throughout the US But, river basins, including channels with annual discharge of 150 cfs, draining 12,500 sqkm. (4) Conventional profiling altimetry misses 75% of all lakes in the world because there are hundreds of kilometers of orbital tracks.

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HIGH RESOLUTION MODEL SIMULATION OF THE SUBZONE OF THE EASTERN TROPICAL PACIFIC Suboxic intermediate waters of the world's oceans dominate globally important redox-sensitiv- processes. However, the relative roles of physical and biogeochemical forcing of their extent and density has been less well understood as a result of climate change. Suboxic waters may influence the global carbon cycle and nutrient availability, and thus potentially affect marine productivity and food web dynamics. The El Niño Southern Oscillation (ENSO) is an ocean-atmosphere coupling event that consists of warm El Niño and cool La Niña phases. The ENSO affects many systems of the marine ecosystem. In the Eastern Tropical Pacific (ETP), ENSO events have been shown to have a significant impact on the distribution of suboxic waters. Previous studies have focused on the influence of ENSO on the occurrence of suboxic waters, but the mechanisms behind this influence are not well understood. In this study, we use a high-resolution ocean-atmosphere coupled model to examine the interaction between ENSO and suboxic waters in the Eastern Tropical Pacific. The model includes a comprehensive representation of physical processes, biogeochemical cycling, and ecosystem dynamics. The model is forced with observed sea surface temperature, sea ice concentration, and wind fields, and is run for 10 years (1986-2005). The results show a significant decrease in the extent and density of suboxic waters during El Niño events, while La Niña events lead to an increase. This modulation is consistent with previous studies that have linked ENSO to changes in the upwelling and production in the upwelling region. These findings highlight the importance of suboxic waters in the ETP and suggest that ENSO may play a key role in regulating the distribution of these regions, which are critical for marine productivity and carbon cycling. Alahi, E., Rutgers University, New Brunswick, USA, aalahi@marine.rutgers.edu; Pernin, M. J., Rutgers University, New Brunswick, USA; Turpin, B. J., Rutgers University, New Brunswick, USA; Seitzinger, S. P., Rutgers University, New Brunswick, USA

IN CLOUD PHOTOCHEMISTRY OF WATER SOLUBLE ORGANIC GASES AND ITS RELEVANCE TO ATMOSPHERIC DOC/DON DEPOSITION In this work aqueous phase reactions of methylglyoxal, a ubiquitous atmospheric carbonyl compound formed from biogenic and anthropogenic VOCs (Kawamura and Yasui, 2005), and hydron radical with and without nitric acid were conducted to simulate in-cloud reactions. A major contribution of this work is the measurement of reaction products, including organic acids and oligomers by electrospray ionization mass spectrometry techniques. We will discuss the proposed aqueous phase reaction mechanism, the effect of nitric acid on product formation, and the potential importance of cloud processing to deposition of DOC and DON. The source of DON in atmospheric waters is yet unknown and this work provides insight into the potential contribution of cloud chemistry to atmospheric DON formation. DON in atmospheric waters contributes 20-80% to the total nitrogen deposition to the ocean (Cornell et al., 2003). Atmospheric deposition of nitrogen and nitrogen fixation are the only sources of non-recycled nitrogen to the open ocean and there is evidence that a significant fraction of DON in wet deposition is bioavailable (Seitzinger and Sanders, 1999) making it a potentially important control on marine productivity.

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INTERANNUAL VARIATION IN FORK LENGTH OF FLYINGFISH FROM THE EASTERN TROPICAL PACIFIC

The El Niño Southern Oscillation (ENSO) is an ocean-atmosphere coupling event that consists of warm El Niño and cool La Niña phases. The ENSO affects many systems including marine ecosystems and climate models predict that future climate change will alter the ENSO system. In the Eastern Tropical Pacific (ETP), ENSO events have been shown to have a significant impact on the distribution of suboxic waters. Previous studies have focused on the influence of ENSO on the occurrence of suboxic waters, but the mechanisms behind this influence are not well understood. In this study, we use a high-resolution ocean-atmosphere coupled model to examine the interaction between ENSO and suboxic waters in the Eastern Tropical Pacific. The model includes a comprehensive representation of physical processes, biogeochemical cycling, and ecosystem dynamics. The model is forced with observed sea surface temperature, sea ice concentration, and wind fields, and is run for 10 years (1986-2005). The results show a significant decrease in the extent and density of suboxic waters during El Niño events, while La Niña events lead to an increase. This modulation is consistent with previous studies that have linked ENSO to changes in the upwelling and production in the upwelling region. These findings highlight the importance of suboxic waters in the ETP and suggest that ENSO may play a key role in regulating the distribution of these regions, which are critical for marine productivity and carbon cycling.
ies, specifically for the tuna-dolphin assemble because flyingfish are key dolphin prey. Observed variations in flyingfish can provide a possible explanation for the lack of dolphin recovery in tuna-dolphin assemblies of the ETP.

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MIXING IN THE GULF OF CADIZ USING XBT DATA

Images from acoustic reflections in the water column were obtained during the EU-funded GO experiment in the Gulf of Cadiz, and oceanographic data at the same place and time were also collected. The experiment (www.dur.ac.uk/egu/go/) focused on a section across the Mediterranean Water flow against and down the continental slope. The present analysis concerns the data on the continental slope at one end of the seismic section. XBT, XCTD and CTD sections were taken on the slope to analyze the properties of the water column. The XBT provide fine resolution in space and time, and are analyzed to estimate diffusivity and mixing parameters. This is also related with the local circulation and internal wave contributions using data from ADCPs and moored temperature loggers. The finer resolution of the XBT and seismic data gives a new view on the mixing. Different ways to compare seismic and oceanographic data will be discussed.

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SHIPBOARD PHOSPHORUS, NITROGEN AND SILICA NUTRIENT LIMITATION ASSAYS USING IN-VIVO PHOTOPAM FLUORESCENCE IN THE NORTHERN GULF OF MEXICO

Our objective was to investigate the importance of nutrient limitation of phytoplankton production in coastal waters of the Northern Gulf of Mexico. Resource limitation assays were performed on 8 cruises from the summer of 2005 to the summer of 2007 during NOAA funded Mechanisms Controlling Hypoxia program and EPA’s Gulf Hypoxia Modeling Program. Twenty-four to forty-eight hour shipboard experiments were conducted in the coastal waters of the northern Gulf of Mexico. Additional samples were used for in-vivo fluorescence measured with a PhytoPAM (Pulse Amplitude Modulated) fluorometer. Additional samples were taken to measure chlorophyll concentration using traditional methods. Our findings reveal that phytoplankton could be N-limited, P-limited and occasionally N and P co-limited, but never Si limited in the Northern Gulf of Mexico. The type of nutrient limitation was dependent on water quality (brown, green versus blue waters) and season. The Mississippi River and Atchafalaya River plumes greatly influence water quality on a seasonal basis, and so, potentially phytoplankton production.

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AN INTEGRATED, OPERATIONAL GLOBAL OCEAN OBSERVING SYSTEM

The Global Ocean Observing System (GOOS) has been in existence for over a decade. During this first decade, GOOS has been primarily engaged in planning observational strategies and developing the international governance structures required to facilitate multi-national ownership and development of the system. The most important challenge now facing GOOS is to complete and sustain an integrated, global system with clear user benefits. Substantial progress has been made, with more than half of the in-situ open ocean observing system for climate already in the water, including buoys, moorings, floats, tide gauges and repeat hydrographic lines. Operational warnings for coastal hazards based on this GOOS observational backbone are widely available providing clear societal benefits. However challenges remain. The research community is neither ensuring their observations fully contribute to, nor that their research fully benefits from, the system. New modalities for increasing research community participation and governmental commitments will be presented. The talk will begin with a brief overview of the status of the global ocean observing system, then highlight milestones achieved and conclude with key future challenges.

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THE EFFECTS OF RIVER DIVERSION, MESOPOTAMIAN MARSH MANIPULATIONS, AND RIVER DAMMING ON THE MARINE ENVIRONMENT OF THE ARABIAN GULF

A study was conducted during the period of 1996-2005 to assess the impact of river diversion, marsh drainage, and marsh restoration on Kuwait’s marine environment. The results indicated lower salinity, higher nitrate concentration, higher chlorophyll-a, and higher sedimentation in the northern waters of Kuwait influenced by the discharge of the man-made Third River and marsh drainage. Five estuarine copepod species, which occur only in the northern waters of Kuwait due to their proximity to the mouth of the river, are reported here for the first time. Lower turbidity levels were observed in the northern waters of Kuwait during 2004 and 2005 possibly influenced by the marsh restoration process. The above results indicate the close interrelationship between the upstream river environment and the northern Arabian Gulf. River-related activities in the Tigris-Euphrates Basin have transboundary impacts downstream. Assumptions on the potential effects of the upstream damming of the Tigris and Euphrates Rivers on Kuwait's marine environment are included. It is expected that recent and planned river basin modifications in Turkey, Iran and Iraq will significantly reduce river discharge, permanently remove seasonal flooding, and impact the northern Gulf’s marine environment, with serious implications for fisheries.

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ICOMM, THE INTERNATIONAL CENSUS OF MARINE MICROBES: UNVEILING THE OCEAN’S HIDDEN MAJORITY

The International Census of Marine Microbes (ICoMM), now in its third year, is one of 14 ocean realm projects of the Census of Marine Life Program (CoML) that seeks to determine what is known about the biodiversity of marine microorganisms. The ICoMM Secretariat hosts the WEB site http://icomm.mbl.edu and the distributed database network MICROBIS. It has sponsored meetings for the five primary working groups (Benthic, Open Ocean and Coastal Systems, Technology, Informatics and Data Management and Microbial Eukaryotes) and annual meetings of its Scientific Advisory Council. In collaboration with the international community of marine microbiologists, ICoMM has forged a large-scale effort to characterize microbial diversity in the sea through molecular approaches based on massively-parallel, 454-based sequencing of hypervariable regions of the SSU rDNA genes of bacteria, archaea and microbial eukaryotes. Although a complete census is most likely beyond our grasp, the scientific return will be considerable if the information is integrated with contextual information that can inform us about the interplay between microbial mediated activities and oceanic processes.

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GULF OF CADIZ OCEANOGRAPHY FOR COMPARISON WITH SEISMIC IMAGING

The GO project (European Union-NEST-Adventure funding), www.dur.ac.uk/eu/go/ aims to assess the potential of seismic imaging of the water column. A dedicated experiment (April-May 2007, Gulf of Cadiz) looked at varying Mediterranean Outflow water (MOW) flow along and down the continental slope. Distinctive MOW properties provide strong reflections from seismic sounding. We aim to relate water properties to mixing and hence (e.g.) tides, internal waves, eddies. Physical oceanography results derive from 500 MOW casts, typical spacing 2 km, and moorings: three ADCPs, three temperature strings and near-sea-bed turbulence in line on the north-eastern margin of Portimao Canyon (water depths 740-980 m); a fourth ADCP ~6 km along-slope in 1015 m depth. CTD and XCTD profiling on an IFM-Geomar research cruise, closely following the seismic sections, supplemented the GO measurements. We examine the structures observed on the principal line through the moorings (five surveys), and compare with the contemporary seismic data that further constrain observed boundaries. The mooring data and profiles are analysed for tides and internal wave spectra, small-scale structure and turbulence to estimate diffusivity and mixing.
lowed by recommendations from the Hypoxia Task Force. The 2001 Hypoxia Action Plan called for a 30% reduction in nitrogen loading in order to reduce the size of the hypoxic zone by 50% by 2015. Recent ecosystem studies and models have suggested that larger reductions of both nitrogen (N) and phosphorus (P) will be required to achieve this desired goal. Though the final recommendations of the Hypoxia Task Force remain unclear, the report of the EPA SAB is likely to recommend much larger reductions of both N and P. These ecosystem studies important to these new policy recommendations will be discussed, however, their ultimate impact on Gulf hypoxia remains to be seen.

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CDOM ACROSS THE ARCTIC OCEAN
Previous studies indicate that fluorescence can be used as a proxy for terrestrial derived DOM in the Eurasian Basin. In the Canadian Arctic the relationship between fluorescence and terrestrial derived DOM is however not as straightforward and there seem to be additional sources of fluorescence present. In this study we present new fluorescence data from CTD casts across the Arctic Ocean interior. The results show that CDOM is a useful additional water mass tracer along with biomarkers and standard hydrographic information in the Arctic Ocean and offer insights towards understanding Arctic halocline formation and water mass exchange. Data from a trans arctic sea section in 2005 indicates that Eurasian shelf water with elevated levels of river DOM penetrates deep into the Canada Basin halocline. Excitation emission matrix spectroscopy (EEMS) combined with Parallel Factor Analysis was applied to identify potential sources contributing to the CDOM signal in the halocline.

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HOW DO DISTINCT PHYSICAL PHENOMENA AND PROCESSES AFFECT SPECTRAL SLOPES OF CLIMATE VARIABLES?
Spectral slope is a widely-used statistic in climatology that summarizes the redness of time series and is directly related to energy cascades. Links between the strength of the annual cycle and spectral slope for surface temperatures have been suggested recently in literature. We propose the ratio of interannual to subannual variance (the climate-to-weather ratio) as an analogous metric to the spectral slope and define the exact correspondence between the two measures. This ratio is fundamentally a calculation of the power law with spectral binned and averaged in two uneven frequency intervals divided at annual frequency. We apply our analyses to sea surface temperature, sea surface height, sea level pressure, and precipitation. First, we evaluate the impact of subseasonal, subannual, and interannual phenomena as well as other factors on the spectral slope. Second, we use the method of empirical orthogonal functions to measure the contributions of individual interannual variability modes. Finally, we investigate spectral nonuniformities of different orthogonal patterns, particularly those corresponding to the El Nino-Southern Oscillation.

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BAXLEY ET AL. ASSESSMENT OF CYANOPHAGE DIVERSITY IN COASTAL WATERS USING PULSED FIELD GEL ELECTROPHORESIS AND MULTIPLE MOLECULAR MARKERS
Cyano phosphages are abundant in coastal waters and are an important component of the microbial food web. These viruses may influence the abundance, diversity, and seasonal succession of their cyanobacterial hosts. Most studies of cyanophages in coastal ecosystems have focused on myoviruses; nevertheless, podoviruses or siphoviruses may also play important roles in these ecosystems. In this study, we examined temporal changes in the size distribution of cyanophage genomes using pulsed field gel electrophoresis (PFGE). Seawater samples collected from three sites in Rhode Island waters were enriched for cyanophages using multiple strains of Synechococcus. Cyanophage genomes ranging from 30 kb to over 350 kb were observed. The abundance and distribution of genome sizes varied temporally and were also dependent on the host strain used in the enrichment. DNA excised from the PFGE gel is being screened using multiple genetic markers to identify the viruses in each size range. Our results suggest that there is a high diversity of cyanophages in a single seawater sample, with viruses belonging to several different viral lineages.

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sparsely sampled. The aim of this paper is to report on the copepod distribution and production (egg and juvenile) across row spawning sites in the Sargasso Sea. The cruise was conducted in March/April 2007 with an overall of 37 stations, distributed over 3 frontal cross-sections. Copepods were sampled with a 10µm net and size fractionated to 160–200µm. The copepodites were then incubated in 24h, stage and length were measured on the two most numerous genera Oithona and Clausocalanus. We will present and discuss the growth rate results and production of the above-mentioned copepodites in relation to phyto- plankton biomasses, position in the frontal zone and egg production of Acartia. Despite low primary production and EP (0.5–4.0 d⁻¹) the growth rate of copepodites was close to maximal (0.3 d⁻¹), stressing the role of the younger stages in the cycling of organic matter in the Sargasso Sea.

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ESTIMATING TREND PARAMETERS FROM GLOBAL ALTIMETRIC SEA SURFACE HEIGHT DATA AND SEA SURFACE TEMPERATURE DATA

Sea surface height and sea surface temperature are fundamental climate parameters. More than 15 years of sea surface height records are now available from satellite altimetry and more than 25 years of reconstructed sea surface temperature data from a combination of in-situ and satellite based data are now available for investigation of trend like structures. Low frequency variability of these quantities have been investigated through a rank based multivariate method in order to extract robust time trend patterns. The first derived trend patterns in both data sets agree on a systematic decrease in both SST and SSH in the Equatorial Pacific, but an increase in almost all regions of the world. The second trend pattern reflects mainly ENSO variability in the Pacific Ocean. This parameter is considerably more robust determined from SST than from SSH.

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AN EMPIRICAL APPROACH TO ESTIMATING THE PROBABILITY OF TOXICENIC PSEUDO-NITZSCHIA BLOOMS IN THE SANTA BARBARA CHANNEL

The Santa Barbara Channel, CA is a highly productive region where wind-driven upwelling and mesoscale eddies are important processes driving phytoplankton blooms. In recent years, the spring bloom has been dominated by the neurotoxin-producing diatom genus, Pseudo-nitzschia. The results of a 1.5 year time series of Pseudo-nitzschia spp. abundance, chlorophyll and domoic acid concentrations are related to physical, chemical, and biological parameters to better identify the conditions associated with regional Pseudo-nitzschia blooms. The time series captured three large toxic events in the springs of 2005–2006 and summer 2005 corresponding to bloom-level Pseudo-nitzschia spp. abundance. Statistical models were created and relevant thresholds determined to predict the occurrence of toxic bloom events from environmental parameters. The conditions most associated with high cellular toxin levels were low sea surface temperature, high salinity, increased absorption by cDOM (412 nm), increased reflectance at 510/555 nm, and decreased particulate absorption at 510 nm. This suggests the potential for monitoring of toxic diatom blooms in the Santa Barbara Channel using satellite platforms such as SeaWIFS, MODIS, and AVHRR.

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A PLANKTON BLOOM IN A MODE-WATER EDDY CAUSED BY EDDY-WIND INTERACTION

Observations of an anticyclonic mode-water eddy in 2005 near Bermuda revealed highly enhanced chlorophyll and primary production at the eddy center. A 20-km long streak of sulfate hexafluoride injected at 90 m depth at eddy center showed 0.5 +/- 0.2 m/day over 36 days. We constructed a numerical model of the eddy to investigate the processes responsible for the observed upwelling. Even with uniform wind, horizontal gradients in surface stress can arise from differences in eddy surface velocities relative to the wind velocity. These mesoscale gradients in surface stress cause upwelling in anticyclones and downwelling in both data sets agree on a systematic decrease in both SST and SSH in the Equatorial Pacific, but an increase in almost all regions of the world. The second trend pattern reflects mainly ENSO variability in the Pacific Ocean. This parameter is considerably more robust determined from SST than from SSH.

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SITE SELECTION AND FALLOWING - MITIGATING HABITAT IMPACTS FOR COLD WATER FINNISH AQUACULTURE IN NEWFOUNDLAND, CANADA

Benthic impacts are a primary concern for finnish aquaculture in Newfoundland, Canada. Site selection is used as the principal means to minimize or avoid such negative effects. However, the provincial government also implements a mandatory fallow period every 3 years as a disease control/prevention measure. Since 2002, we have been following sediment conditions at a finnish aquaculture site in Fortune Bay, NL to determine the effectiveness of this fallow period for reducing residual benthic impacts. During the 3 year grow out period, sediment sulfide increased 180% while redox potential decreased significantly under the cages. After 3 months of falling redox levels had decreased and sulfide levels were near background. Comparisons made in 2006 with several other fallowed finn sites indicate that sediment conditions return to near background levels at most sites over the following period. Thus the mandatory 3rd year fallow period in combination with appropriate site selection criteria, appear to provide effective mitigation of the benthic effects of finnish aquaculture in coastal Newfoundland.

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INCREASING UPTAKE AND FATE OF CO2 IN NORTH ATLANTIC SUBTROPICAL MODE WATER (STMW)

Mode waters play an important role in heat, nutrient and carbon storage/dynamics of the subtropical gyres. Time-series data from the Bermuda Atlantic Time-series Study in the North Atlantic demonstrate that dissolved inorganic carbon concentration (DIC) in subtropical mode water (STMW) has increased at a rate as fast as anticipated from equilibrium with the atmosphere for the past 20 years. Thus, North Atlantic STMW may play a significant role as a short-term carbon sink, accounting for as much as 3-10% of the current net annual ocean uptake of CO2. The mechanisms responsible for this additional CO2 increase in STMW have not been fully resolved. During the 2006 and 2007 CLIMODE field program, which focused on STMW in the North Atlantic Ocean, we extensively sampled inorganic carbon at the region of formation of STMW and throughout the subtropical gyre. Preliminary results from these cruises are presented here and discussed in terms of the dominant processes contributing to the STMW DIC budget, including air-sea gas exchange, physical mixing and advection, primary production and respiration, as well as the fate of DIC in the STMW.

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THERMAL AND HYDRAULIC DYNAMICS OF SHALLOW LAKE ELLIDAVATN IN ICELAND

In the age of global warming, water temperature is becoming an ever more important parameter in surface water quality. Lake Ellíðavatn, one of the major recreational areas of the capital of Iceland, has experienced an unprecedented temperature increase over the past 25 years which is believed to threaten the Arctic charr stock in the lake. Increased aerial and fluvial pollution from nearby urban development is an additional cause for concern. To address these developments, a new study characterizing thermal and hydraulic dynamics in shallow Lake Ellíðavatn is being undertaken. Early results from lake temperature and fluvial pollution from nearby urban development is an additional cause for concern. To address these developments, a new study characterizing thermal and hydraulic dynamics in shallow Lake Ellíðavatn is being undertaken. Early results from lake temperature and fluvial pollution from nearby urban development is an additional cause for concern. To address these developments, a new study characterizing thermal and hydraulic dynamics in shallow Lake Ellíðavatn is being undertaken. Early results from lake temperature and fluvial pollution from nearby urban development is an additional cause for concern. To address these developments, a new study characterizing thermal and hydraulic dynamics in shallow Lake Ellíðavatn is being undertaken. Early results from lake temperature and fluvial pollution from nearby urban development is an additional cause for concern. To address these developments, a new study characterizing thermal and hydraulic dynamics in shallow Lake Ellíðavatn is being undertaken. Early results from lake temperature and fluvial pollution from nearby urban development is an additional cause for concern.
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RIVER DISCHARGE ESTIMATION THROUGH ASSIMILATION OF REMOTELY-SENSED WATER SURFACE ELEVATIONS

New methods of measuring surface water elevations from space have the potential to revolutionize the type, frequency, and spatial scale of global observations. Although satellite altimeters can measure surface water elevation directly, river discharge (and consequently freshwater inflow to oceans) cannot be directly measured. Data assimilation offers the potential to indirectly estimate river discharge by ingesting satellite observations into a hydrodynamics model. Our work demonstrates the potential of such an approach in an identical twin data assimilation experiment. Early results revealed some of the limitations that need to be overcome for an operational implementation of such an estimation system. Simulated river elevation profiles for the Ohio River were generated by the IPI Instrument Simulator to represent satellite measurements of surface water with errors representative of those that would be inherent in observations from a dual-sensor Ka-band wide swath altimeter. Model errors are represented by introducing errors in model parameters, channel geometry, as well as precipitation that is used to drive a hydrologic model which produces boundary inflow conditions for LISFLOOD. Model and observation errors are evaluated through a simultaneous state-parameter estimation Ensemble Kalman filter. Boundary conditions are shown to have a large effect on the estimation process, and ways to estimate their errors are explored through error covariance bias correction.

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10-70-DAY VARIABILITY OF KUROSHIO TRANSPORT IN THE EAST CHINA SEA

Absolute transport of the Kuroshio in the East China Sea (ECS) north of Okinawa was determined using Current-and-Pressure-recording Inverted Echo Sounders (CPIESs) and acoustic Doppler current profilers (ADCPs) across the Kuroshio from December 2002 to November 2004. This transport exhibits spectral peaks at 11, 15 and -60 days. The 15-day signal, which appears to come from the Kuroshio off Taiwan, extends through the whole water column in contrast to the 11-day signal which is largely confined above 300 m depth. The 11-day signal is likely due to the local growth of instabilities. Complex Empirical Orthogonal Functions (EOF) analysis of the 60-day signal shows that the first EOF explains 93% of the variance occurring in the band between 50 and 70 days. This EOF has large amplitudes towards the northwest (i.e., towards the continental slope) and phase propagation is also in this direction. Phase speed is 4 cm/s and wavelength 200 km. The 60-day signal may be due to short barotropic Rossby waves, generated in the ECS shelf-region, whose energy propagates eastward.

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UNCOVERING BIODIVERSITY IN ESTUARIES: THE ENIGMATIC PICOEUKARYOTES

Estuaries are famous for being highly biological productive and for supporting tremendous biodiversity. One of the most abundant organisms in these ecosystems are picoeukaryotes. They are responsible for a significant fraction of the primary production in both marine and freshwater ecosystems. Their small size (0.5 - 3 micrometers) and cryptic morphology; have led to the use of DNA-based analytical methods. To assess the diversity of picoeukaryote communities along an estuarine gradient we used Restriction Fragment Length Polymorphism (RFLP) fingerprinting of a fragment of the 18s rDNA gene. Picoeukaryotes collected along an estuarine gradient were all remarkably diverse, and decreases with distance from the point source. The benthic effects of an intensive sea bream fish farm in the Gulf of Aqaba, Red Sea were examined by taking replicated sediment cores along a transect extending from the cages to a station outside the anticipated range of influence. Cores were sampled for loss-on-ignition (organic matter content), pore-water nutrients, redox potential, benthos and SOD. A comparison of stations indicated a 50% decrease in SOD within 25m from the edge of the fish farm to values that were not much greater than background levels.

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GLOBAL ANALYSIS OF CONCURRENT DECADAL CHANGES IN THE WORLD OCEAN PHYTOPLANKTON AND THEIR FORCING VARIABLES (SST, WIND, IRRADIANCE)

A consistent time series of the world ocean chlorophyll concentration was produced from satellite ocean color observations by the CZCS sensor (1979-1983) and the SeaWiFS sensor (1998-2002) (Antoine et al, 2005). This reanalysis showed an overall increase of the world ocean average phytoplankton chlorophyll (Chl) by as much as 20% over two decades. Following this result, a project, called “GLOBOPY”, was recently set up to analyze these decadal changes in the global ocean phytoplankton in parallel to their forcing variables. The objective is, therefore, to confront the ocean colour record with those other parameters which are likely to have played a role in the evolution of the total phytoplankton biomass (temperature, irradiation, wind…). The data are taken from other satellite observations and from re-analyses of the outputs of global weather forecasting models. This analysis allows a first phase of interpretation of the observed changes, by checking their coherence with those observed in the forcing variables of the phytoplanktonic compartment.

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INFLUENCE OF THE ORINOCO RIVER PLUME ON PHYTOPLANKTON SIZE CLASS DISTRIBUTION IN THE CARIBBEAN

River discharge from the Orinoco River is largely responsible for bringing nutrients into Caribbean waters in the buoyant surface plume hence influencing phytoplankton growth. During a study of the influence of the Orinoco River plume in the Caribbean, phytoplankton size class distribution was characterized in order to better understand the dynamics between river plume discharge and phytoplankton size class distribution. Seawater was filtered using 47mm GF/F filters. For the size fraction analysis, seawater was filtered by sequential filtration using 47mm polycarbonate filters of 0.2, 2.0 and 20.0 µm pore sizes. Filter samples were then analyzed by reverse phase HPLC coupled with a Diode Array detector. Diadinoxanthin and Fucoxanthin, diagnostic pigments for diatoms and dinoflagellates, increase with decreasing salinity along the plume but are restricted to the two larger size class fractions. 19'-butanoyloxyfucoxanthin, diagnostic of prymnesiophytes, shows similar behavior; but is absent in the near field of the plume. Divinyl chlorophyll b, diagnostic of prorocentroccus, is a major component of the pigment suite of the plume. Presence of other pigments and their size class distribution is discussed.

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VERIFICATION OF THE WIND-DRIVEN TRANSPORT IN THE NORTH PACIFIC SUBTROPICAL GYRE USING GRIDDED WIND-STRESS PRODUCTS

Using gridded wind-stress products constructed by satellite scatterometers (ERS-1, 2 and QuikSCAT) data and those by numerical weather prediction model(NCEP-reanalysis), we are carrying a series of experiments using the POL Coastal Ocean Modelling System (POLCOMS) based on a set of experiments provided by the POL Coastal Observatory. These include the 12-16MHz WERA phased HF radar array, providing the assimilated data set, as well as ADCP data from two mooring points and observations from spatial surveys and ferrybox lines providing the validation. The study examines the effect of assimilating hourly, 4 km resolution surface currents from the HF radar in different tide and wind conditions throughout 2006 in a 1.8 km Irish Sea 3-d model setup. Our assessment of the system capability will be presented.

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SEDIMENT OXYGEN DEMAND AS A MEANS TO EXAMINE THE ASSIMILATIVE CAPACITY OF THE BENTHOS TO WASTES GENERATED BY A FISH FARM IN THE RED SEA

The sustainability of activities that release particulate organic wastes to the sea may be assessed by measuring the ability of the benthic community to assimilate these wastes. In healthy benthic communities the assimilation of organic compounds is performed by a community of aerobes, and benthic assimilative rates may be measured by means of sediment oxygen demand (SOD) measured by means of oxygen consumption. The loading of particulate organic matter to the seafloor is generally greatest below net cage fish farms and decreases with distance from the point source. The benthic effects of an intensive sea bream fish farm in the Gulf of Aqaba, Red Sea were examined by taking replicated sediment cores along a transect extending from below the cages to a station outside the anticipated range of influence. Cores were sampled for loss-on-ignition (organic matter content), pore-water nutrients, redox potential, benthos and SOD. A comparison of stations indicated a 50% decrease in SOD within 25m from the edge of the fish farm to values that were not much greater than background levels.
estimate wind-driven transports of the North Pacific subtropical gyre, and compare them in the central portion of the gyre (around 30N) with geostrophic transports estimated from historical hydrographic data (World Ocean Database 2005). The wind-driven transports for QSCAT and NCEP are both in good agreement with the geostrophic transports within reasonable errors, except for the regional difference in the eastern part of the zone. The difference in the eastern part results from an anti-cyclonic thermohaline flow in the surface. We also examined the consistency of the Sverdrup transports estimated from the products by comparing them with the results of the western boundary current in previous studies. The sum of the Sverdrup transport for QSCAT or NCEP and the thermohaline transport, agrees well with the northward transport of the western boundary current. It is concluded that the Sverdrup balance can hold in the North Pacific subtropical gyre.

In the abundance of heterotrophic microbes and picoeukaryotes, enhanced microbial activity was examined using terminal restriction fragment length polymorphisms of the 16S ribosomal RNA gene. This suite of daily and diurnal measurements documented 2-fold increases in the abundance of heterotrophic microbes and picoeukaryotes, enhanced microbial activity and shifts in the major bacterioplankton groups following the spawning events.

FOLLOWING NUTRIENT LOADING DUE TO CORAL SPAWNING

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WAVE-DRIVEN SETUP AND ALONGSHORE FLOWS OBSERVED ONSHORE OF A SUBMARINE CANYON

The effect of alongshore variations in the incident wave field on wave-driven setup and on alongshore flows in the surfzone is investigated using observations collected onshore of a submarine canyon. Wave heights and radiation stresses at the outer edge of the surfzone (water depth < 2.5 m) varied by up to a factor of 4 and 16, respectively, over a 450 m alongshore distance, resulting in setup variations as large as 0.1 m along the shoreline (water depth > 0.3 m). Even with this strong alongshore variability, wave-driven setup was dominated by the cross-shore component of the wave radiation stress tensor, and setup observed in the surfzone is predicted well by a one-dimensional cross-shore momentum balance. Stronger cross-shore and alongshore setup gradients contribute to the alongshore flows observed in the inner surfzone, and a simplified alongshore momentum balance suggests that the large [O (1 m/s)] currents are tidal rectification and density-driven circulation. Stronger circulation of the gyre occurs during the later part of the stratified season (July—August and September—October). The density-driven flow along the gyre is set-up by weak tidal mixing in the deep basin in the central Bay of Fundy and strong tidal mixing on the shallow flanks around Grand Manan Island and western Nova Scotia. Residence times longer than 30 days are predicted for particles released in the proximity of the gyre. A set of climatological runs were conducted to evaluate the relative importance of the different forcing mechanisms affecting the gyre. The main mechanisms are tidal rectification and density-driven circulation. Stronger circulation of the gyre occurs during the later part of the stratified season (July—August and September—October).

MODEL SIMULATIONS OF THE BAY OF FUNDY GYRE

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The characteristics of a persistent gyre in the mouth of the Bay of Fundy are studied using model simulations. A set of climatological runs were conducted to evaluate the relative importance of the different forcing mechanisms affecting the gyre. The main mechanisms are tidal rectification and density-driven circulation. Stronger circulation of the gyre occurs during the later part of the stratified season (July—August and September—October). The density-driven flow along the gyre is set-up by weak tidal mixing in the deep basin in the central Bay of Fundy and strong tidal mixing on the shallow flanks around Grand Manan Island and western Nova Scotia. Residence times longer than 30 days are predicted for particles released in the proximity of the gyre. A set of hindcast model simulations were conducted to study both the recent (2005—2007) interannual and intra-annual variability during the stratified season. Data assimilation of ADCP velocity data was used to improve the skill of the simulations. The resulting circulation suggests that during 2005 the strength of the Gyre was reduced which contributed to weaker reten- tion. The strongest flow and retention was estimated for late-spring 2007.

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WAVE-CURRENT INTERACTIONS IN THREE DIMENSIONS

A theoretical framework for wave-current interactions based on the Generalized Lagrangian Mean is presented together with some first results obtained with the primitive equations ROMS model forced by a simple wave model (Thornton and Guza 1983). The different forces appearing in the 3D balance are discussed, together with a possible parameter- ization of strong wave nonlinearity.

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DISTRIBUTIONS OF STABLE ELEMENTS AND RADIOISOTOPES IN SOME ESTUARINE AREAS OF JAPAN

Variations of the concentrations of chemical compounds in the hydrosphere, such as rivers, estuaries and coastal areas, are caused by changes of the environments and weather conditions. As chemical properties differ between fresh water and seawater, the behaviors of these compounds compositions are different in each environment. It is important for the understanding of the behaviors of these compounds to determine the concentrations of stable elements and radionuclides in these areas. A survey of Japanese rivers was conducted, and then a database was prepared. The concentrations of chemical compounds were investigated in order to clarify the distributions and behaviors of these from the estuarine to coastal areas. Major chemical compounds, i.e. nutrients and salinity, and minor components, i.e. halogen, selenium and heavy metals and POC etc., were determined in estuarine areas. The nutrient concentrations in estuarine areas were higher than in the coastal areas, as there was the diffusion in river water in the surface layer of the estuaries. Furthermore, there were high correlations between the chloride, bromine and iodine concentrations. We will discuss the behaviors on the basis of the concentration distributions of nutrients in some estuarine areas of Japan.
The amount of genomic information available for diatoms is increasing rapidly. In recent years, whole genome sequences have been completed for the centric diatom Thalassiosira pseudonana and the pennate diatom Phaeodactylum tricornutum. Two more pennate diatoms are currently being sequenced—the polar diatom Fragilariaopsis and the toxic diatom Pseudo-nitzschia multiseries. These large-scale sequencing projects have generated new hypotheses about diatom capabilities and thus have laid the foundation for detailed studies into their physiology and ecology. I will provide an update on current diatom genome sequencing projects and will describe new ways that these data are being used to better understand how diatoms transport and process silicon.

Evolutionary Optimization in Marine Biogeochemistry Modeling: An Example from Optimal Foraging

The process of constructing ocean ecosystem models for use in biogeochemistry includes selecting mathematical functions to represent dynamical interactions among state variables. Usually several choices exist among functions that have been used in past models (e.g., multiplicative vs. Liebig vs. Geider/Armstrong descriptions of light-nutrient interaction), and it is often not clear which of them should be used. Here I argue that evolutionary optimization, a staple in the field of evolutionary ecology, can be used to sort among competing mathematical descriptions. Furthermore, in many cases optimality arguments lead to alternative, more powerful functional descriptions, whose parameters may be easier to interpret and measure, leading to a more productive dialogue between empiricists and modellers.

Portuguese Man-O-War (Physalia physalis) is a marine jellyfish, which is an invasive species that cryptically uses the planktonic stages of the crustacean species Bopyrus minor as a means of dispersal to colonize new areas. We tested the efficiency of Bopyrus as a dispersal agent using a newly developed laboratory model that can simulate the dispersal process and evaluate the factors that influence the success of Bopyrus' larval stages. The model incorporates the dynamics of Bopyrus' dispersal and the environmental conditions that affect its survival and recruitment into new areas. We found that Bopyrus' dispersal is influenced by both biological and environmental factors, and that the optimal dispersal strategy varies depending on the environmental conditions. Our results suggest that further research is needed to understand the factors that influence Bopyrus' dispersal and to develop effective strategies for managing its invasive spread.
examples from my own work and that of others, I emphasize the need to apply multiple approaches, specific to the life stage of the larve, to effectively validate and enhance our understanding of these organisms. Application of those approaches, particularly within the framework of an intensive coastal ocean observing system, is a necessary precursor to model acceptance and advancement.

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COUPLING SATELLITE BIO-OPTICS, NUMERICAL MODELS AND OBSERVATIONS TO DEFINE A COASTAL ECOSYSTEM

We define a three-dimensional ecosystem of the coastal ocean by assimilation of observations with an ocean model. The 3-D volume of coastal bio-optical/physical properties was determined by coupling surface bio-optical satellite properties, vertical density properties from circulation models and in situ profiles of bio-physical properties. Relationships between density profiles, 1% light level, and profiles of chlorophyll and backscattering coefficients were determined from observations. These physical-bio-optical relationships were constrained by satellite surface properties and used to extend a subsurface profile by incorporating model fields of mixed layer depth, degree of stratification, and 1% light level. The equations used to characterize the profile shape were optimized by in situ profiles from sea-gliders and stations observations and the variability of these optimized coefficients determined. This approach considers surface satellite accurate with uncertainty in the subsurface profile. By exploiting in situ vertical properties to constrain profile shape and extending these relationships both spatially and temporally, we reduce the uncertainty of subsurface shape and define the bio-optical ecosystem. The 3-D bio-optical ecosystem volume is demonstrated in the northern Gulf of Mexico and other regions.

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RECENTLY ENHANCED PRIMARY PRODUCTIVITY IN THE ARCTIC OCEAN

In 2007, the Arctic Ocean experienced an unprecedented loss of sea ice, with a summer minimum ice extent that was 23% below the previous low in 2005 and nearly 40% below the mean low for 1979-2000. This loss of sea ice increased the area of the Arctic Ocean exposed to summer solar insolation by 1.3 million square kilometers, or 15%. In addition, an earlier spring melt and later autumn freeze in the Arctic in recent years resulted in a longer phytoplankton growing season. Satellite ocean color data suggest that chlorophyll concentrations in the newly exposed areas of the Arctic Ocean in 2007 range from 0.25 to 0.80 mg m⁻², typical of concentrations found at lower latitudes. These observations, along with satellite-based estimates of sea surface temperature and cloud cover, were used as input to a primary production algorithm to estimate rates of phytoplankton primary production throughout the Arctic Ocean. We will present recent estimates of changes in pan-Arctic productivity, including the contribution by the new and unprecedented area of open water observed in 2007.

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THE ROLE OF NUTRIENTS IN LYNGBHYA GROWTH AND CHEMICAL DEFENCE

Benthic cyanobacteria of the genus Lyngbya form harmful algal blooms (HABs) that occur in marine and estuarine environments throughout tropical and subtropical oceans of the world. They are extremely prolific producers of biologically active secondary metabolites, many of which deter grazing by generalist herbivores. Nutrient blooms of Lyngbya occur regularly throughout Florida and may be triggered by terrigenous nutrient inputs. In addition, these blooms may grow unchecked as grazers avoid consuming the filaments. In this study we examine the ecology of Lyngbya blooms in Florida including the effects of nutrient additions and light on Lyngbya growth and toxin production. We use a bioassay approach to assess the role of nitrogen, phosphorus, iron and low light conditions on the growth and secondary metabolite production of Lyngbya spp. from Florida, USA. We also assess how these compounds affect potential grazers and the implications of these blooms for the marine ecosystem.

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THE LACAR-ICOMM NETWORK: IDENTIFICATION OF RESEARCH CAPABILITIES AND OPPORTUNITIES FOR ASSESSING MARINE MICROBIAL DIVERSITY IN SOUTH AMERICA AND THE CARIBBEAN

The International Census of Marine Microbes (ICoMM), the South American and the Caribbean Census of Marine Life (CoML) regional committees, launched a regional ICoMM node (LACar-ICoMM). This network aims at promoting discussions on marine microbial studies carried out in both regions in order to identify research capabilities, complementary strengths and possibilities for enhanced collaboration in assessing marine microbial dynamics and diversity. Studies dealing with bacterial, phytoplankton, phytobenthos and/or cyanobacterial ecology and/or taxonomy are carried out in coastal and oceanic marine systems modulated by geographic and seasonal patterns, as well as by the expression of large South American rivers or strong upwelling systems, in tropical and temperate areas. Bacteria capable of degrading pesticides and hydrocarbons are also monitored (activity and diversity) in the Caribbean (Colombian Caribbean, Orinoco Delta), as well as in tropical (Microbial Observatory of Rio de Janeiro, Guanabara Bay, Brazil) and temperate waters and sediments of South American threatened coastal systems. The application of molecular tools in monitoring marine microbe diversity and dynamics represents a common priority for each type of study and a challenge for future research in the area.

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A CONTRIBUTION OF WIND FORCE TO A PRIMARY PRODUCTIVITY IN THE PHILIPPINE ARCHIPELAGOS

In June, 2007, a wind driven surface current along the Cuyo East Pass in the Philippine Archipelagoes was observed by the Synthetic Aperture Radar (SAR) on the Advanced Land Observation Satellite (ALOS). Simultaneously, the moored Acoustic Doppler Current Profiler (ADCP) at the west of the Panay Island observed the northward current in the surface to 150 m depth from the middle of June to the beginning of July, 2007, while the south wind was dominant. The Moderate Resolution Imaging Spectroradiometer (MODIS) on the AQUA observed the decrease of the sea surface temperature and chlorophyll a concentration. The MODerate resolution Imaging Spectroradiometer (MODIS) on the AQUA observed the decrease of the sea surface temperature and chlorophyll a concentration. The satellite observations provided the horizontal response of the primary production and the ADCP provide the time series of the vertical distribution of water mass. This study examined the mechanism of the primary production in the Philippine Archipelagoes based on these observations and from the point of response of biological activities to the environmental changes, which could be determined by the seasonal winds.

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DEEP MEAN ZONAL EQUATORIAL CURRENTS GENERATED BY A YANAI WAVE TREMA

In the Pacific and Atlantic basins, a set of zonal currents with a complex meridional and vertical structure is observed below the thermocline and within 5° from the equator: the thermally modulated by geographic and seasonal patterns, as well as by the expression of large South American rivers or strong upwelling systems, in tropical and temperate areas. Bacteria capable of degrading pesticides and hydrocarbons are also monitored (activity and diversity) in the Caribbean (Colombian Caribbean, Orinoco Delta), as well as in tropical (Microbial Observatory of Rio de Janeiro, Guanabara Bay, Brazil) and temperate waters and sediments of South American threatened coastal systems. The application of molecular tools in monitoring marine microbe diversity and dynamics represents a common priority for each type of study and a challenge for future research in the area.
Elucidating shifts within microbial communities are a prerequisite for gaining a better understanding of organic matter (DOM) availability over a tidal cycle in Apalachicola Bay, FL. Elucidating shifts within microbial communities are a prerequisite for gaining a better understanding of organic matter (DOM) availability over a tidal cycle in Apalachicola Bay, FL. Elucidating shifts within microbial communities are a prerequisite for gaining a better understanding of organic matter (DOM) availability over a tidal cycle in Apalachicola Bay, FL. Elucidating shifts within microbial communities are a prerequisite for gaining a better understanding of organic matter (DOM) availability over a tidal cycle in Apalachicola Bay, FL. Elucidating shifts within microbial communities are a prerequisite for gaining a better understanding of organic matter (DOM) availability over a tidal cycle in Apalachicola Bay, FL. Elucidating shifts within microbial communities are a prerequisite for gaining a better understanding of organic matter (DOM) availability over a tidal cycle in Apalachicola Bay, FL. Elucidating shifts within microbial communities are a prerequisite for gaining a better understanding of organic matter (DOM) availability over a tidal cycle in Apalachicola Bay, FL. Elucidating shifts within microbial communities are a prerequisite for gaining a better understanding of organic matter (DOM) availability over a tidal cycle in Apalachicola Bay, FL.

To further our understanding of the temporal variability of DOM, we set out to characterize the seasonal and diurnal changes in DOM composition and bioavailability in this estuarine system. Our data suggest that the temporal variability of DOM composition and bioavailability is strongly influenced by the interaction of physical processes with biological activity.

We investigated the diurnal and seasonal variability of DOM composition and bioavailability in the Apalachicola Bay estuary, FL, using a combination of field observations and modeling approaches. Our results show that the temporal variability of DOM composition and bioavailability is strongly influenced by the interaction of physical processes with biological activity. We found that the temporal variability of DOM composition and bioavailability is strongly influenced by the interaction of physical processes with biological activity.

In summary, we found that the temporal variability of DOM composition and bioavailability is strongly influenced by the interaction of physical processes with biological activity. Our findings suggest that the temporal variability of DOM composition and bioavailability is strongly influenced by the interaction of physical processes with biological activity.
may directly impact observations at nearby AmeriFlux towers. We have collected lake water samples, analyzed above lake CO2 content of the strom, measured CO2 fluxes, and developed a coupled ecosystem carbon-hydrodynamic model of Lake Superior in an attempt to estimate these fluxes and understand their controlling mechanisms. Water samples collected monthly since January 2007 have pCO2 concentrations above the atmospheric equilibrium value; CO2 concentrations measured in June were elevated above what would be expected on land, and direct flux measurement in August confirmed that the lake was emitting CO2. Simplest extrapolations from these observations suggest the lake source may be significant. Initial whole lake flux estimates from the coupled hydrodynamic model will be compared with measured fluxes.

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BIO-OPTICAL CHARACTERISTICS OF THE WESTERN ARCTIC OCEAN: IMPLICATIONS FOR OCEAN COLOR ALGORITHMS

Global ocean color algorithms designed to estimate chlorophyll a concentration (chl) are not accurate at high latitudes. While a regional Arctic OC4 algorithm was designed to be applicable to high northern latitudes, its applicability also remains uncertain. To examine these issues, we investigated the light absorption coefficient of phytoplankton, non-algal particles (NAP), colored dissolved organic matter (CDOM), and remote sensing reflectance, Rs(t) above-most part of the Western Arctic Ocean. A higher pigment packaging effect was identified relative to that at lower latitudes. The CDOM absorption dominated and is accounted for over 50% of the total non-water absorption at all wavelengths used for ocean color algorithms, and did not covary with chla. Our evaluation shows that when turbid waters are excluded, the performance of the OC4L is much better than that of SeaWiFS OC4V4 and MODIS OC3M. The reason why the OC4L performs well despite strong CDOM absorption is discussed.

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RELIANT PHYSICAL AND BIOLOGICAL CLIMATE CHANGES IN THE GULF OF ALASKA

Recent measurements of zooplankton biomass and biological productivity in the Gulf of Alaska have raised a number of questions regarding possible linkages between climate and availability of renewable resources. In this article we compare 3 abrupt oceanic regime shifts in the Gulf of Alaska, the 1976-1977 warming shift, the 1998 cooling episode, and the 1998 to 1999 El Niño to La Niña transition. We investigated the light absorption coefficient of phytoplankton, non-algal particles (NAP), colored dissolved organic matter (CDOM), and remote sensing reflectance, Rs(t) above the seasonal warming that had on estuarine salt exchange. A geometrically similar estuary to the Chesapeake Bay (200 km long, 20 km wide) and a similar mean freshwater flux (2500 m3s) was used to force the model. Applying a Mellor-Yamada vertical mixing scheme with a backscattering coefficient of 0.001 m3s to a 150-day model run, we first established the initial estuary salinity equilibrium gradient. Then running the model for 10 days, a river induced freshwater plume progressed southward over the shelf and detached from the coast. When upwelling winds were imposed for 3 days, the river plume moved northward in the alongshore direction, increasing the estuary salinity and total salt exchange out of the estuary. We quantified these changes in estuarine salt exchange and volume by also shifting the onshore and duration of upwelling winds in order to compare with past Chesapeake Bay research.

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THE INFLUENCE OF UPWELLING WINDS ON ESTUARINE SALT EXCHANGE

Typical shelf-estuary modeling has integrated simplified models for either the estuary or the coastal ocean. In this analysis we included the complexity of each region using the Regional Ocean Modeling System (ROMS) to characterize the impact that upwelling directed winds had on estuarine salt exchange. A geometrically similar estuary to the Chesapeake Bay (200 km long, 20 km wide) and a similar mean freshwater flux (2500 m3s) was used to force the model. Applying a Mellor-Yamada vertical mixing scheme with a backscattering coefficient of 0.001 m3s to a 150-day model run, we first established the initial estuary salinity equilibrium gradient. Then running the model for 10 days, a river induced freshwater plume progressed southward over the shelf and detached from the coast. When upwelling winds were imposed for 3 days, the river plume moved northward in the alongshore direction, increasing the estuary salinity and total salt exchange out of the estuary. We quantified these changes in estuarine salt exchange and volume by also shifting the onshore and duration of upwelling winds in order to compare with past Chesapeake Bay research.

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THE COUPLING OF HYDRODYNAMICS AND NUTRIENT EXCHANGE IN NATURAL SEAGRASS CANOPIES, PART TWO: CANOPY CHARACTERISTICS AND NUTRIENT UPTAKE

Rates of nutrient uptake and the partitioning of uptake spatially within a canopy are the result of both biological characteristics of the canopy and the interaction between the canopy and the overlying water. Here we examine these interactions within vegetated canopies in Florida Bay, FL. These canopies are dominated by the seagrass, Thalassia testudinum. However they have a range of blade densities and understory characteristics. We identified species within each canopy and estimated the volume and cross sectional area of the canopy filled by vegetation. These characteristics were then compared with hydrodynamic data from a multi-instrument array to examine how complex canopy form influences hydrodynamics. We also used a field-deployable racetrack flume to measure the uptake of ISNO ammonium by the canopy over a range of hydrodynamic conditions and partitioned uptake among species and among locations within the canopy. Our data indicates that hydrodynamic regime and partitioning of nutrient uptake are influenced by characteristics of natural canopies.
the composition of Ocean samples in terms of end members of the water masses that Schlosser, P. Truong, G. Babbin, A. R. the future carbonate system in deep North Atlantic will be discussed. fluvial input in the water formation regions, calcium carbonate dissolution, remineralization of salinity abruptly increased in LSW and NEADW in 2003, persisting to the present, and showed changes in alkalinity-salinity relationships over the last 15 years. Through the 1990s and up formed every winter in the Labrador Sea, and North East Atlantic Deep Water (NEADW) and The Labrador Sea is one of two sites in the North Atlantic that produce intermediate and spheric forcing fields come from the ERA40 reanalysis and from the CORE product. Estimations of the mixed layer heat content and the study of associated mechanisms often rely on numerical simulations. OGCMs are usually forced with NWP fields such as the ECMWF or NCEP (re)analyses or with observations-derived products. Although it is clear that the nature of atmospheric forcing products and their space-time resolution have a significant impact on model results in terms of surface heat content, little is known about the influence of uncertainties in one given atmospheric product. In this study we propose to explore the sensitivity of a model response in terms of mixed-layer heat content representation to 1/ the use of different atmospheric reanalyses with similar space-time resolution and 2/ small perturbations on a given reanalysis meant to represent a priori uncertainties. The approach is based on stochastic modelling. We address the case of the North Atlantic during a period of mixed-layer deepening (September 1994 - March 1995). We use the NEMO/OPA model in a A/A, horizontal resolution configuration; atmospheric forcing fields come from the ERA40 reanalysis and from the CORE product.

Aseyt Scott-K, Bedford Institute of Oceanography, Dartmouth, Canada, Aseytu Scott-K@mac.léo-mpo.gc.ca; Jones, E. P, Bedford Institute of Oceanography, Dartmouth, Canada, Jonee@mac.léo-mpo.gc.ca; Gershey, R. M., BDR Research Limited, Halifax, Canada, bd-research@ca.inter.net DECADAL VARIATION OF ALKALINITY IN THE LABRADOR SEA The Labrador Sea is one of two sites in the North Atlantic that produce intermediate and deep water by winter convection. The Labrador Sea consists of Labrador Sea Water (LSW), formed every winter in the Labrador Sea, and North East Atlantic Deep Water (NEADW) and Denmark Strait Overflow Water (DSOW) produced in the Nordic Seas. We report significant changes in alkalinity-salinity relationships over the last 15 years. Through the 1990s and up to 2002, alkalinity and salinity showed strong negative correlation in LSW and NEADW. The salinity abruptly increased in LSW and NEADW in 2003, persisting to the present, and showed a positive correlation with alkalinity. Possible causes of these changes include changes in Arctic fluvial input in the water formation regions, calcium carbonate dissolution, remineralization of organic matter, mixture of different source waters. These will be evaluated and implications for the future carbonate system in deep North Atlantic will be discussed.

Babin, A. R., Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY, USA, ar,babin11@eolouab.com; Truong, G., Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY, USA, gst2102@columbia.edu; Newton, R., Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY, USA, benwton@leidos.columbia.edu; Schlosser, P., Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY, USA, schlosser@leidos.columbia.edu OXYGEN ISOTOPE RATIOS IN THE ARCTIC OCEAN: IMPLICATION FOR THE FRESHWATER BALANCE Oxygen isotope ratios (H18O/H16O and H18O/H16O) of water and salinity data are used to identify the composition of Ocean samples in terms of end members of the water masses that determine the freshwater budget of the Arctic Ocean. These include the Atlantic and Pacific inflows, meteoric water, and sea ice melt. Starting from the GIN Global Seawater Oxygen-18 database (Schmeiker et al., 1999), which contains oxygen isotope and corresponding salinity measurements compiled over the last thirty years, we added new data to the database and determined the errors in the 18O fields, using several methods, including rms error about a smooth fit to profiles. We used the 18O data, together with salinity and nutrient measurements, to calculate the contributions of the individual water masses to the Arctic Ocean freshwater balance. The errors in the freshwater calculations were determined from those of the individual variables through a matrix inversion. Sea ice melt and meteoric water fraction errors were found to be strongly anti-correlated.

Babolin, M. CNRS - Laboratoire d'Océanographie de Villefranche, Villefranche-sur-Mer, France, merve@obs-vlfr.fr; Belanger, S., Université E du Québec I Rimouski, Rimouski, Canada, sionel_belanger@ uqtr.ca PAN-ARCTIC PRIMARY PRODUCTION AND ORGANIC MATTER PHOTOSYNTHESIS: SIGNIFICANCE OF THESE TWO LIGHT-DRIVEN PROCESSES Primary production and CDOM photo-oxidation have opposing impacts on carbon fluxes in the ocean. The balance between the two processes may be significantly affected in the near future by climate change. This is especially true for the Arctic Ocean, which is increasingly exposed to light as perennial ice recedes, and which receives increasing amounts of terrigenous organic matter as the permafrost thaws and river discharges increase. In this study, we used remote sensing data to estimate the pan-Arctic distributions of primary production and CDOM photo-oxidation, and how they evolved from 1998 to now. Ocean color, ozone, cloud and ice data are combined to run a radiative transfer, and primary production and photo-oxidation, and sensitivity analysis is conducted to quantify the impact of chosen ocean color algorithms and of various model parameters on results. Our results provide the first pan-Arctic estimates of primary production and CDOM photo-oxidation based on remote sensing, and allow determining how these two processes compare. Also, we show how CDOM affects primary production through shading.

Baio, A. L., AAAS Science and Technology Policy Fellow, Washington, USA, babsona@gmail.com; Kawase, M., University of Washington, Seattle, USA, kawase@ocean.washington.edu MODELLING SILL EFFECTS ON FLOOD STRATIFICATION, INTERNAL TIDES, TRANSPORT AND RESIDENCE TIMES The effects of sill height on stratification, residence time and transport are studied using the Regional Ocean Model System (ROMS) with idealized fjord bathymetry and steady forcing. Six cases of increasing sill height, residence time does not monotonically increase with increasing sill height. This is partially due to the lowest sill height case having anomalous stratification. This case has the highest energy converted to mixing. Internal tides are generated in all cases off the sloping headwall and in some of the cases off of the sill. The three tallest sill cases are jet basins according to Stigebrandt and Aureus (1989) dividing between jet and wave basins. Jet basins have a mean tidal velocity that is greater than the internal wave speed. Within the basin is a cyclonic gyre, in the time mean, at all depths except the thin outflowing surface layer and a thin bottom layer. The strength of this gyres increases with sill height, as internal Rossby radius decreases. Bachratt, B. C., University of Montreal, Montreal, Canada, charlyne.bachratt@umontreal.ca A MODEL FOR DEEP-SEA HYDROTHERMAL VENT FAUNA BIOGEOGRAPHIC DISPERSAL Since their discovery in 1977, deep-sea hydrothermal vent fields have fascinated marine biologists because of their fauna based on chemosynthesis and the high level of symbiosis among trophic types. This fauna was found to harbor new species, genera, and families that were new to science. Its biomass is high despite harsh environmental conditions. This fauna has been studied by scientists from several countries. Few studies have focused on biogeographic relationships among regions of the world ocean. Our objectives are to (1) recognize large areas (biogeographic provinces) with differing faunal composition and (2) determine the dispersal and evolutionary relationships among these areas. Our study benefited from a recent compilation of all hydrothermal species in 63 fields. Architecturally constrained multivariate regression tree pointed to a preliminary division of the world ocean into 6 to 9 provinces; this result will undoubtedly be revised as new oceanic areas are explored. We then analyzed the relationships among these faunas and generated a hypothesis about the center of dispersal of hydrothermal faunas. This result will be tested using phylogenetic analysis of some groups of organisms.
seep habitats occur in abundance along the entire east and south slope of NZ's North Island. Seep communities were characterized by vestimentiferan worms in the genera Lamellibrachia, Siboglinum pogonophorans, vesicomyid clams, a solemyid (Acharax sp.) and a species of bathymodiolin mussel. Core and grab samples revealed numerous additional described species of paracardid crustaceans and polychaete worms. The initial assessment of community composition suggests that the NZ margin hosts a broad diversity of seep fauna, each likely harboring its own characteristic fauna. While the NZ margin appears to represent a new biogeographic province for seep fauna, there may be high species overlap with the nearby Kermadec Arc hydrothermal vents. Unfortunately, even as these cold-seep ecosystems are being discovered, they appear to be threatened by bottom trawling along the entire NZ margin. Fishing and other anthropogenic disturbance may endanger seep communities on a global scale.

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THE ROLE OF MECHANICAL VERSUS BUOYANCY FORCING IN DETERMINING THE RESIDUAL CIRCULATION IN THE OCEAN

Eddy residual-mean circulation in the ocean requires the presence of a gradient in the buoyancy input as argued by Walin (1982). The buoyancy forcing can be a function of the flow, such as the air-sea heat loss associated with western boundary currents. However, we argue that the buoyancy forcing is not always the rate limiting process in determining the residual circulation and instead mechanical forcing is important. Here, the residual circulation is examined for two different regimes: an open ocean front, with characteristics similar to fronts observed in the Southern Ocean, and a shelf-sea front, separating stratified to tidally well-mixed waters. The buoyancy forcing is solved for either as a function of the Ekman flow in the mixed layer or as a function of tidal mixing. For both regimes it is the mechanical forcing that controls, and localize the residual circulation. This process is analogous to the stratosphere, where the breaking of gravity waves is responsible for driving the residual-mean flow.

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INFLUENCE OF THE RAPID/MOCHA AND FLORIDA CURRENT CABLE DATA ON THE ECCO-GODAE OCEAN STATE ESTIMATE

The incorporation of local temperature/salinity observations from the RAPID/MOCHA mooring array, as well as the cable estimates of volume transport in the Florida Current, is tested in the ECCO-GODAE estimation system for their impact on the meridional overturning circulation and heat transport in the Atlantic. These data are added to the global data sets normally used in the ECCO-GODAE least-squares fits over the one-year period March 2004-March 2005. Preliminary results show that western and eastern boundary mooring array data without the cable observations modify the estimated state only regionally and produce a shift in the meridional overturning of about 1 Sv. We also investigate the extent to which the non-eddy resolving model can represent the observed variations that include eddy signals. Using the cable data as observational constraint increases the time-mean Gulf Stream transport, the amplitude of the seasonal cycle, higher frequency variability, as well as the overturning circulation by about 3 Sv between 25 and 45N.

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HYPERSONTAL DATA IN SPECTRAL ANALYSIS OF NEARSHORE WATER QUALITY PARAMETERS

The focus of the research is to characterize the physically based surface spectral reflectance for the NJ nearshore waters and to retrieve the water constituent concentrations from the atmospherically corrected AVIRIS signals. Hyperpectral data were collected using the NASA/AVIRIS in conjunction with simultaneous in-water measurements. AVIRIS records the integrated effects of the solar source, the atmosphere and the targeted surface. To use AVIRIS data, the generation of accurate reflectance from radiance is a required input parameter for retrieval of nearshore water constituent concentrations. Atmospheric correction algorithm - Tafka developed by the NRL will be used to reduce the effects of the atmosphere so as to infer the water-leaving radiance. The algorithm uses lookup tables generated with the vector radiative-transfer code (RTC). AVIRIS data will be used to do the model inversion to describe the entire system from remote sensor to hydroxys for retrieval of the optical water quality parameters. In conjunction with bio- optical models these optical properties can be used to characterize the water in terms of chlorophyll, CDOM and inorganic material. The bio-optical modeling and RTC are the main tools for using remote sensing as an operational monitoring tool to study the ecological communities of phytoplankton important in global change studies.

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DEEP OCEAN ENVIRONMENTAL LONG TERM OBSERVATORY SYSTEM (DELOS); INITIATION OF A 25 YEAR STUDY OF DEEP-OCEAN ECOSYSTEMS OEFFS OFFSHORE HYDROCARBON OPERATIONS

The deep-sea environment into which hydrocarbon operations are gradually extending is generally poorly understood with surveys regularly discovering new habitats and communities of animals previously unknown to science. Hitherto only a very small number of deep-sea sites in the world’s oceans have been the subject of long-term studies exceeding 5 years, but these studies have shown important annual cycles with considerable variability from year to year and changes in dominant fauna over decadal time scales. In an oil production area such spontaneous changes need to be distinguished from any anthropogenic influences imposed on the deep-sea environment. The DELOS system comprises two environmental monitoring platforms situated in the Southwest Atlantic Ocean at 1400m depth off Angola. One in the far field will be 5 km from sea floor infrastructure, and one in the near field within 50 metres of a well. Each platform will have a camera, oceanographic, acoustic, and guest module with an additional sediment trap module in the far field. DELOS will be installed in early 2008 and over time will lead to improved understanding of deep ocean ecology.

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VOLATILIZATION OF POLONIUM BY TELLURITE RESISTANT MARINE MICROBES

Tellurite resistant (TeR) microorganisms from Indian River Inlet (Delaware, U.S.A) salt marsh sediments were examined for their potential roles in biogeochemical cycling of tellurium (Te) and its group 16 congener polonium (Po). We hypothesized that TeR microbes may produce volatile alkylated species of both Te and Po thereby mediating transfer of Te and Po from the marine environment to the atmosphere. The hypothesis is based on the homology of some tellurite resistant determinants to S-adenosylmethioine (SAM) alkyltransferases. Previously, we demonstrated that our TeR microbes do volatilize Te, primarily as dimethyl telluride. Here, we show that these organisms also volatilize Po, transferring between 2.3 and 5.5% of a 10 Bq Po-209 spike from the media to the headspace over a 10-day period. The addition of tellurite to cultures appears to suppress Po volatilization, with the majority of the radioactivity being found in particulate materials.

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LONG-TERM CHANGES IN ATLANTIC DEEP-WATER FISH POPULATIONS: EFFECTS OF FISHING AND CLIMATE

Nothing is known about long-term trends in the majority of deep-water fishes, particularly those which are not fisheries targets. We analyzed scientific bottom trawl data obtained using identical techniques from 1979-1989 and 2000-2002, and extending from the depths exploited by slope fisheries (<1500 m) to the abyssal plain (>4000 m). At abyssal depths there are possible links between surface climate and fish abundance, probably mediated by changes in carrion supply to scavenging fishes. We also demonstrate that significant decreases in abundance are apparent in both target and non-target species at all depths from 800 to 3000 m. As many deep-water fishes have large adult depth ranges, and some migrate down-slope with increasing age, fishery impacts on the upper slope appear to reduce the recruitment of adult fish to lower slope habitats. This effect at least doubles the depth at which fisheries impacts occur and potentially increases the area affected by fishing from 11% to 23% of the seafloor.
We present novel methods, using k-means clustering combined with statistical tech-
niques, for detecting and segmenting upwelling and frontal boundaries. We demonstrate
our methods in the Monterey Bay coastal regions using Advanced Very High Resolution
Radiometer (AVHRR) satellite data. Using the clusters with different numbers of classes,
we introduce a clustering-differencing approach for detection of frontal boundaries.
We also introduce statistical criteria to determine the presence of upwelling and its
segmentation. We demonstrate the representativeness of this method for the period of
August 2003 and validate the results with the Upwelling Index, a metric based on estimated off-
shore Ekman drift driven by alongshore wind stress.

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HOW ON EARTH WILL WE MEASURE THE IMPACT OF OCEAN ACIDIFICATION
OVER BASIN SCALES?

Remote sensing is likely to play a key role in assessing the impact of ocean acidification in
the global ocean. Cocolithophorids could be a key functional group to watch; they
should be particularly sensitive to decreases in ocean pH due to their being covered by
coccoliths made of calcium carbonate (otherwise known as particulate inorganic carbon).
We briefly review the method for space-based remote sensing of suspended PIC,
highlighting the advantages and limitations of the technique. The ocean color PIC algo-
rithm specifically targets backscattered light from the smallest calcium carbonate particles
such as plated cocolithophores and detached coccoliths. We will use field results to
show the utility of the PIC algorithm that has been calibrated and validated as well as the
future challenges for relating cocolithophore variability and PIC standing stock to ocean ac-
idification. The global standing stock and annual production rate of PIC will be discussed.
A five-year time series of suspended PIC concentration (derived from NASA's recently-
reprocessed MODIS AQUA mission) will be shown to highlight the spatial and temporal
variability in the global standing stock of particulate inorganic carbon.

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HOTSPOTS: DENSITY AND SPECIES RICHNESS FOR CETACEANS IN
THE OCEANIC EASTERN TROPICAL PACIFIC

Biodiversity hotspots have received much attention but relatively little is known about
hotspots in oceanic systems. We describe density and species richness hotspots for cetae-
cans in the eastern tropical Pacific based on data collected using line transect methods
during an 18-year period. Density hotspots were clearly evident in three oceanographically
distinct regions: the Equatorial cold tongue, the Costa Rica Dome, and waters to the west
and east of the Isthmus of Panama. A smaller hotspot centered along the 10N thermocline
ridge. Hotspot species generally mirrored hotspots of density but tended to be located along
the edges of many species-specific density hotspots. This result contrasts sharply with results
from terrestrial systems, where richness hotspots typically represent centers of endemism.
Endemism is rare for cetaceans in the oceanic tropical Pacific, and richness hotspots may
represent areas of marginal habitat for many species. Focusing conservation efforts on richness
hotspots for oceanic cetaceans, and perhaps for other oceanic species, may not facilitate
their conservation.

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THE OCEAN OBSERVATORIES INITIATIVE (OOI) NETWORK: INTEGRATING
ADVANCED TECHNOLOGIES.

The National Science Foundation's (NSF) Ocean Observatories Initiative (OOI) supports
the construction and operation of an interactive, integrated ocean observing network.
This research-driven network will provide advanced technology to enable next-gen-
eration studies of fundamental ocean processes. The OOI will afford observations at
coastal, regional, and global scales on timescales of milliseconds to decades in support
of investigations into climate variability and ocean ecosystems, biogeochemistry, coastal
processes, mixing dynamics, plate-scale geodynamics, fluid-rock interactions, and
the sub-seafloor biosphere. The elements of the OOI include arrays of fixed and re-
locatable moorings, autonomous underwater vehicles, and cabled seafloor nodes. These elements
will be integrated through a system-wide cyberinfrastructure allowing for remote control
of instruments, adaptive sampling, and near-real time access to data. Implementation of
the network will stimulate new avenues of research and the development of new infra-
structure, instrumentation, and sensor technologies. The OOI is coordinated for the NSF
by the Consortium for Ocean Leadership/ Joint Oceanographic Institutions which focuses
on the science, technology, education, and outreach for an emerging network of ocean
observing systems.
MODELING PLANKTONIC GROWTH AND GRAZING IN THE COLUMBIA RIVER PLUME REGION

A coupled circulation/biogeochemical model was developed for the Washington-Oregon coast in order to determine the role of the Columbia River plume in along-coast gradients in primary production. The circulation model (ROMS 2.2) has 400 m resolution near the river mouth and is forced by tides, wind from a mesoscale atmospheric model (MM5), and variable riverflow. The biological model is a constant nitrogen budget which tracks nutrients, phytoplankton, zooplankton, and detritus (NPZD) in every grid cell. Crucially, zooplankton ingestion mortality rate, and some zooplankton model parameters were determined empirically rather than by tuning, using an equivalent models of the equations using a rich biological database obtained in the RISE (River Influences on Shelf Ecosystems) program. Observed and modeled rates in the nutrient-depleted field far are an order of magnitude higher than rates commonly assumed a priori in ecosystem models of this type. Results show that the Columbia River plume acts as a semi-permeable barrier to southward, along-shelf transport, and thus is at least partly responsible for the high productivity of the Washington shelf.

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USE OF MODIS IMAGERY TO DETECT LANDSCAPE-SCALE CHANGES IN VEGETATIVE AND HYDROLOGIC PROPERTIES OF THE FLORIDA EVERGLADES

The Comprehensive Everglades Restoration Plan (CERP) will impact the Everglades from its northern headwaters in the Kissimmee basin to Florida Bay in the south. The Moderate Resolution Imaging Spectroradiometer (MODIS) offers an inexpensive tool to detect and monitor inter-seasonal changes in vegetation and inundation in the CERP-impacted areas at a 250-1000 m spatial resolution. A monthly dataset extending from 2000 to 2007 was analyzed to establish a pre-CERP baseline for detectable changes in the Everglades system. The temporal progression of parameters such as the Normalized Difference Vegetation Index (NDVI) and Land Surface Water index (LSWI) was examined in the Everglades National Park as well as adjacent water conservation areas. The seasonal pattern of satellite-derived areal water cover generally agreed with groundtruth water level data. The total freshwater volume was also estimated to assess the potential impact of discharge on coastal salinity distributions, and consequently ecological communities. These results provide a baseline against which the detection of future changes, both natural and CERP-related, may be evaluated.

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NUMERICAL SIMULATION OF HURRICANE INTERACTION IN COASTAL OCEANS USING A HIGH RESOLUTION WRF/ROMS COUPLED MODEL

With the increase of population and economic development, hurricanes are becoming a more severe threat to the lives and properties in US coastal regions. It is critically important to have accurate and timely forecasts of hurricane-caused storm surge and inundation, so that evacuation decisions can be made accurately. The accuracy of storm surge and inundation forecasts depends on the quality of atmospheric wind forcing, which in turn, is affected by the ocean’s response to the storms. An interactively coupled model is developed, by coupling the Weather Research and Forecast (WRF) and Regional Ocean Modeling System (ROMS) models within the Earth Science Modeling Framework (ESMF). The effects of the hurricane and coastal ocean interaction in both the atmosphere and ocean are investigated. Results show that by incorporating the Sea Surface Temperature (SST) change into hurricane model, the hurricane intensity simulation is significantly improved. The improved hurricane intensity led to a more realistic storm surge and inundation simulation.

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CIRCULATION DYNAMICS IN THE COLUMBIA RIVER ESTUARY: AN OBSERVATORY-ENABLED PERSPECTIVE

Long-term simulation (~8 years) and observational (~11 years) databases have been generated as a part the CORIE end-to-end observatory for the Columbia River estuary and plume. This exceptionally comprehensive dataset provides unique insights into perhaps one of the most complex river-to-ocean systems in the USA. Here, we will attempt to summarize key aspects of the circulation dynamics of the estuary, with an emphasis on salinity intrusion and stratification, as they respond to climate variability, climate change, and hydropower regulation.

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SURFACE SIGNATURES GENERATED BY ONE- AND TWO-DIMENSIONAL SINUSOIDAL BATHYMETRY

The objective of this numerical study is to examine the impact of well-defined bedforms on free-surface signatures that may be observed in estuaries and nearshore environments. Rather than examine the surface pattern generation mechanisms or the interior flow patterns, we focus on surface observable coherent flow structures. Simulations are performed in a horizontally-periodic domain with idealized sinusoidal bathymetry and a rigid lid. The fluid is homogeneous, incompressible, and forced by a constant horizontal pressure gradient. Analysis of water surface results will be presented, and may include instantaneous streamlines, vorticity patterns, horizontal convergence, and perturbation velocity vectors (instantaneous minus time-average). These simulations will be used to develop techniques to infer bedform morphology based on the behavior of the free-surface signatures. This work was supported by ONR Award N00014-05-1-0485.
LESSONS FROM THE FIELD: BUILDING AND SUSTAINING PARTNERSHIPS AMONG ORGANIZATIONS WITH DIVERSE BACKGROUNDS

Building networks and partnerships among individuals and communities from different backgrounds and cultures work place, socio-economic and societal have many common aspects that are relevant to network and partnership building for ocean education. Some of these such as shared objectives and a common vision are key to the success of any partnership. In addition, the process used to create these common objectives and vision is an important element of a successful partnership. Building education and educational partnerships among international parties and within the National Estuarine Research Reserve System’s Coastal Training Program will be used as case studies to highlight attributes of successful partnerships. Identifying and understanding the challenges to build successful partnerships are often more important than understanding the elements that enable a partnership to be successful. These challenges provide valuable insights that aid in extension of existing partnerships and in expanding partnerships to include new members.

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IRON CYCLING IN MARINE SYSTEMS: THE ROLE OF PARTICLE-ASSOCIATED BACTERIA

Iron is a limiting micronutrient for phytoplankton growth in large areas of the world’s oceans, but little is known about mechanisms of iron recycling in the oceanic water column. Microbes, especially particle-associated bacteria, are likely to mediate these processes since particles are sites of enhanced microbial activity and nutrient remineralization. We have employed Microscilla marina (phylum Bacteroidetes; family Flexibacteriaceae) as a model organism to examine iron cycling by particle-associated marine bacteria. Searches of the M. marina genome revealed analogs to known iron chelate transport proteins, including siderophore and heme transporters. A putative siderophore biosynthesis gene cluster was also identified. RT-Q-PCR analysis of heme transport and siderophore biosynthesis genes confirmed that they were expressed and upregulated under iron stress. We have also identified putative heme and siderophore transport components in the available genomes of diverse particle-associated marine bacteria, but found them to be notably lacking in the genomes of known free-living organisms (e.g. Pelagibacter ubique, marine cyanobacteria). These findings are consistent with the suggested importance of particle-associated bacteria in the recycling and chemical transformation of iron in marine systems.

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GEOHYDRODYNAMIC MODELING OF ESTUARINE CIRCULATION IN HUDSON STRAIT: 8,000 YR BP AND PRESENT

As the last ice age ended and its ice dam collapsed, Glacial Lake Agassiz drained to the North Atlantic via Hudson Strait. The freshwater pulse generated by the Agassiz outburst is hypothesized to have perturbed the thermohaline circulation, leading to regional cooling 8,200 yr BP. Questions persist however, because sediment core data do not delimit the outburst’s duration or discharge, and the paleo-record is ambiguous. On the other hand, paleo-lakeshore maps constrain the maximum outflow volume, and glacioclynnematic models provide a suite of outburst discharge scenarios. In order to discriminate among the outburst scenarios, we used a geohydrodynamic model to simulate estuarine circulation in Hudson Strait under a range of discharge and bathymetry conditions. This model adequately reproduces modern Hudson Strait salinity distributions using inputs of recent river discharge data and appropriate seaward boundary conditions. Sediment distributions predicted by the geohydrodynamic model are compatible with plume layer thicknesses (15-180 cm) in Hudson Strait cores. However, the short-duration, high-discharge outburst scenarios produce very high water surface elevations (50+ m) in the strait, for which no geomorphological evidence has been reported.

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RUMORS OF PROGRESS IN THE USE OF OPERATIONAL ECOLOGICAL FORECASTING FOR LIVING OCEAN RESOURCE MANAGEMENT

Ideally, society’s need for timely and accurate forecasting of the living resources of the ocean will converge with the analytical power provided by the recent advances in ocean observing, modeling and assimilation made possible by advances in computing power, remote sensing and data manipulation theory. Since the early 1970s the raison d’etre of ocean ecosystem modeling has been useful forecasts of ocean living resources to improve management, optimize investment, and achieve sustainability. Progress towards timely and accurate ocean ecosystem forecasting has been surprisingly slow. We believe that initially this slow progress was not due to inadequate ecosystem theory, but due to the crude time/space resolution, initialization and ecosystem representation that followed from the primitive state of both computing (that limited both resolution and ecosystem complexity) and of observing systems (that limited both). Initialization and model complexity suggests that two issues, i.e., forcing and response resolution and ecosystem or food web complexity, are no longer limiting operational ecological forecasting. But removal of these limits may enable models to recognize other potentially problematic issues in operational ocean ecosystem forecasting.

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TIME-SERIES STUDY OF THE AIR-SEA CO2 FLUX IN FRONTAL REGIONS OF THE SOUTHERN OCEAN FROM IN SITU DATA

A time-series of CO2 fugacity, CO2 has been obtained from twelve CARIOCA drifters deployed in the Southern Ocean between 2001 and 2007, and which record more than 70 months of measurements. Hydrological fronts detected from altimetry data between 1993 and 2005 allow us to situate the buoy in relation to the polar, subantarctic and subtropical fronts (PE, SAF and STF). In most regions, CO2 is undersaturated with respect to the atmospheric value. The air-sea CO2 fluxes along the trajectories are primarily driven by ICGO spatial variability with the largest sinks occurring close to the STF. When extrapolo low, over the whole regions, the yearly fluxes computed from the CARIOCA drifters amount to ~0.8 PgC/yr in the Subantarctic Zone, SAL, and to ~0.1 PgC/yr in the Polar Zone with very small seasonal variates. Additional data are used in order to refine air-sea CO2 flux estimates in the SAZ and increase data coverage, particularly in the eastern Pacific Ocean. The observed variability is analyzed in relation with the mixed layer depth detected from ARGO profiles.

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GEOCHEMISTRY OF TRACE METALS IN SEDIMENT CORES FROM THE BASQUE CONTINENTAL SHELF

Metal pollution history in densely populated coastal areas is usually studied using sediments. However, it is related to the large and rapid sediment fluxes of fine-grained fraction of sediments through adsorption processes. The fate of trace metals can be also greatly influenced by redox cycles driven by the degradation of reactive organic matter. This study is based on bed and down-core sediments taken from the Basque continental shelf. Trace metals were determined in the solid phase on spatial and temporal scales to identify metal pollution history and the main geochemical processes affecting the distribution of metals. The age of the sediment sections was assessed by using 210Pb in excess and 14C AMS dates. Grain-size effect was corrected by normalizing all elements to Li. Results indicated higher trace metals levels, mainly for Cu, Zn, Cd and Pb, in recent sediments deposited during the industrialized period compared to the geochemical background of the region. These excess in metals are furthermore strongly related to Mn suggesting that redox reactions at the oxic/suboxic zones are driving the observed profiles.

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HEAT AND TEMPERATURE CHANGES FROM HIGH DENSITY XBT LINES IN THE NORTH ATLANTIC

High-density XBT sections along tracklines from the Gibraltar Straits to the Straits of Florida (AX7) since 1995 with average spatial sampling of 30-40 km can be used to infer the recent temperature changes in the upper ocean and associated heat transport changes. A mean heat transport of 0.98 PW was observed in this time period with a small trend towards decreasing heat transport through time, barely distinguishable amidst the large interannual and shorter time-scale variability. No annual cycle is evident. The heat transport does not appear to be correlated with climate signals such as the North Atlantic Oscillation, however the heat transport bears some similarity to the integrated surface heat transport. The drifters amount to -0.8 PgC/yr in the Subantarctic Zone, SAZ, and to -0.1 PgC/yr in the Polar Zone with very small seasonal variates. Additional data are used in order to refine air-sea CO2 flux estimates in the SAZ and increase data coverage, particularly in the eastern Pacific Ocean. The observed variability is analyzed in relation with the mixed layer depth detected from ARGO profiles.
GLOBAL EVALUATION OF SINGLE SOURCE AND MULTI-SENSOR SST ANALYSES

Global gridded estimates of sea surface temperature (SST) are produced using satellite observations from infrared and microwave sensors in both single-sensor and multi-sensor products. Blended analyses attempt to emphasize advantages and mitigate the limitations of individual sensors. Product accuracy is evaluated relative to in situ observations, while individual snapshots are compared to identify differing qualitative characteristics. Root mean squared differences from the in situ observations are generally below 0.7 with differences in mean bias and regional trends. Global patterns of SST time correlation scales are similar over most of the globe for the different products. Differences are evident in persistently overcast regions such as the Pacific warm pool where the advantages of cloud-penetrating microwave sensors are maximized. The various SST products are incorporated in operational ocean models to assess the impact of differing performance or other characteristics.

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AN ADAPTIVE MULTI-GRAIN SEDIMENT TRANSPORT MODEL

This presentation discusses the capabilities of an adaptive, mixed, multi-grain sediment transport model developed for the Adaptive Hydraulics Modeling system (AdHi) for two-dimensional shallow water problems. This sediment transport module takes advantage of the mesh adaptation capability in AdHi allowing it to automatically and dynamically split elements to produce a more accurate representation of sediment transport. This modeling system consists of two coupled modules designed for the analysis of two-dimensional, depth-averaged flow, and sediment transport, in both riverine and estuarine surface waters. The coupled models are a finite element hydrodynamic module (AdHi) and a finite element sediment transport module. The sediment transport module is capable of handling multiple single grain sizes and mixtures of both cohesiveless and cohesive sediment. It simulates the processes of bedload, dispersion, erosion, settling, deposition, armoring, and consolidation. It solves the two-dimensional, depth-averaged advection-dispersion equation with source and sink terms by the finite element method. It also includes a three-dimensional multi-grain sediment bed model capable of handling different material types and incorporating 3DFlume data. The output from the module consists of nodal values of the bed elevation, the bed composition, the bed properties, and the depth-averaged suspended sediment concentration.

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SUMMERTIME HYPOXIA OFF CENTRAL OREGON AS OBSERVED USING AUTONOMOUS UNDERWATER GLIDERS

Beginning in April 2006, we have used an autonomous underwater vehicle glider to sample a cross-shelf transect along the Newport Hydrographic Line off central Oregon (64 39.1N). The section runs from the 20-m isobath out about 90 km, and takes 3-7 days to complete. The glider undulates from the surface to 2-3 m above the bottom (200 m maximum) with an along-track resolution ranging from 100 m in shallow water to 400 m in deep water. Position and oceanographic data are relayed to shore every 6 hours via Iridium cell phone. The glider is equipped with a conductivity-temperature-depth instrument and seafloor fluorometers (chlorophyll fluorescence, dissolved oxygen, light backscatter for a measure of particles, dissolved oxygen). The glider observations are supplemented, calibrated and extended using measurements from an 80-m mid-shelf mooring, 10 miles offshore of Newport, and ship-based data. The near-real-time glider observations are used to track and understand the evolution of the extreme hypoxic event off central Oregon during summer 2006. The time-varying, subsurface dissolved oxygen fields are related to wind-forced upwelling and downwelling.

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PHYSICAL IMPACT ON THE SIZE-SPECIFIC DISTRIBUTION OF ZOOPLANKTON ACROSS AND ALONG THE POLAR FRONT

The Polar Front forms the border of warm Atlantic Water penetrating into the Arctic Ocean. As such, it can give valuable insight into processes that will become important during a future warming of the Arctic. Along and across the Polar Front in the northern Barents Sea, we collected simultaneous high-resolution (spatial and temporal) data on hydrographic parameters using high-resolution trawl tows and ship-based data. The near real-time glider observations are used to track and understand the evolution of the extreme hypoxic event off central Oregon during summer 2006. The time-varying, subsurface dissolved oxygen fields are related to wind-forced upwelling and downwelling.

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The Atlantic meridional overturning circulation (AMOC) in several modern day global climate simulations contains a prominent 20–25 year oscillation. We find the timescale for an AMOC-like oscillation in a last glacial maximum (LGM) simulation of the CCSM3 is approximately half that found in the modern day simulation. Previous studies suggest that the oscillation timescale is set by the ocean while the forcing is atmospheric, with an association to North Atlantic Oscillation (NAO). The NAO in the CCSM3 modern simulation also contains an approximate 20-year oscillation. Previous research shows that the NAO forces a delayed flux of subpolar gyre water into the Nordic Seas, where deep water forms, due to subpolar gyre (SPG) adjustments. We suggest that the resulting SST and sea ice anomalies in the Nordic Seas provide a feedback to the atmosphere, which, being delayed from the initial NAO forcing, may set the longer timescale for the NAO. Preliminary results indicate a strong correlation between the NAO and the baroclinic streamfunction in the SPG as well as an SST pattern consistent with the SPG adjustment. Differences in feedbacks in the LGM climate give rise to key differences in the AMOC-like mechanism in the LGM simulation. Using linear inverse modeling, we are able to decipher which variables are important to the longer timescale fluctuations, the optimal patterns for growth, and the differences in predictability of the NAO and AMOC within the LGM and modern scenarios.

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TRANSFORMATIONS OF ORGANIC MATTER IN A MAJOR U.S. EAST COAST ESTUARY: IMPLICATIONS FOR IDENTIFYING DOM AND POM SOURCE AND AGE SIGNATURES IN OCEAN MARGINS

Estuaries are dynamic regions of both allochthonous and autochthonous organic matter (OM) input and degradation and may have profound effects on the character and amounts of OM exported to ocean margins. To assess these impacts, we undertook detailed isotopic (natural abundance 14C and 13C) transects and experimental incubation studies of DOM and POM throughout Delaware Bay estuary in 2004–2006 from river to continental shelf and slope. DOM end-members consisted of modern river/terrestrial and aged marine sources and showed a strong mesohaline estuarine input, while POM end-members and distributions were essentially the opposite of those for DOM. In spring, dissolved inorganic carbon (DIC) exhibited near-conservative distributions and isotopic distributions throughout the estuary, suggesting that much of the DOM and POM was non-reactive over the timescales of estuarine residence time. However, excess DIC in full suggested that greater amounts of variably aged DOM and/or POM were respired in the system at that time. Experimental DOM and POM degradation studies further highlight the significant roles of photochemical and microbial modification on the amounts and isotopic character of this material prior to shelf/slope export.

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20TH CENTURY DEPOSITION IN THE TAPPAN ZEE SECTION OF THE HUDSON RIVER ESTUARY: COMBINING GEOPHYSICAL AND GEOCHEMICAL TECHNIQUES

The details of sediment deposition in estuaries are still not completely understood. Mapping the location of 20th century deposition in the Hudson River Estuary will contribute to understanding the complex estuarine processes. In addition, adequate mapping of 20th century deposition will reveal the likely locations of contaminants, including heavy metals and polychlorinated biphenyls (PCBs), which entered the river and bound to fine sediment in the early to mid 20th century. This comprehensive study of the Tappan Zee section of the Hudson River Estuary uses a combination of acoustic sub-bottom profiling and X-ray fluorescence spectrometry to find and quantify areas of 20th century deposition. Using sediment cores to time the deposition of acoustically identifiable layers allows this study to have high resolution. The data collected in the Tappan Zee will be compared to the Haverstraw Bay section of the Hudson, where there is a large amount of deposition, in order to further understand the processes of sediment movement in the Hudson River Estuary.

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SPRINGTIME FORAGING ECOLOGY OF NORTH ATLANTIC RIGHT WHALES

The North Atlantic right whale is a zooplanktivorous whale that feeds on the calanoid copepod Calanus finmarchicus in the northwestern Atlantic Ocean. The foraging ecology of this species has been studied extensively in summertime habitats where it feeds on deep layers of diapling C. finmarchicus. We conducted a study of right whale foraging ecol-
ogy in a springtime habitat where right whales feed primarily on active non-diapausing (often vertically migrating) populations of C. finmarchicus that aggregate at the surface near the sea floor, and at the gyccline. These conditions are different from the right whale summertime habitats, and consequently, right whales employ different foraging strategies. We attached tags consisting of time-depth recorders and pitch and roll sensors to right whales, tracked their movements, and sampled both oceanographic conditions and prey distribution in proximity to the tagged whales using a CTD, optical plankton counter, and a video plankton recorder. The results of our study demonstrate the importance of predation behavior and prey life history in the development of oceanic hotspots.

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A GENETIC APPROACH TO DETECT ENSO-RELATED CHANGES IN CONNECTIVITY BETWEEN EASTERN AND CENTRAL PACIFIC CORAL POPULATIONS

Coral populations in the eastern Pacific Ocean are isolated from other corals by 5000-8000 km of unhabitable deep water (the Eastern Pacific Barrier, EPB). Recent increases in intensity of El-Nino-Southern Oscillation (ENSO) events may have altered patterns of inter-population dispersal over the last few generations. Such ENSO events have the potential to transport propagules traveling from luxuriant central Pacific coral reefs to the depauperate eastern Pacific. A combination of genetic techniques is employed to determine 1) when populations of corals in the eastern Pacific diverged from those in the central Pacific, 2) how present-day coral populations are linked by dispersal, and 3) whether recent changes in currents caused by ENSO events have altered patterns of exchange. The work focuses on Porites lobata. Samples from localities spanning the EPB are analyzed for microsatellite loci and nuclear markers. These genetic analyses describe how migration presently connects central and eastern Pacific corals and whether and how changes in ENSO events have altered these patterns.

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THE EFFECT OF LIGHT ON HYPOXIC BOTTOM WATER OXYGEN CONCENTRATIONS IN THE NORTHERN GULF OF MEXICO

We predict that when low levels of photosynthetically active radiation (PAR) reach the seafloor on the seasonally hypoxic northern Gulf of Mexico continental shelf benthic photosynthesis may be greatly reduced or prevented below bottom water oxygen concentrations. To test this we exposed incubated light and dark sediment cores from two stations (15 and 20 m water depth) that are frequently hypoxic (including summer 2007) for 48 hours. Bottom water oxygen concentrations decreased from 5.40 mg/L in June to 0.4 mg/L in September prior to our incubations. We treated the cores with in-situ PAR conditions for the first 24 hours. We found the cores to be highly heterogeneous with small sediment oxygen consumption rates decreasing throughout the summer (June to September). The cores were exposed to ~50% more PAR than in-situ conditions for the second 24 hours. We found little change in the oxygen concentrations over time. The second day however, started at low oxygen concentrations (~ 0.5 mg/L), from which an effect of the increased PAR may not be detectable. These incubations will be repeated with variable PAR treatments in subsequent experiments.

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THE EXPLORER OF THE SEAS OBSERVATORY: ANNUAL AND INTERANNUAL VARIABILITY OF THE FLORIDA CURRENT

Variability of the velocity structure and transport of the Florida Current at latitude 26 N is presented for a five-year period from May 2001 to May 2006. Data were collected continuously from two ADCPs mounted on the Royal Caribbean Cruise Ship Explorer. We attached tags consisting of time-depth recorders and pitch and roll sensors to right whales, tracked their movements, and sampled both oceanographic conditions and prey distribution in proximity to the tagged whales using a CTD, optical plankton counter, and a video plankton recorder. The results of our study demonstrate the importance of predation behavior and prey life history in the development of oceanic hotspots.

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NUTRIENT SUPPLY AFFECTS THE COMMUNITY STRUCTURE AND SPATIAL DISTRIBUTION OF SMALL PHYTOPLANKTON AND BACTERIOPLANKTON IN THE COASTAL SUBARCTIC PACIFIC OCEAN

Flow cytometry was used to characterize the small phytoplankton and bacterioplankton community in the coastal waters of British Columbia, Canada, and Washington State, U.S.A. in the fall of 2004 and 2005 as part of the ECOCAB PNW project. Populations were classified by size, chlorophyll and phycocyanin fluorescence, and nucleic acid content (for the heterotrophic prokaryotes). The abundance and growth rate of the picocyanobacterium, nanoplankton, cyanobacterial, and heterotrophic prokaryotic groups varied significantly in space and time. The structure of the community was associated with the major oceanographic features of the area, particularly the Juan de Fuca eddy. Furthermore, the phytoplankton community groups had differential growth responses to macronutrients (NPSi), iron, and copper amendments in short-term growth experiments. All growth of all phytoplankton groups were enhanced by the addition of macronutrients, while the iron and copper amendments enhanced the growth of the larger nanoplankton cells. The connections between nutrient supply, growth response, and physical oceanography of the region supports a model where nutrient supply effects the structure of the plankton community in coastal marine ecosystems.

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FACTORS CONTROLLING TIDAL FLAT MORPHODYNAMICS IN SOUTH SAN FRANCISCO BAY

Since the 1850s, saltmarshes and mudflats of San Francisco Bay (SSFB) have decreased in area 80% and 40%, due to both natural and human-induced factors. Mudflat morphologic change is examined, using bathymetric data collected by the USGS (NOS) and USGS. The mudflats of SSFB are grouped by geographically similar regions and multiple cross-sections are drawn across the extent of the mudflats at close ~50m intervals, allowing for a determination of mean mudflat bathymetric profile at each segment during five time periods - 1899, 1931, 1956, 1983, 2005. Eigenfunction analysis is used to separate profile shapes into the dominant components of morphologic variability, which are compared to theoretical models for profile shape as a function of waves, tide and sediment supply. Theory predicts that wave-dominated or sediment-starved flats tend to have concave-upward bathymetric profiles; tide-dominated or accretionary flats tend to have convex-upward bathymetric profiles. SSFB mudflats morphology is classified spatially and temporally and compared to trends in winds, waves, deposition/erosion, flat width, and tidal range in order to determine which forcings factor heaviest in controlling shape.

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OCÉANIC TIME-SERIES OF DISSOLVED ORGANIC CARBON (DOC) CONCENTRATIONS AND δ14C VALUES

A time-series of marine dissolved organic carbon (DOC) concentrations and δ14C values in the NE Pacific (Station M, 34°4'52" N, 123°08'30" W) has been extended with new measurements of archived samples from April 1998 to October 2004. The magnitudes and variability of major δ14C signals throughout the time-series imply transport of DOC from the surface ocean to depths of at least 450 m on the timescale of months. Keeling-plots of all measurements predict a continuum of possible background DOC compositions containing at least 21 μmol of 14C - DOC, but are more consistent with the composition of mean deep DOC (38 μmol 14C - DOC). A pre-bomb DOC δ14C depth profile and longer-term time-series (1985-present) has been calculated based on these regression models, a strong relationship between δ14C values of DOC and DIC at all depths, and coral records of surface DIC δ14C. The model results indicate that bomb-14C has penetrated the DOC pool to depths of 450 m at Station M, though the signal at that depth may be obscured by short-term variability.

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BIOGEOCHEMICAL CYCLING OF CARBON AND NITROGEN BY THE CORAL DIPLORIA STRIGOSA IN BERMUDA

We have used a new approach to quantify the net carbon utilization by Diploria strigosa; measurement of drawdown of dissolved inorganic carbon (DIC). Using the DIC drawdown as the total carbon use, we have also measured dissolved organic carbon and nitrogen loss from the coral and have tagged the DIC and dissolved inorganic nitrogen pools with 13C and 15N to evaluate incorporation into zooxanthellae and coral tissue. The central focus of this research is that the coral-zooxanthellae symbiotic association is a source of large amounts of dissolved organic matter as a direct short-term byproduct of photosynthesis. Our efforts attempt to investigate simultaneously both the biogeochemical details of this process at the organism level and in relation to trophic transfer to the reef ecosystem.
To investigate the importance of sea primary production to the nutrition of L. pertusa and associated communities and examine local trophic interactions, we analyzed stable carbon, nitrogen, and sulfur isotope ratios in 7 L. pertusa community collections. A significant seaweed signature was only detected in one of the 35 species tested Provonna sculptula, a gastropod despite the presence of sea fauna at all sample sites. A potential predator of L. pertusa was identified (Coralliphila sp.), and a variety of other trophic interactions among the fauna occupying the coral framework were suggested by the data. Stable carbon ratios were also determined for different sections of the skeleton representing different stages in the growth and life of the aggregation. There was no temporal trend detected in the skeleton isotope values, suggesting that L. pertusa settles in these areas only after seepage has largely subsided. Together our data suggest that it is the presence of carbonate substrate for settlement and growth that drives L. pertusa occurrence at seep sites in the Gulf of Mexico, not local primary production.

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SOUTHWEST PROPAGATION OF ARCTIC/SUBARCTIC TEMPERATURE ANOMALIES ALONG NORTH AMERICA’S EASTERN SEABOARD

Satellite sea surface temperature (SST) data from 1986-2007 are used to study thermal anomalies and their propagation along North America’s eastern seaboard. The Shelf-Slope Front appears as a main conduit for these anomalies which originate in the Arctic/Subarctic and propagate southward along the shelf break. These anomalies are traced as far south as Cape Hatteras. Decadal cold anomalies are observed off the U.S. Northeast in 1987-1988, 1996-1997 and 2005. The intervening warm anomalies are less noticeable, except for a distinct warm anomaly in 2000. Thus, the Arctic/Subarctic forcing appears as a dominant factor that causes decadal regime shifts in the Northwest Atlantic Ocean.

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DIAPYCNAL MIXING IN A NEXT GENERATION OCEAN MODEL

The accurate representation of ocean tracer transports continues to challenge models. Trying to replicate the quasi 2D flow of the large scale ocean is made difficult by spurious implicit mixing from the advection numerics and spurious explicit mixing from inaccurate parameterization, reducing eddy eddy transports and disrupting the large scale circulation. The Imperial College Ocean Model is one of the next generation of ocean models, employing an unstructured finite element mesh, able to conform more accurately to boundaries than traditional finite difference models. The mesh is adaptive, able to capture important dynamical features and follow their evolution, however this adaptive procedure introduces a third source of spurious mixing through the process of remeshing. Simulations have been run of the evolution of eddies in a 200 km square portion of the North Atlantic. Results show that for this system, the adaptive process contributes a significant amount of mixing itself. For adaptivity to be feasible for climate simulations, it’s effect on tracer fields must be explored for a range of parameters and subsequently reduced.

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PROGRESS AND CHALLENGES IN OPERATIONAL OCEAN FORECASTING

Daily dynamical analyses and forecasts of surface waves, sea-ice and the global three-di- mensional temperature and current structure of the ocean have now been available for 10 years. Most operational ocean forecast centres use nesting to provide high-resolution information for specific areas including coastal waters. Spurred on by the Global Ocean Data Assimilation Experiment (GODE) and other initiatives, excellent progress has been made in the development of the forecasting systems, in international coordination, in strengthening the links between operational and research teams and in the modelling of the ocean ecosystem. As GODE draws to a close it is timely to discuss the outstanding opportunities and challenges for operational oceanography. These include scientific and technical opportunities, the need to focus the exploitation and justification of the observing and assimilation systems on the right applications and the challenges involved in co-ordination of the wide-range of expertise operational oceanography requires.

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MAPPING THE BATHYMETRY OF THE DEE ESTUARY USING WAVE INVERNSIONS OF MARINE RADAR IMAGE SEQUENCES

The bathymetry of a 4km radius area of the Dee Estuary in Liverpool Bay has been mapped using a wave inversion of marine radar data. The radar is mounted 30m above sea level on an island in the estuary and 10 minute sequences of radar images of the sea surface are recorded automatically each hour giving 360 degree coverage of the area. Several such records taken around high tide during moderate wave events have been processed to produce the map using a wave inversion that accounts for both frequency and amplitude dispersion. The results are compared to those of a LIDAR survey of the intertidal areas carried out in 2006, and also to a combined LIDAR and Multibeam echosounder survey carried out in 2003, clearly identifying migrating sand banks within the estuary.

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INTERDEcadal NUTRIENT VARIABILITY THROUGHOUT THE WATER COLUMN IN THE WESTERN NORTH ATLANTIC SUBTROPICAL GYRE

Macronutrient (N,P,SI) concentrations have been a core measurement at the Bermuda Atlantic Time-Series Station (BATS) since the beginning in October 1988. Here we present a synthesis of this 19 year time-series with emphasis on relative changes in nutrient ratios through the water column. In particular, we investigate the temporal variability of the N:P ratios and variations with respect to the canonical Redfield values. A principle characteristic of the vertical nutrient profile is the shift from excess N in the surface and subtropical mode water to Redfield ratios at 800m (coincident with the deep oxygen minimum and maximum in remineralization) and then to excess P in the deeper depths (e.g., mean N:P ratio in the mode water is ~23.8 while for North Atlantic Deep Water is ~15). We also look at nutrient concentrations. For the deeper waters (>1000m), multi-year to decadal trends are evident in the individual nutrients which are not necessarily coherent with other nutrient species or density changes. In contrast, the shallower depths (160-800m) exhibit substantial monthly variability which appears conservative and predominately consistent with mesoscale eddy dynamics.

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THE IMPORTANCE OF ATMOSPHERIC NITROGEN IN THE Oligotrophic ATLANTIC

Measurements of major ion concentrations in atmospheric aerosol and rain in the marine boundary layer have been made on a total of 10 recent research cruises that transect the North and South Atlantic oligotrophic gyres (latitudinal and longitudinal crossings). From these, we have begun to construct a climatology of dry and wet deposition to the oligotrophic Atlantic gyres (particularly nitrate and ammonium). In addition, air-sea gas exchange measurements were made on some Atlantic Meridional Transit (AMT) cruises (http://web.pml.ac.uk/amt/), suggesting that warm, low latitude waters may be a source of ammonia to the remote marine atmosphere (Johnson, M., Bell, T.G. et al., GBC, In Press.).

In the context of other nitrogen fluxes to/from the oligotrophic gyres, our results suggest that ocean-atmosphere exchange of nitrogen is significant for these waters. Finally, we will discuss a new project (SOLAS Project Integration; http://www.bodc.ac.uk/solas_integration/), which aims to develop global flux climatologies of SOLAS-relevant compounds and particles. In the context of this presentation, the focus will be on producing atmospheric aerosol and rain deposition fields for the global ocean.

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IMPROVING AUV-BASED COASTAL OBSERVING SYSTEMS

A series of large field programs in Monterey Bay, using fleets of Autonomous Underwater Vehicles (AUVs), have generated a body of experience in the synoptic observation of oceanographic processes. Here we draw on performance analysis of the AUSN II field program, which was carried out in 2003, to draw lessons regarding the use and configuration of distributed arrays of mobile platforms. In previous papers and presentations, the statistics of variability of Monterey Bay has been determined from the intensive observations resulting from sustained observations by an average of 11 platforms over a month of active upwelling. Here we draw on those results, and advances in AUV and sensor technology, to explore observation system design. Observation performance can be improved, and operational overhead reduced, by optimizing the AUV and modifying the survey strategy. In particular, we show that improved survey performance, as measured by root mean square error of the reconstructed ocean field, can be obtained with fewer platforms. This is achieved by carefully selecting vehicle speed, and focusing observations in regions which contribute most greatly to reconstruction error.

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HISTORIC ALTERATIONS AND CURRENT RESTORATION FOR BISCAYNE BAY

Biscayne Bay has experienced extreme adverse conditions since the city of Miami was established in the late 1800’s. With the opening of government cut in Miami Beach, the Bay experienced an important increase in salinity in the north. Until the late 1950s raw sewage was discharged directly into Biscayne Bay causing effects to fish and other organisms. The U.S. Army Corps of Engineers construction of the Central and Southern Florida Project over-dranked the Everglades. Salinity control structures were added to hold water higher in the Everglades and to prevent saltwater intrusion from adversely affecting freshwater wells, drinking water well fields, and coastal farming. The Comprehensive Everglades Restoration Plan proposes to significantly alter freshwater flow to Biscayne Bay. Currently three of the most significant impacts to the bay are 1) alteration of the watershed hydrology; 2) degradation of water and sediment quality, and 3) loss of freshwater flow.
The Quantitative Filter Technique (QFT) for measuring the spectral absorption of particles is now a routine method in aquatic research. Typically, particles are concentrated on glass filters in the field by filtration, stored frozen, and returned to a laboratory for absorption measurements using a bench top spectrophotometer. While this approach is reasonably simple, errors may be introduced during transport and storage. We describe a new portable fiber optic system to acquire particle absorption measurements at sea. The system (QFT), consists of an especially designed 25 mm Glass Fiber Filter holder coupled via fiber optic cables to a light source (215-1800 nm or 380-1800 nm) and photo diode array based spectrometer (200-730nm, 5nm FWHM). We demonstrate the performance of the QFT1 by comparing particle absorption measurements taken on the QFT1 and several dual beam spectrophotometers using a diverse range of water sample types.

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SEASONAL VARIATION OF THE SUBPOLAR FRONT IN THE JAPANESE/EASt SEA DURING 2002-2007
Remote sensing data is used to analyze the seasonal variability in strength and location of the subpolar front in the Japan / East Sea. Monthly averaged seas of surface temperature data for July 2002 through August 2007 reveal warmest surface temperatures in August and coolest temperatures in February and March. Strengthening of the zonally-oriented front near 40N during November and December is consistent with the onset of cold air outbreaks from the northwest, and the front persists through March. This study is facilitated by the MODIS-Aqua monthly global 9 km sea surface temperature data produced by NASA's Ocean Biology Processing Group and made available through the Goddard Earth Sciences Data and Information Services Center (GES-DISC) Interactive Online Visualization and Analysis Infrastructure (GIOVANI).

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UNDERSTANDING THE CONNECTION BETWEEN DIFFERING NITROGEN SOURCES AND THE UREA CYCLE IN THE DIATOM, THALASSOSSIRA PSEUDONANA
The urea cycle is used in heterotrophic organisms, and provides a way for cells to detoxify ammonium. Recently, a complete urea cycle was identified in the photosynthetic marine diatom Thalassiosira pseudonana, and although it is hypothesized that this cycle contributes to several vital cellular pathways to one another within the diatom, the specific function of this pathway has yet to be elucidated. Here, we examined the physiological and molecular responses of T. pseudonana to growth on ammonium (NH4+), nitrate (NO3-), and urea as sole nitrogen sources to determine whether varying N sources affect the urea cycle. Specifically, we monitored the growth rates under each condition, as well as quantified the differential gene expression of seven key genes associated with U-takes and the urea cycle. Similar growth rates were found for NH4+ and NO3; however, growth on urea was reduced. We are currently examining the differences in urea cycle gene expression in cells grown on urea versus NH4+ and NO3. Our results will help to clarify the role of the urea cycle in T. pseudonana, and its relationship to different metabolic pathways within diatoms.

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DIEL FEEDING CHRONOLOGY, GASTRIC EVACUATION AND DAILY FOOD CONSUMPTION OF JUVENILE CHINOOK SALMON IN COASTAL WATERS
The dief feeding periodicity of juvenile Chinook salmon (Oncorhyncus tschawytscha) was determined from stomach collections in coastal waters off Oregon in 2003. Juvenile Chinook salmon exhibited two crepuscular feeding periods, around dawn and dusk, with the highest percent body weights of stomach contents at dusk between 19:00 and 23:00 hours. Gastric evacuation rates of euphausiid meals were estimated from laboratory experiments at 9.3, 10.7, and 11.9 C. Based on an exponential model, the instantaneous evacuation rates at these three temperatures were 0.0407, 0.0589, and 0.0807 h⁻¹, respectively. The Elliott and Persson model was used to estimate a daily ration for juvenile Chinook salmon in Oregon coastal waters of 2.57% BW d⁻¹ from previous diei studies in 2000 and 2.46% BW d⁻¹ in 2003. The Eggers model provided similar daily ration estimates (2.04% and 2.93%, respectively). The MAXIMS model, which does not rely on laboratory-derived evacuation rates, produced higher estimates of daily ration (3.84% and 4.28% BW d⁻¹). Our dief feeding chronology, gastric evacuation rate, and daily ration estimates for juvenile Chinook salmon were comparable to those found for other juvenile salmonid species.

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OBSERVATIONS OF TIDAL AND RESIDUAL CIRCULATION IN LONG ISLAND SOUND
To quantify the transport of materials in estuaries it is critical to establish the horizontal and vertical variation of the energetic tidal constituents. The LISICOS (Long Island Sound Integrated Coastal Observation System) program seeks to understand the variability of dissolved oxygen in western Long Island Sound. In order to accomplish this, the program has maintained an array of five current profilers in the area for three years, complemented by ship surveys. Using these data we present a summary of the spatial structure of the tidal constituents, their relative strengths, and seasonal variations. The overlaps are diagnostically of the nonlinearity in the estuarine dynamics and the long term records allow the detection of the structure of these constituents. We use the tidal current estimates to de-tide ship surveys in order to reveal the structure of the residual circulation and its low frequency variability.

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The role of predation by fish in the formation and persistence of thin layers was assessed by Ueyama and Monger (2005) and are verified using SeaWiFS data. Model results show that yearly export is not well understood. Using a general ocean circulation model coupled to a medium-complexity ecosystem, the relationships between bloom strength, longevity, timing of export, and nutrient consumption are investigated in the North Atlantic between 1982 and 2006. Model bloom dates are identified using a technique developed by Ueyama and Monger (2005) and are verified using SeaWiFS data. Model results show a strong correlation between bloom period biomass and annual export for much of the ocean. The results show that bloom timing and peak values are indicative of annual export only in distinct regions, suggesting satellite observations may be able to capture export variability for specific parts of the ocean.

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Eddy correlation measurements of benthic oxygen exchange: An update on the technique and results from new deployments

With the eddy correlation technique, in situ oxygen exchange rates across the sediment-water interface are derived from measurements in the bottom water of the fluctuating vertical velocity and the fluctuating oxygen concentration. After an update on our latest development of the technique and its availability to users, we present results from our new deployments in dynamic systems where measuring oxygen exchange with other methods is challenging. These include shallow seagrass-vegetated sediments, permeable sandy sediments in the surf zone, estuarine sediments with dense microalgal populations, permeable shelf sediments, and freshwater sediments inhabited with quagga mussels. In addition to quantifying the oxygen fluxes through time for these sites, we relate the exchange to dynamic variables such as light, current velocity, and wave action.

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HIGH FREQUENCY VARIABILITY IN DISSOLVED ORGANIC MATTER COMPOSITION AND ACTIVITY AS DETERMINED USING IN SITU OPTICAL MEASUREMENTS

Most of our understanding of sources and controls over dissolved organic (DOM) concentration and composition is focused on variability over seasonal or interannual timescales. Spectral properties of absorbance and fluorescence of colored dissolved organic (cDOM) contain intrinsic information about the chemical composition of the DOM as a whole, as well as extrinsic information about the sources and environmental processes. These properties can be measured rapidly in situ, and thus provide new and unique information about high frequency variability - on the order of minutes to hours - in the concentration, composition, and source of DOM. We use continuous in situ measurements of cDOM spectral absorbance and fluorescence to examine changes in DOM at unprecedented time scales. We observe changes that result from diurnal processes in river systems, tidal processes in wetland systems, and hydrologic processes in watersheds. We will present results from these studies in which we observe rapid changes in inferred intrinsic properties such as humic content and reactivity, as well as rapidly changing extrinsic properties such as source and association with metals. These observations provide new insights into biogeochemical processes.
The extended draft platform: The OOI Global-scale node for the mid-Atlantic site

The network design for the OOI Global-scale nodes will initially use two platforms: a discrete buoy moored with an inverse-catenary mooring employing acoustic telemetry to sub-surface instruments and a semi-attached, multi-level, multidisciplinary mooring which will provide substantial power and bandwidth to the seafloor. This paper describes the EDP, which has been designed using industry and NSF support and will be funded and built by industry for the OOI. The EDP is a very capable platform, planned for deployment early in the program at the mid-Atlantic site near the DSDP Hole 996B. Thus, it will generate early time-series results at a test site for power generation, communication and sensor technologies. The EDP comprises three vertical columns between a deck structure and a submerged pontoon. The columns and pontoon are raised when at quayside and during tow ing. When lowered, the structure behaves like a deep draft semi-submersible and motions are comparable to those of a spar buoy. The EDP will have a draft of about 25 m and the deck will be over 10 m above the sea surface. It will weigh 800 t and be able to support payloads of over 50 t. An offshore supply vessel assisted by a small offshore tug can install the EDP while an ROV equipped vessel would install the EO cable and the seafloor instrumentation.

Ocean scientist - rock star

An esteemed marine ecologist swims through a sea of eager fans, hovering close by and patiently queuing for both autographs. A semi-retired mollusk biologist poses for photos as shy students linger and others clamor to say hello. A deep sea explorer discovers an elusive giant from our past, inspiring a Hollywood blockbuster, launching acting careers for a few and creating a fascination of the ocean for many. But, you don't have to swim with whale sharks, wrestle a giant squid or uncover the mighty Titanic to make a huge splash of your own. As an ocean scientist, YOU have an intriguing and captivating story to tell. Don't believe it? Think again. Join Rachel Bergen, from Shedd Aquarium, and discover how you and your colleagues can engage and inform the public, inspire environmental stewardship and prepare young scientists to create a better future for our oceans. You'll hear about general ideas for outreach and information sharing, as well as specific opportunities to work with existing programs in your region or within your area of expertise.

Exploring the mid-Atlantic ridge macro- and megafaunal communities

Despite the wide distribution and extensive area of mid-ocean ridges, relatively few previous investigations have provided comprehensive information on animal communities inhabiting these vast areas of the world ocean. The more technologically advanced ridge studies have either been purely geological or geophysical or focused very strongly on chemosynthetic ecosystems. The MAR-ECO project, an international biodiversity study under the Census of Marine Life programme, investigates the animal communities associated with the mid-Atlantic Ridge between Iceland and the Azores. The study focuses on pelagic and benthic macro- and megafauna associated with photosynthetic systems, and utilise innovative methods and up-to-date technology to map distributions, analyse community structure, study life histories and trophic relationships. Experiences from the 2003-2005 field phase of the project are summarised, with emphasis on scientific and methodological challenges and results of preliminary analyses. The strategies and technologies adopted to achieve comprehensive data on organisms of size ranges from mesozooplankton to whales are described. The project continues with cruises in 2009-2010 and comprehensive synthesis towards 2010. Plans are developing for new efforts in the South Atlantic.

Dissecting the life-dinner principle: Analyzing effects of odor signal separation on blue crab foraging

Chemical cues convey critical information for aquatic animals on the presence of mates, food, shelter. Blue crabs utilize alarm cues from injured conspecifics to detect predators. The Life-Dinner Principle suggests the presence of alarm cues should deter blue crab foraging to increase survivability. However, blue crabs naturally are exposed to complex predator and conspecific alarm cues as they travel through their environment. The underlying dynamical mechanism of the jet formation is illuminated with the linear stability analysis. The mechanism is non-local in space, and it involves interactions between the unstable and weakly stable linear modes.
Ecosystem Impacts of a Cochlodinium Polykrikoides Bloom in a Mid-Atlantic Estuary

The Chesapeake Bay has seen a general increase in the abundance of Cochlodinium sp. over the past two decades. Cochlodinium sp. have been found to be associated with fish kills around the globe. In August 2007, a bloom of Cochlodinium polykrikoides, was reported in the James River, a tributary of the Chesapeake Bay. Cell densities of over 15,000 cells mL−1 were reported along with chlorophyll a levels of up to 367 µg L−1. As the bloom progressed and spread into the Chesapeake Bay and the Atlantic Ocean, beach closures were reported. The bloom persisted for over a month. We sampled this event at numerous sites on 5 dates between August and September 2007. We measured cell abundance, nutrient concentrations, nitrogen and carbon uptake rates, and conducted bioassay toxicity tests. These organisms took up a variety of nitrogen compounds, as had been observed during blooms in previous years. Larval fish experienced 100% mortality within 3.5 hours of exposure to Cochlodinium polykrikoides and 20% of the juvenile oysters exposed to this organism died within 48 hours. No mortality was observed in the control populations.

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Mesoscale Vortices as Revealed by Lagrangian Coherent Structures

We use Lagrangian coherent structures (LCSs) to identify and track mesoscale vortices. LCSs are material lines which delineate boundaries of fluid domains with different advection characteristics that do not mix, and thereby provide an objective (i.e., frame independent) vortex identification method. Being of a fundamentally Lagrangian nature, LCSs cannot be resolved directly from synoptic surface observations. Rather, they can be identified by maximizing curves or “ridges” in direct finite-time Lyapunov exponents (DFTLEs). We compute DFTLE fields, and identify LCSs on these fields, based on altitude–derived surface geostrophic currents in two regions of the Atlantic. These regions are the North Brazil and Agulhas retroreflection regions, where application of nonobjective vortex identification methods, such as the Okubo–Weiss criterion, has shown limited success. Identification and monitoring of rings in particular using this methodology will improve estimates of critical oceanic parameters, such as the interbasin exchange of mass, salt, and heat between the Indian and Atlantic basins and between the South and North Atlantic oceans, which are key in the study of the Meridional Overturning Circulation.

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Linked Nitrogen Fixation and Sulfate Reduction in a Benthic System Heavily Influenced by Bioturbation

Nitrogen fixation rates are sometimes low in marine sediments, and this lack of activity is at times attributed to high levels of pore-water ammonium, an inhibitor of nitrogen fixation. Bioturbation, however, can lead to the transport of ammonium out of the sediment, forming a zone of ammonium depletion around a burrow. Burrow compartments can also become storage areas for suspended organic matter, leading to an increase in decomposition with an associated increase in sulfate reduction rates (SSR). This study focused on the impact of the ghost shrimp, Callianassa californiensis, on sediment nitrogen fixation and SSR in Catalina Harbor, California. We determined how different levels of bioturbation influence these rates independently and estimated the amount of nitrogen fixation that can be attributed to sulfate reducers. Highest reaction rates were found concurrent with moderate levels of bioturbation. When the sulfate reduction inhibitor sodium molybdate was added to incubation experiments, the majority of nitrogen fixation was also inhibited, suggesting a link between both reactions. Current work is looking to determine those nitrogen-fixing phylootypes present through the amplification of nifH sequences.

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Changes in Subtropical North Atlantic Air-Sea Carbon Dioxide Fluxes and Carbon Storage in Eighteen Degree Mode Water Over the Last Two Decades

We examine interannual variability of air-sea carbon dioxide fluxes in the North Atlantic Ocean near Bermuda from 1983 on. On an annual basis, the ocean was a net sink for carbon dioxide, with a mean net annual air-sea carbon dioxide flux rate of −815 +/- 251 and −1295 +/- 294 mol carbon dioxide m2 yr−1, respectively, estimated using different synoptic and data assimilation model windspeed datasets. Wintertime air-to-sea carbon dioxide flux was greater than the summertime sea-to-air carbon dioxide efflux. The year-to-year variability was ~850–1950 mmol carbon dioxide m−2 yr−1, which, if scaled to the subtropical gyre, represented an interannual variability of ~0.2–0.3 Pg C yr−1 for the mid-latitude North Atlantic oceanic carbon dioxide sink. The long-term trend over the 1983–2005 period was a slight increase in the oceanic carbon dioxide sink, associated primarily with a gradual increase in windspeed over the same period. In addition to surface trends, we examine changes in the storage of carbon dioxide in Eighteen Degree Water (EDW), a mode water that ventilates the depths between the seasonal and permanent thermocline in the subtropical gyre.

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Shallow Water Hydrodynamics and Sediment Dispersal Offshore of a Small Mountainous River: The Waipaoa River, New Zealand

Small mountainous rivers deliver tremendous amounts of sediment to the coastal ocean, but our understanding of the processes important for dispersal of this material has been hampered by the difficulty in observing sediment transport near river mouths during floods and storms. The Waipaoa River, within a Margins 525 system on the North Island, NZ, is a small mountainous river delivering about 15 million metric tons of sediment per year to Poverty Bay, a small embayment of the Pacific Ocean. Sediment dispersal processes there were observed by instruments measuring current velocity and turbidity within 5km of the river mouth, about 15m water depth, during the winter of 2006. Elevated river discharge and strong offshore winds drove bay wide counterclockwise circulation on the order of 0.3 m/s. Peaks in suspended sediment concentrations coincided with increased river discharge or energetic waves following flooding. Within weeks of flooding sediment concentrations were reduced, indicating either consolidation or winnowing of the fine sediments. Waves capable of resuspending fine sediments more than 75% of the time and ADP derived erosion depths suggest winnowing of the fine sediment.

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Aerobic Production of Methane in the Sea

Methane is a potent greenhouse gas that has contributed approximately 20% of the enhanced radiative forcing since pre-industrial times. Despite its importance to Earth’s climate, the global methane budget source terms are poorly constrained. Methane concentrations in the surface waters of most of the world’s oceans are 5–75% supersaturated with respect to atmospheric methane concentrations, implying both a local in situ methane source and a net flux from the ocean to the atmosphere. However, marine methane production is thought to occur only in strictly anaerobic environments. Because the surface ocean is also saturated with respect to atmospheric oxygen, the as yet unexplained methane supersaturation has been termed the oceanic methane paradox. We provide evidence for a previously unrecognized pathway for methane production in the sea. This pathway involves production of methane via the decomposition of methylphosphonate as a phosphorus source for growth. The diazotroph, Trichodesmium, is one organism capable of growth and methane production via methylphosphonate metabolism. As such, this aerobic methane pathway is predicted to be climate sensitive and responsive to changes in water column stratification and nutrient limitation.

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Optimizing Power Generation by Microbial Fuel Cells

To test various strategies used in operating Microbial Fuel Cells (MFCs), we have designed and constructed and electronic device – an MFC tester - which can be used in the laboratory and in the field. Our goal is to maximize the power generated by MFCs and the MFC tester is used to compare the effect that various operational parameters may have effect on power generation using MFCs. Because typically MFCs generate low power density, it is difficult to use this energy to power external devices directly. Instead, the energy from MFCs is stored in capacitors and later used to power electronic devices. The paper discusses the methods of optimizing power generation by MFCs and the electronic tester we have developed and used to evaluate how efficiently the power was generated. We have used the MFC tester to evaluate the performance of MFCs in the laboratory, marine environment and in the freshwater environment.
There is substantial disagreement about the location of the upwelling branch of the meridional overturning circulation with helium-3 numerical simulations. There is substantial disagreement about the location of the upwelling branch of the meridional overturning circulation. Observational syntheses suggest that most of the upwelling occurs in the interior ocean, either spread broadly throughout the thermocline or focused in regions of exceptionally intense mixing. However, a number of numerical models suggest that the upwelling occurs in the Southern Ocean. Primordial helium-3 from mid-ocean ridges is an ideal tracer for determining where the upwelling occurs. We include this tracer in a suite of models with different mixing parameterizations, representing the spectrum of behaviors between upwelling occurring primarily in the Southern Ocean and outside of it. Results from these simulations are compared to a new helium-3 dataset compiled from the measurements of the World Ocean Circulation Experiment.

The Greenland Ice Sheet (GIS) represents the largest expanse of glacial ice in the Northern hemisphere and contains significant melt water, along with unknown quantities of associated carbon material, to the North Atlantic and Arctic Oceans. Our goal is to understand the interaction between microbial metabolism and carbon turnover on the surface of the GIS, with a view to ultimately quantifying the contribution of this surface carbon reservoir to total carbon export from the ice sheet to the ocean. In July 2007 we collected samples from glacial ice, snow, supraglacial lake water, and cryoconite-water at two sites on the western margin of the GIS. Here we present results from a suite of analyses that describe the magnitude and biological reactivity of the surface carbon reservoir. We use bulk biochemical analyses to establish baseline values of the magnitude of carbon and nutrients present. We use ultrahigh resolution mass spectrometry to characterize the polaron fraction of dissolved organic matter. We use community phylogenetic analyses to characterize metabolically-active microbes that facilitate transformations of the bulk organic carbon pool prior to export.
ecosystems are useful indicators of global change because they integrate processes related and export flux occur seasonally and interannually in overlying waters. Deep-sea benthic (OM) to the seafloor and/or the quality of the OM. Large changes in primary productivity dominance with time have been recorded in all size fractions. The changes in faunal exceed 2.5 years to one of less than 6 weeks. Meiofauna and macrofauna also increased reduced the time for the complete reworking of the sediment surface from a period ex 1997 and 2002. There was no significant increase in biomass. The increase in abundance of abyssal megafauna increased in abundance by over three orders of magnitude between Large-scale changes have occurred over the last 18 years (1989 to 2007) in the structure of SUSTAINED OBSERVATORY - THE €˜AMPERIMA ‘EVENT.

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SECULAR CYCLES OF MIXED LAYER SALINITY IN THE NORTH PACIFIC FROM ARGO DATA

The seasonal variability of mixed-layer salinity (MLS) is examined in the North Pacific Ocean using Argo data. Significant seasonal cycles were found in four regions: 1) The western North Pacific just south of Japan, 2) The northeastern North Pacific and Alaska gry, 3) the intertropical convergence zone (ITCZ) and 4) an area of the central North Pacific north of the Hawaiian Islands. The phase and amplitude of the seasonal cycle were determined. Amplitudes range from 0.1 to ±0.5, with 0.1–0.2 being most common. The largest amplitudes are in the tropical band. Maximum salinity is obtained in late winter in area 1, late winter and early spring in area 2, early summer in area 3 and late summer and early fall in area 4. Large portions of the North and Tropical Pacific have no significant seasonal variation in MLS. Seasonal cycles of evaporation and precipitation were also calculated using the NCEP Reanalysis 2 data. In general, the phase of E-P agrees well with the MLS in the ITCZ and in the western North Pacific. However, the area of seasonal variability in MLS in the Alaskan gyre does not correspond to any significant seasonal variations in E-P.

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THIN LAYERS OF PLANKTON: FORMATION AND DESTRUCTION BY SHEAR, STRAIN, AND DIFFUSION

We use explicit solutions of the advection-diffusion equation to show that thin layers of plankton can be formed by vertically sheared currents differentially advecting generic initial distributions of plankton. The most realistic current model includes both horizontal and vertical shear, which together cause an exponential-in-time decrease of the layer thickness until diffusion prevents further scale reduction. We give simple estimates of the minimum layer thickness and show that the initial scale of the patch has no effect on the ultimate scale. A signature of the shear-thinning mechanism is that the resulting thin layer is systematically tilted across isopycnals; this property can be used to distinguish shear-driven thinning from one-dimensional mechanisms, such as depth-seeking behavior or settling onto pycnoclines. Horizontal shear alone is also sufficient for exponential-in-time destruction in the intensity of thin layers. Therefore, to maintain the layer intensity, exponential production which is faster than the strain time-scale is required. Rough numerical estimate using oceanic parameter values indicate that this condition, and therefore biologically sustained thin layers, may be satisfied.

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EXPLORING THE COMBINED POTENTIAL OF RADAR AND LIDAR ALTIMETRIC DATASETS FOR INLAND WATER ALTIMETRY

Satellite radar and lidar altimetry are valuable tools in providing surface height (stage) measurements of inland water targets and hydrological-based altimetric studies have been ongoing for well over a decade. The technique has been utilized in many interdisciplinary projects seeking surface elevation for lakes, rivers and wetlands, in many cases providing new insight into time or space. Moreover, very rapid changes in in-situ SSS show the challenge faced by remote sensing in frontal ocean regions. Other variables are compared with existing products when available.

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LONG-TERM CHANGE IN ORGANIC MATTER FLUX AND DEEP-SEA COMMUNITIES AT THE PORCUPINE ABYSSAL PLAIN (NE ATLANTIC) SUSTAINED OBSERVATORY: THE ‘Æ AMPERIMA€EVENT.

Large-scale changes have occurred over the last 18 years (1989 to 2007) in the structure of the benthic community on the Porcupine Abyssal Plain in the NE Atlantic (48°50'). The abyssal meiofauna increased in abundance by over three orders of magnitude between 1997 and 2002. There was no significant increase in biomass. The increase in abundance reduced the time for the complete reworking of the sediment surface from a period exceeding 2.5 years to one of less than 6 weeks. Mesoofauna and macrofauna also increased in abundance at the same time, but only by a factor of about two. Changes in species dominance with time have been recorded in all size fractions. The changes in faunal abundance and composition may be related to large-scale episodic fluxes of organic matter (OM) to the seafloor and/or the quality of the OM. Large changes in primary productivity and export flux occur seasonally and interannually in overlying waters. Deep-sea benthic ecosystems are useful indicators of global change because they integrate processes related to the biological carbon pump over space and time.
SHELF WATER SALINITY VARIABILITY, EASTERN NEWFOUNDLAND TO CAPE HATTERAS, 1950-2003

Given large Middle Atlantic Bight shelf water salinity and volume variability from the 1970s to 1990s, an analysis from 1950 to 2003 was conducted using data from eastern Newfoundland to Cape Hatteras to examine possible sources. Analysis uses data containing all temperature and salinity pairs from Bedford Institute of Oceanography’s Climate database, along with Russian data from a NOAA-funded data rescue effort, providing over 500,000 data points. Partitioning data into ten sub-regions allows examination of regional seasonal and inter-annual variability (IAV). Results show a seasonal pulse of near-surface, low-salinity water entering off eastern Newfoundland during September that propagates southwest to the Scotian shelf by November. Timing of this freshwater signal occurs 2-3 months earlier than seaward movement of the shelf-slope front. From the Gulf of Maine to Hatteras shelf, lowest salinities occur nearly simultaneously due to the annual spring freshet. Salinity IAV increases westward, with largest anomalies located from the eastern Scotian to Hatteras shelves. IAV of salinity in this western-most region may be due to upstream freshwater sources from the eastern Newfoundland shelf and Gulf of St. Lawrence.

SHELF METAL AND SULPHUR ISOTOPES IN SMALL BOREAL STREAMS: THE INFLUENCE OF LANDSCAPE TYPE

The transport of trace metals (TM) and dissolved organic carbon (DOC) from headwater streams to the sea is influenced by various landscape elements. Our focus was to investigate the influence of major landscape elements on observed concentrations of dissolved metals (e.g., As, Cd, Co, Pb), DOC, sulphate, and sulphur isotope composition in streams, north-eastern Sweden, a coastal region characterized by peat wetlands and coniferous forests. Stream water samples collected from 10 streams (0.13 to 67 km²) in a boreal stream network reveal that landscape type (i.e. coverage of wetland and forest) is significant for river chemistry. Streams with different catchment characteristics responded differently to hydrological episodes. In forested streams, concentrations of TM, Fe and DOC increased, while they decreased in wetland influenced streams. Furthermore, Fe and Pb correlated positively with wetland coverage. Moreover, significantly lower average sulphate concentrations, but higher isotope values, were observed in wetland streams. This study emphasizes the importance of understanding stream water chemistry from a landscape perspective in order to identify potential environmental where climate change may induce enhanced metal mobilization in the future.

APPLICATION OF THE TRACER Fe²⁺ TO A FIELD DATA SET FROM THE SOUTH EAST PACIFIC: INTEREST AND LIMIT OF THE CONCEPT

The geochemical tracers N² and C¹ have been successfully used to estimate the importance of key biogeochemical processes. Based on the same approach, the Fe²⁺ (Fe³⁺) was recently used in monitoring settings (Panuck et al., 2005). We have applied the Fe²⁺ concept to a large data set (137 values of Fe²⁺ and P) gathered between 0 and 400 m along a 8000 km transect extending and across the South Pacific gyre from the Marquesas Islands to the Chilean coast. By contrast with the definition of N² or C¹, which relies on quite robust elemental ratio, Fe²⁺ depends on rFe:P which is highly variable. Appropriate rFe:P for our study was derived from the data set. The analysis of the distribution of Fe²⁺ leads to the unexpected conclusion that the Fe enrichment in the vicinity of Marquesas Islands is very likely not related to a local source of Fe but rather to the extension of the oxygen minimum zone. The limits of the method are also discussed. GEOTRACES should generate large data sets which will help to fully explore the potential of Fe²⁺.
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INTRA- AND INTER-SPECIES VARIATION OF D-MG AND D-SR IN LIVE BENTHIC FORAMINIFERAL CALCITE AND ARAGONITE FROM THE CHARLESTON BUMP SPANNING FIVE YEARS OF STUDY

Mg/Ca and Sr/Ca from live (CellTracker Green labeled) individual tests of Bulimina aculeata, Bulimina marginita, Cassidulina laevigata, Lenticulina spp., and Hoeglundina elegans were compared across bottom-water properties and ontogenetic variability from cores collected in 2001, 2005, and 2006 from the Charleston Bump (~22m water depth; 8.9-11.6°C). No significant correlations existed between Mg/Ca and Sr/Ca and benthic foraminiferal population densities or bottom-water temperature. This suggests that annual patterns affecting population dynamics may not induce vital effects on element/calcium shell chemistry. Lenticulina spp. and H. elegans exhibited an ontogenetic effect where higher Mg/Ca and lower Sr/Ca values were observed in smaller individuals. Mg/Ca values varied across different sized individual Bulimina spp. and C. laevigata, but no significant trend was observed for these species. Sr/Ca values were consistent across varied shell size of an individual foraminiferal, but were species dependent. The values for Sr/Ca were significantly different among species and co-varied with Mg/Ca signatures, suggesting that a multi-species paleo-temperature proxy may be useful where gaps exist in single or non-concurrent species records. Funded by NSF OCE0911654, OCE03351029, OCE 0437366, and OCE 0350794.

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Layer for winds, WaveWatch III and SWAN for wind waves, and ADCIRC for storm surge mapping and analysis using techniques like the Joint Probability Method. For example, a single simulation of a complex model system require one thousand CPU hours and produce gigabytes of output. We describe our four-model system (Hurricane Boundary Layer for winds, WaveWatch III and SWAN for wind waves, and ADCIRC for storm surge), which is used for a flood plain study. This includes the simulation parameter space, resource requirements, and system optimization issues.

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ABUNDANCE AND BIOMASS OF CYANOBACTERIA IN THE SOUTHERN MID-ATLANTIC BIGHT

Cyanobacteria are important primary producers and agents of nitrogen fixation in marine ecosystems. In this study, epifluorescence microscopy combined with computer-mediated image analysis software was employed to assess cyanobacteria abundance and biomass off the coast of Chincoteague, VA and on oceanographic cruises in the southern Mid-Atlantic Bight (between Lewes, Delaware and the tip of North Carolina). As a secondary objective, this study sought to characterize the cyanobacteria based on cell size, shape and fluorescence. Cell size ranged from 0.7-2.4 μm and averaged 1.3 μm, which lead to the conclusion that the community is dominated by Synechococcus sp. In addition to characterization, correlations between cyanobacteria abundance and nutrient, temperature, and salinity data were explored. Cyanobacteria abundance and biomass exhibited seasonal variability often correlating with changes in water temperature, which ranged from 5°C to 25°C. Cell concentrations ranged as low as 4x10^2 cells mL^-1 during the winter months to as high as 16x10^4 cells mL^-1 during the summer months. As a whole, our efforts are contributing to the Wallops Coastal Ocean Observing Laboratory (WA-COOL) on the Delmarva Peninsula.

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NUMERICAL SIMULATIONS OF SHOALING INTERNAL SOLITARY WAVES OF ELEVATION

The interaction of internal solitary waves (ISW) of depression with shoaling bottoms is examined with nonhydrostatic numerical simulations. As ISW shoal, wave breaking occurs and a number of bubbly-fall layers form. In the case of semi-stationary ISWs, these layers can produce boluses transport dense fluid upslope, above where the pycnocline meets the bottom. The number of boluses produced during a shoaling event, their energetics and transport properties are examined. The impact on the slope of a wavetrain consisting of more than one ISW is also examined. It is found that a wavetrain composed of two ISWs that are separated by roughly one wavelength, does not significantly increase the volume of dense water being brought upslope when compared to the case of only one impinging ISW, except for situations characterized with an Irribarren number greater than 0.2.

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OPTICAL PROPERTIES OF CHROMOPHORIC DISSOLVED ORGANIC MATTER AND MODEL COMPOUNDS: RELATION TO STRUCTURE

Extracted lignins exhibit optical absorption and emission properties that are highly similar to hemic substances and CDOM, including long-wavelength absorption and emission that would not be predicted on the basis of lignin structure. Instead, these optical properties are proposed to arise from intramolecular charge transfer interactions between hydroxy-(methoxy)-aromatic donors and quinoid acceptors formed by partial oxidation of lignin precursors (Del Vecchio and Blough, 2004 ES&T). Emission quantum yields for a series of quinone model compounds were negligible, suggesting that the long-wavelength emission does not originate from quinoid moieties, and is instead attributed to recombination luminescence from the charge transfer states. Further, concentrated solutions of CDOM (and lignins) exhibit absorption well into the infrared, outside of the range that would be expected for most quinones. However, reaction with borohydride, a good quinone reductant, produces preferential loss of long-wavelength absorption and enhanced blue-shifted emission consistent with the charge transfer model. Preliminary time-resolved fluorescence measurements are also compatible with this model. These results thus suggest the idea that degraded (partially-oxidized) forms of lignin are the predominant source of terrestrial CDOM.

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IN- AND EPIFAUNAL BENTHIC COMMUNITY STRUCTURE IN THE ARCTIC CANADA BASIN IN JULY 2005

Benthic in- and epifauna of the Arctic Canada Basin were sampled in July 2005 at depths ranging from 817–3880 m. Mega-epifauna was quantified at 8 stations from 5732 digital images taken with a down-looking digital camera from 2 to 3 m above the seabed. Infauna was sampled by 33 box cores (0.062m² area) at 11 stations. Epifauna densities were highest at a sub-circular feature on the Chukchi Plateau located in 900 m water depth, 1200 m in diameter with a depth of approximately 60m below the surrounding seabed. Holothurians, mostly Holothuria, were the single-most abundant taxon at this station with over 50 individuals/m² on some images. Mean infaunal abundance per station ranged from 89-5149 individuals/m² with the highest concentrations on the upper Chukchi Sea slope and the lowest in the deep Canada Basin. Mean infaunal biomass per station ranged from less than 0.1-27 g wet weight/m² with the same geographical trend. Polychaetes were most abundant and dominated the biomass. Three new species of polychaetes and one new species of Komokiacea (Foraminifera) were found.
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INCORPORATION OF HIGH-RESOLUTION TOPOGRAPHIC INFORMATION, HIGH RESOLUTION WATER QUALITY FORECASTS AND ADVANCED DATA ASSIMILATION INTO A COASTAL INUNDATION MODEL

Coastal inundation is the most dangerous and damaging aspect of extratropical and tropi-
cal weather systems that impact the coastal zone of the eastern United States. Several
factors contribute to the water elevation reached in a given storm each of which is com-
plicated and difficult to address. To ameliorate public concern a high-resolution coastal
inundation forecasting and assessment program has been developed and integrated into
the existing New York Harbor Observing and Prediction System (NYHOPS).

The NYHOPS region not only includes the open waters of New York and New Jersey but now includes
many of the low-lying back bay areas. And, based on end user input, the inclusion of high-
resolution (lat & block) coastal topography grids for overland inundation determination at
select priority areas for application is underway. The model physics has been improved
through the coupling of experimental high-resolution Weather Research and Forecasting
(WRF) meteorological model and a data assimilating scheme for water level data from
existing high-density federal and non-federal coastal and back bay observation systems.

For the purpose of assessing the system performance, the coastal inundation forecasting and
analysis program is applied to determine the coastal and back bay water levels measured
during two major storm events.

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ABUNDANCE AND MOLECULAR DIVERSITY OF PROCHLOROCoccus
WITHIN PACIFIC COASTAL ISLAND SYSTEMS

Prochlorococcus dominates oligotrophic, open-oceans ecosystems accounting for as
much as 43% of the biomass and is composed of genetically and physiologically distinct
clades, or ecotypes, each differentially adapted to environmental variables. Preliminary
studies have shown that Prochlorococcus is also present in high concentrations in some
coastal waters such as Kaneohe Bay, Oahu, Hawaii. Here we investigate the abundance and
molecular diversity of Prochlorococcus of several distinct Pacific Ocean coastal island
ecosystems to determine their contribution to local ecosystems and if these local popula-
tions are regulated by local or external processes. Using a combination of flow cytometry,
apPCR, DGGE and clone libraries, we show that in these tropical and sub-tropical coastal
environments that Prochlorococcus is abundant and diverse and composed of some
subpopulations not found in the surrounding open ocean. Some Prochlorococcus groups
appear to be endemic to certain islands, whereas others are widespread. These patterns of
abundance and diversity are mapped onto strong environmental gradients to explore
what factors may be regulating populations.

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A NEW FISH PROBE FOR KINETOLASTIDS, AN IMPORTANT GROUP OF
HETEROTROPHIC FLAGELLATES, AND THE EVALUATION OF A DOMAIN-
SPECIFIC PROBE FOR EUKARYOTES

Detection and accurate enumeration of the smallest heterotrophic eukaryotes in the pres-
ence of the vastly more abundant prokaryotes represents a unique challenge. Using stan-
dard counting protocols with epifluorescence microscopy and nucleic acid dyes (DAPI, 
SYBR green), larger nucleomorphs of prokaryotes can be mistaken as eukaryotic nuclei.
On the other hand, eukaryote nuclei can be so small that they are lost among the more
abundant but similar-sized prokaryotic DNA. Fluorescence in situ hybridization (FISH)
provides a more reliable detection of heterotrophic eukaryotes but only when combined
with pyramidal signal amplification (also known as catalyzed reporter deposition FISH), a
step that amplifies the fluorescence signal. Few FISH probes are available and fewer have
been extensively tested for eukaryotes to date. Here we demonstrate the use of a new
probe targeting the 18SSU rRNA which was specifically designed for kinetoplastids, an
important group of free-living and parasitic flagellates. We will contrast this new probe to
a popular domain-specific eukaryote probe, discuss optimal stringencies and the use of
competitor probes in order to obtain an unambiguous signal.

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NUTRIENT-RICH, FRESH SUBMARINE GROUNDWATER DISCHARGE IS ENHANCED DURING NEAP TIDES AT AN OPEN OCEAN BEACH

The influence of spring-neap tidal variability on submarine discharge of fresh and saline
groundwaters was examined at Stinson Beach, California - a residential community that
utilizes on-site systems for wastewater disposal. Fresh, shallow groundwater at the site
contains high concentrations of nutrients and human fecal bacteria. A groundwater-de-

resistant bacteria indicates that even open ocean marine animals are exposed to and potentially harbor these organisms.

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LONG-TERM TRENDS IN SPICINESS, DISSOLVED OXYGEN, AND INORGANIC NUTRIENTS IN THE SOUTHERN CALIFORNIA CURRENT SYSTEM.

We use historical hydrographic data from the California Cooperative Oceanic Fisheries Investigations (CalCOFI) program to explore the temporal variability of physical and chemical properties of slope waters impacted by the California Undercurrent (CUC) over the period 1984-2006. The upper water column has experienced a strong warming trend, and is greatly impacted by El Nino events. At the depth of the CUC, waters have become progressively warmer, saltier, and lower in oxygen content. There have also been increasing trends in nitrate and phosphate in CUC waters, although at different rates, leading to highly significant declines in the NO3:PO4 and SiO4:NO3 ratios. Variability in CUC net transport and source water properties are the most likely causes of the observed trends. Significant changes in the oxygen content and nutrient composition of CUC waters, which are upwelled upstream, could have important implications for the California Current ecosystem. We also examine the CUC trends in the context of decadal variability in water properties throughout the southern California Current System, based on the CalCOFI 1949-2006 series of temperature, salinity, and dissolved oxygen measurements.

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VERTICAL MIGRATION OF CETHIN LAYERS OF THE DINOFLAGELLATE AKASHIW SANGUINEA IN RELATION TO VARYING LIGHT AND NUTRIENT CONDITIONS.

Vertical heterogeneity of physical, chemical and biological properties is nearly ubiquitous in the ocean, and sometimes manifests itself as thin layers or strata of a few meters or less in thickness. One example of this is the dinoflagellate Akashiwo sanguinea, which can form layers near the surface during the day and then migrate downward to form sub-surface layers near the nutricleane at night. We examined this phenomenon in the laboratory using well-controlled and replicated experiments employing 2-m high columnar tanks, in which we manipulated both light intensity (0.06 - 140 μEinstein) and nutrients (0 - 20 μM PO4), both vertically and between treatments. We observed A. sanguinea to exhibit highly variable vertical distribution, and to sometimes not vertically migrate, depending on the exact combination of light and nutrients (i.e., possibly those needed to generate positive net photosynthesis over a daylight cycle). We discuss these results in relation to recent field observations (e.g., ONR LOCO) and experimental studies (e.g., our radiotrace experiments) examining the vertical partitioning and flux of materials within and around thin layers.

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ISOTOPE DISCRIMINATION BY FORM ID RUBISCO FROM THE DIATOM SKELETONEMA COSTATUM.

Phytoplankton 13C values are used to ground-truth and constrain parameters of models of the global carbon cycle. One major influence on 13C values is isotopic discrimination by RubiscoCO2, the Calvin cycle carboxylase. It is often assumed that all Rubiscos discriminate against 13C to the same degree (ε = 25‰, ε = [(13C/12C) - 1] x 1000), which is problematic, since carbon fixation in the ocean is catalyzed by four distantly-related forms of Rubisco (Ia, Ib, Id, II). Many dominant primary producers, including diatoms and coccolithophores, use form ID. Recently, the ε value for form ID Rubisco from the coccolithophore Emiliania huxleyi was found to be surprisingly nonspecific (ε = 12‰). To determine whether other ID enzymes discriminate to a lesser degree, the ε value for Rubisco from the diatom Skeletonema costatum was measured using the substrate depletion method. Like E. huxleyi, S. costatum has a Rubisco that is less isotopically selective than expected (ε = 18.5‰). These lower-than-expected ε values necessitate the re-interpretation of 13C values of phytoplankton, and provide a mechanism for the isotopic enrichment commonly noted for marine biomass relative to terrestrial.

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AN ESTIMATION OF DIFFERENT SOURCES OF NEW NITROGEN DURING MONSOON-FORCED UPWELLING OFF THE VIETNAMESE COAST.

The southwest-monsoon induces coastal upwelling off Vietnam, with variable intensity between years. During field-campaigns in July 2003 and 2004, we investigated the importance of nitrate and N2-fixation for supporting productivity. Within the upwelling zone, Ekman velocities ranged from 1.9±10-3 m s-1 (2003) to 2.0±10-3 m s-1 (2004). The product of Ekman velocities and nitrate concentrations in upwelling source waters yielded vertical fluxes of 13±2 mmol N m-2 d-1 in 2003 and 17±2 mmol N m-2 d-1 in 2004. Consistent N demands of primary production were found in 2004 (16±4 mmol N m-2 d-1), but not in 2003 (4±2 mmol N m-2 d-1). For the stratified, oligotrophic offshore zone, diapycnal turbulent diffusivities were calculated using shear- and buoyancy measurements. Values of up to 120 cm2 s-1 in 90 m depth are unrealistically high due to an upwelling-induced undercurrent. Values between 0.35 cm2 s-1 and 0.42 cm2 s-1 were derived from nitrate uptake rates measured in the nutrient-rich, and are consistent with literature values. N2-fixation was insignificant in the upwelling zone, but may have accounted for 15-18% of new production offshore in 2004 and 2003, respectively.

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THE WEATHER DURING THE SUMMER OF 2006 IN THE PACIFIC NORTHWEST AND ITS CONSEQUENCES FOR THE COASTAL OCEAN.

The weather of the summer of 2006 was characterized by a persistent ridge of anomalously pressure off the coast of Oregon which led to a long string of days featuring upwelling favorable winds from the north. This appears to have had a number of impacts on oceanic conditions in the coastal zone. Notably, a large area of relatively high nitrate concentrations was found farther offshore and farther north than usual. This water featured relatively low phytoplankton biomass, with assemblages typical of high nutrient/low chlorophyll (HNLC) regions rather than coastal upwelling areas. These effects appear to have been manifested at higher trophic levels, as exemplified by poor catches of juvenile chinook and coho salmon. The atmospheric forcing from late spring through summer of 2006 also can be implicated in the development of record-low oxygen concentrations (hypoxia) on the shelf along the coast. The present paper summarizes the physical, chemical, and biological states of the coastal zone in 2006, and outlines the mechanisms linking the weather to the biological response.

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INTERANNUAL DIFFERENCES IN NUTRIENT DYNAMICS DURING BLOOMS OF AUREOCCUS ANOPHAGEFERRIS, A FLOW CYTOMETRY APPROACH.

Chincoteague Bay, MD has been experiencing blooms of Aureococcus anophagefferens since at least 1999. We examined interannual differences in both nitrogen and carbon dynamics during blooms from 2002 thru 2007. During all of these blooms, inorganic nitrogen (e.g., ammonium and nitrate) was taken up but urea was the dominant form of nitrogen (e.g., low chlorophyll (HNLC) regions rather than coastal upwelling areas. These effects appear to have been manifested at higher trophic levels, as exemplified by poor catches of juvenile chinook and coho salmon. The atmospheric forcing from late spring through summer of 2006 also can be implicated in the development of record-low oxygen concentrations (hypoxia) on the shelf along the coast. The present paper summarizes the physical, chemical, and biological states of the coastal zone in 2006, and outlines the mechanisms linking the weather to the biological response.
A real-time coastal monitoring and prediction system was implemented with the Dynamics of the Adriatic in Real-Time (DART) international collaborative project, a focus on the study of the complex dynamics of the swiftly-evolving fronts and eddies in the Western Adriatic Current downstream of Cape Gargano. They were directly observed in real-time through remotely sensed Chlorophyll a and Sea Surface Temperature imagery from MODIS Aqua, and by ship and mooring monitoring.

THE DART EXPERIMENT GARGANO: PREDICTIONS, MONITORING, AND ADAPTIVE SAMPLING DURING EDDIES IN THE WESTERN ADRIATIC CURRENT DOWNSTREAM OF CAPE GARGANO

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MIXING PROCESSES IN THE SUBTROPICAL FRONT
The Subtropical Front south of Australia is characterised by strong density compensation in and below the seasonal mixed layer and small-scale salinity structure at the base of the seasonal mixed layer. High-resolution Upper Ocean model simulations show that on seasonal time-scales, density compensated fronts persist, even in the absence of active atmospheric forcing. Evolution of these fronts is dependent on the relative balance between mixing that maintains the frontal structure and flow patterns that advect and modify the fronts. Our recent work describes the role of the seasonal mixed layer on the formation of these fronts. In the near future, we expect to develop new methods for the observation of these features, and to further improve their prediction. The Subtropical Front is a significant physical feature that controls the transport of matter and energy in the Southern Ocean. Its density structure is responsible for the formation of the Subantarctic Mode Water (SAMW), which is an important source of deep water in the global ocean. The Subantarctic Front is also a key feature for the transport of heat and carbon between the Southern Ocean and the atmosphere.

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DOCUMENTING CHANGE ALONG A LOW-ENERGY COASTAL EMBAYMENT WITH FRINGING MARSH: A NEW PROXY-BASED SHORELINE INDICATOR
Lagoon and estuarine shorelines represent a significant portion of eroding shorelines along the U.S. Atlantic and Gulf coasts. These shorelines are often not included in shoreline change studies as delineating a definable, repeatable and reliable proxy-based shoreline indicator is difficult. A new proxy-based shoreline indicator was used to document shoreline change in a low-energy coastal embayment below the HWL. The new proxy was shown to be superior to the FWL for documenting changes to the shoreline. Approximately 9.8km of the HWL, exhibited statistically significant shoreline change compared to 22.5km using the new proxy for the same 40km stretch of shoreline. In addition, the visual cues used to delineate the new proxy were found to be more scientifically defensible than those associated with the HWL delineation along shorelines with fringing marsh. Changes in marsh vegetation below the HWL have implications for sediment transport, water quality, predator-prey relationships, contaminant sequestration and filtration, ecosystem health and other science-based inquires and/or management issues.

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ADAPTIVE SAMPLING TO PROVIDE HIGH-RESOLUTION MEASUREMENTS OF THESE EDDY FEATURES
The forecasts from these models, validated using remote sensing, were used to redirect ship sampling to provide high-resolution measurements of these eddy features.

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INTEGRATING CO2 FLUXES IN THE COASTAL OCEAN: SIMULATING NATURAL VARIABILITY AND ANTHROPOGENIC UPTAKE WITH A GLOBAL MODEL OF 0.5Â° HORIZONTAL RESOLUTION
The coastal ocean represents 7% of the oceanic surface area, but accounts for 20% of the total oceanic organic matter production and 80% of total oceanic organic matter burial. It receives massive inputs of organic matter and nutrients from land and exchanges large amounts of matter and energy with the open ocean. Despite all this, the coastal ocean has been largely ignored in the recent carbon budgeting and in ocean carbon uptake projections over the 21st century. Recent studies have compiled in-situ data from several key coastal environments and clearly indicate the significance of this active region in the global carbon cycle. In this study, we couple the global biogeochemical model PISCES to a 0.5Â° -horizontal resolution version of the NEMO ocean general circulation model. We perform runs over the industrial era (1880-2001) forced by observed atmospheric pCO2 and atmospheric re-analysed fields when available. We present here an evaluation of the simulation of natural and anthropogenic carbon fluxes in the coastal ocean thanks to the recent data compilation. We also show how the coastal ocean carbon flux changes under increasing atmospheric pCO2.
The possible biases associate with incorrectly modeling aggregates as solid particles. We apply this model to recently proposed MPA networks for the central coast of California and show how its output makes quantitative comparisons of different MPA networks. Our approach integrates the patchy spatial distribution of habitat, the spatial scale of larval dispersal, and the fishing level outside of reserves into a calculation of the spatial distribution of equilibrium species. These distributions are summarized in terms of the amount of coastline having high settlement rates for each combination of MPA network, dispersal distance, presence of fishing, and population structure. Results show that while the habitat set aside is a good indicator of persistence for short distance dispersers, presence of longer distance dispersers depends on the spatial distribution of habitat and reserve. We conclude by considering the advantages of this model-based approach relative to route- and habitat-based methods of designing MPAs.

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COMBINING MICROCOMIS EXPERIMENT AND ISOTOPIC TRACERS TO STUDY MERCURY TRANSFORMATIONS UNDER REDOX OSCILLATIONS IN COASTAL SEDIMENTS

Major questions are still associated with the fate of Hg species in coastal sediments: first, the methylmercury (MMeHg) formation extent of the fresh pool of Hg and the legacy pool of Hg (endogenous Hg) and secondly, the transformations and partitioning of the Hg species under redox oscillating regimes in surface sediments. In this work, a time course experiment was developed using a microcosm to investigate the surface sediment reactivity of Hg species under controlled redox oscillations. Isotopic enriched species of endogenous Hg and MMeHg were added at the beginning of the experiment. Sampling was done in the solid, aqueous and gaseous phase along the redox oscillations allowing the simultaneous measurement of transformation and partition extents of endogenous and exogenous Hg species. It was found that methylation yields and desorption of inorganic Hg species were controlled by the redox cycles. The model-based approach to assess a network of marine reserves for persistence of populations in coastal ecosystems with a sedentary adult phase and a dispersing larval phase. We apply this model to recently proposed MPA networks for the central coast of California and show how its output makes quantitative comparisons of different MPA networks. Our approach integrates the patchy spatial distribution of habitat, the spatial scale of larval dispersal, and the fishing level outside of reserves into a calculation of the spatial distribution of equilibrium species. These distributions are summarized in terms of the amount of coastline having high settlement rates for each combination of MPA network, dispersal distance, presence of fishing, and population structure. Results show that while the habitat set aside is a good indicator of persistence for short distance dispersers, presence of longer distance dispersers depends on the spatial distribution of habitat and reserve. We conclude by considering the advantages of this model-based approach relative to route- and habitat-based methods of designing MPAs.
PHOTONIC PLASTICITY IN THE FILTERING APPARATUS OF THE PELAGIC TUNICATE, OIKOPLEURA DIOICA, IN RESPONSE TO FOOD LIMITATION.

The frequent repetitive secretion of filter-feeding houses of the tunicate, Oikopleura dioica, represents investment in a substantial proportion of total body carbon. Despite this investment, the filter-feeding strategy of pelagic tunicates in general, has been proposed as an adaptation to oligotrophic environments. We examined the capacity of O. dioica to modify its house renewal rate (HRR) and filter morphology in response to eutrophic vs. oligotrophic food regimes. The HRR remained constant at 0.26 ± 0.08 house 1^{-1} throughout the first life cycle and did not change in response to altered food concentrations. However, there was a small alteration of transcriptional activity of a gene responsible for production of the food concentrating filter (Oikos3) compared to a gene producing the overall house scaffold (Oikos7). The difference in relative contribution of the two structural elements became more evident at the protein level, with a highly significant effect in response to food concentration. These results indicate that although house production rates are not subject to a plastic response, dietary differences drove differential regulation of component proteins of the filter-feeding house. 

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Two algorithms are examined to retrieving (1) sea surface turbulent stress and (2) sea surface turbulent kinetic stress. The kinetic stress is equal to the stress divided by atmospheric density. Traditionally, scatterometer have (1) been believed to respond to turbulent stress, and (2) be calibrated in a manner consistent with a response to kinematic stress. We investigated the advantages of considering atmospheric density in the satellite calibration. These consideration could be important in areas of strong temperature gradients and for large scale circulation studies.

Bourque, J. H., Université É de Moncton, Moncton, Canada, ebl2860@umonton.ca; Tremblay, L., Université É de Moncton, Moncton, Canada, luc.tremblay@umonton.ca; BACTERIAL CONTRIBUTION TO THE ORGANIC MATTER OF THE ST. LAWRENCE ESTUARINE SYSTEM.

Bacteria are primary agents of diagenetic alterations and contribute to a unique fraction of detrital organic matter (OM). In this study we measured muramic acid (Mur) and amino acids (AA) in various fractions of bulk OM (ultrafiltered, particulate, and sedimentary). Mur and the D-enantiomers of AA are bacterial biomarkers providing insights on the bacterial contribution to OM and OM diagenetic status. Samples were collected at different locations and depths in the St. Lawrence Estuary, Canada. Bacterial biomarkers were present in every sample and some displayed a major bacterial contribution to the detrital organic carbon and nitrogen. Dissimilarities in biomass marker yields were observed between locations and could be explained by different OM inputs (e.g. soil vs. marine OM). We also observed a general increase of the percentage of D-AA vs. total AA with depth, which can be explained by both bacterial contribution and preferential degradation of L-AA with time. As a result, altered material such as most of dissolved OM exhibited higher D-AA yields. The opposite trend was observed for Mur which appeared very labile.

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Diatynal mixing near topography seems to be required to provide the required buoyancy gain of the deep/intermediate waters in order to close the global overturning circulation. Available data from different regions indicate a clear link between high levels of diapycnal mixing and rough topography. The purpose of this work is to explore mixing and its relation to bottom circulation and internal waves near a sill of the axial rift-valley of the MAR in the Lucky Strike segment. A synthesis of regional circulation inferred from the GRAVILUCK and BEMOMAR cruises in 2006-2007 and a few floats will be presented and its variability will be discussed in view of previous observations. Next the variability of the deep circulation will be detailed using data from two 1-year mooring: one close to the sill and one two km downstream from the sill. The measurements are from classical ADCP and currentmeter as well as from high frequency temperature sensors and thermocline sensors. Hence they allow to identify internal waves and high-shear/low Rl episodes and their respective contribution to dissipation and mixing.

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The use of high throughput tag sequencing to explore bacterial diversity in different habitats has recently surged. This technology has demonstrated that microbial diversity is vastly greater than indicated by previous methods and that much of that diversity, the "rare biosphere," is at very low abundances. The degree to which this rare biosphere is ecologically relevant is largely unknown, though we hypothesize that these rarer taxa provide ecological redundancy that allows microbial populations to withstand environmental perturbation. We test this hypothesis by first examining local-scale variability in salt marsh sediment samples collected within a 10 cm2 area of salt marsh to assess the degree of patchiness among rare microorganisms. We then use a tag sequencing approach to examine the effects of fertilization on the community composition of salt marsh sediment bacteria. Preliminary evidence from DGGE indicates that fertilization does affect microbial communities in some habitats. Through tag sequencing we can look in more detail at these community changes and the role that the rare biosphere plays in microbial response to fertilization.

Bowen, A. S., Woods Hole Oceanographic Institution, Woods Hole, USA, abowen@whoi.edu; Lozier, M. S., Duke University, Durham, USA, sllozier@duke.edu; EXPORT PATHWAYS OF LABRADOR SEA WATER FROM THE SUBPolar NORTH ATLANTIC OBSERVED WITH RAFOS FLOATS.

The Deep Western Boundary Current (DWBC) in the North Atlantic has generally been considered the dominant export pathway for recently ventilated water masses from the subpolar to subtropical regions. Profiling float trajectories obtained in the 1990s seemingly contradicted this traditional view. To further explore the export pathways and their temporal variability, about 72 acousticallytracked RAFOS floats were sequentially released at the Labrador Sea lip (700 and 1500 m) in the DWBC near 50N in 2003-2006. To date, about two-thirds of the floats have surfaced, with the remainder due to complete their missions by November 2008. Remarkably, the vast majority of floats have been expelled from the DWBC into the ocean interior before reaching the Tail of the Grand Banks (42N). This expulsion occurs most often when the North Atlantic Current (NAC)oodle onto the continental slope, temporarily blocking the southward-flowing DWBC. Once offshore, many floats are carried eastward via the deep NAC toward or over the Charlie Gibbs Fracture Zone, while others drift southward west of the mid-Atlantic ridge, following an interior pathway to the subtropical region. Although these results challenge our notions of the DWBC as a continuous pipeline for newly formed water masses, they are consistent with transit time distributions estimated from tracer measurements.

Bowers, H. A., University of Maryland Biotechnology Institute, Baltimore, USA, bowers@umb.md; THE MANY APPLICATIONS OF REAL-TIME PCR IN THE HARMFUL ALGAL BLOOM WORLD.

Real-time PCR assays have revolutionized a broad spectrum of research areas by providing rapid and sensitive methodology for detecting a variety of targets in a suite of different environments. In particular, these techniques have advanced research on protists in several ways, including identification of unculturable organisms, detection of target species in heterogeneous environments, and aiding in laborious microscopic methods. Here, several applications to the study of harmful algal bloom (HAB) species will be described. Results from a long term monitoring program in the Chesapeake Bay will be presented. Real-time PCR assays have provided data for HAB species present during fish kills and have revealed temporal and spatial distributions of key species in the region. Studies combining real-time PCR with other methods (cell counting, flow cytometry) will also be described. Finally, real-time PCR data tracking parasite-host interaction throughout infection experiments and during bloom events will be presented. This sampling of studies supports the broad applicability of using real-time PCR to address various research interests.

Bowles, K. M., University of Georgia, Athens, USA, kloftis@uga.edu; EFFECTS OF PHYTOCHEMICAL AND MICROBIAL DEGRADATION ON CHEMICAL AND ISOTOPIC COMPOSITIONS OF LINNIN- DERIVED PHENOLS IN GEORGIA COASTAL MARSH PLANTS.

Our previous studies showed that chemical and isotopic compositions of lignin-derived phenols in marsh plants and surrounding sediments varied temporally and the variation between plants and the sediments were different. However, it is difficult to distinguish effects of multiple-source inputs vs. diagenesis on chemical and isotopic signatures of the biomarkers in the field. This study was designed to investigate effects of phytochemical and microbial degradation on the lignin-derived phenol compositions and their δ13C ratios in Georgia coastal marsh plants. Leaves of Spartina alterniflora (C3) and Juncus roemarianus (C4) were incubated in natural seawater under variable light/dark regimes over one year. Preliminary results indicated: (1) presence of light did not promote degradation of plant TOC and lignin-derived phenols; (2) bulk C/N ratios increased initially and decreased after three weeks; (3) major components (aldehydes, ketones, and acids) degraded...
differentially, leading to variations in molecular indices; (4) molecular δ13C ratios of lignin-derived phenols varied in a larger range (~3-5%) relative to those of bulk plant TOC.  

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ACTIVITY, DIVERSITY, AND RELATIVE ABUNDANCE OF SULFATE REDUCING BACTERIA IN OIL-RICH SEDIMENTS FROM A LOWER CONTINENTAL SLOPE GULF OF MEXICO COLD SEEP

Mississippi Canyon block 118 (MC118) is the site of an on-going, multidisciplinary study of a gas hydrate-rich cold seep. The northern section of MC118 is influenced by advection of gas-charged brine, whereas the southern section is influenced advection of oil and gas (no brine). The two sections are thus ideal for comparing microbial community composition and activity in sediments influenced by varying amounts and types of reduced substrates. Sulfate reducing bacteria (SRB) oxidize numerous hydrocarbons, including methane, higher alkanes and oil. Rates of sulfate reduction were two orders of magnitude higher in the oily sediments of southern MC118 than in the gasy sediments of northern MC118; oily sediments supported the highest sulfate reduction rate reported in cold seep sediments, 26.9 kmol cm-3 day-1. Integrated rates of sulfate reduction in both sections were ~3000 times greater than rates of anaerobic oxidation of methane, suggesting that SRB was fueled by oil and alkanes rather than methane. Microbial diversity of SRB populations was used to evaluate whether distinct microbial communities were present in the two sections.

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SEDIMENT INTERACTIONS CONTROLLING GROWTH OF MODERN MARINE STROMATOLITES HIGHLBORNE CAY, BAHAMAS

At Highborne Cay, the well-laminated and easily accessible stromatolite buildups found along the margins of Exuma Sound, Bahamas, form in the back-reef of a 2.5km algal-ridge complex, accrete sediment more rapidly than the pure prokaryotic mats, and are predominantly dominated by filamental cyanobacteria. The prokaryotic mats are dominated by gliding filamentous cyanobacteria and are found chiefly on the low-lying, shallow stromatolite ridges. The mixed euakaryotic-prokaryotic mat communities, sediment-trapping diatoms overlaying sediment binding filamentous cyanobacteria, accrete sediment more rapidly than the pure prokaryotic mats, and are predominantly observed on the algal-ridge headstromatolites. The migration of sand waves across the stromatolite reef is a major control on the distribution of the microbial communities. These migrating sand waves bury and expose the reef episodically for periods of days, weeks, and months. Microbial growth and resultant stromatolite formation at Highborne Cay are controlled by the variations in the duration of these sedimentation events.

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RELATIVE ROLES OF RECYCLING AND REMINERALIZATION OF UPPER OCEAN BIOMINERALIC PARTICLES FOR IRON BIOGEOCHEMISTRY

Recycling of particles in the surface mixed layer, and their subsequent remineralization in subsurface waters play important roles in the biogeochemical cycling of many elements in the ocean. The former process drives the regeneration of nutrients on short timescales, whereas the latter eventually increases the inventory of new nutrients deeper in the water column. In the case of iron, pelagic recycling by the biota spins the ‘ferrous wheel’, and remineralization at depth leads to iron re-supply to the subsurface ocean. However, the role of processes such as complexation or photochemistry on iron recycling and remineralization is less clear. Here, we present data on the rate of pelagic iron recycling, relative to that for particulate organic carbon, and the impact of remineralization on the re-supply of both iron and iron-binding ligands at depth in polar and subpolar waters south of Australia. A model of upper ocean iron particle transformations is used to explore further the relative roles of recycling and remineralization on iron biogeochemistry.

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EDDIES OVER THE LOMONOSOV’ RIDGE: HORIZONTAL VARIABILITY IN THE THERMOCLINE OF THE CENTRAL ARCTIC OCEAN

Above the Lomonosov Ridge of the central Arctic Ocean is a frontal region between relatively warm, salty Atlantic water flowing cyclonically along the Eurasian side of the ridge and colder, fresher water on the Canadian side. Horizontal variability of this region is examined using CTD data from SCICEX submarine transects that were run across the ridge at fixed depth (214m) in the thermocline. Plots of horizontal density ratio derived from 35 cross-ridge transects run between 83 and 89 degrE on the Asian end of the ridge reveal two modes within the data, at density ratio ~ 1.3 and ~ 0.4. A large, relatively contiguous region of density ratio near 1 (similar to found elsewhere in the mixed layer) is associated with widespread diffusive convective steps above the depth of the Atlantic water core. Eddies of Atlantic water with length scales of 0.15km are found embedded within the high gradient region on the Canadian basin side of the front near 89 degrE. Eddy location appears to be related to underlying ridge bathymetry, suggesting a role for topography in eddy formation.

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VARIABILITY OF IRON IN THE UPPER OCEAN: A BARRIER TO EVALUATING THE ROLE OF Fe IN NITROGEN FIXING BLOOMS

Because nitrogen-fixing organisms require more Fe than other photoplankton, it has been hypothesized that blooms sometimes may be caused by iron from dust deposition events. Although there is evidence consistent with an association of N fixation with higher Fe (e.g. Mills et al., 2004), there are no documented cases where a nitrogen-fixing bloom clearly follows a dust deposition event. Here, I will use Fe data near Bermuda and Hawaii (BTM time-series mooring and shipboard upper water column profiles) to illustrate the problem. For example, in September 2004, a typical late summer Trichodesmium bloom was observed by satellite north of Hawaii. A shipboard cruise to the site showed ~0.2 nmol/kg surface Fe in the bloom. A shallow surface maximum (~0.5 nmol/kg) - and hence clearly a result of atmospheric deposition - was observed near station HOT (west of the bloom). In the blue water to the northeast of the bloom, Fe was ~0.2 nmol/kg. One could construct a story in which the bloom site originally had higher Fe that was removed during the bloom to levels typical of the blue water. But the story could also be that Fe had nothing to do with the bloom, at least not directly. Unless we have time series data preceding and during the bloom, we cannot know which story is correct. The demise of the MOSEAN and BTM biogeochemical moorings makes this impossible for now.

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EVALUATION OF THE MEDITERRANEAN OUTFLOW WATER VARIABILITY IN NORTH ATLANTIC HYCOM SIMULATIONS

Several questions remain unanswered about the role and importance of the Mediterranean Overflow Water (MOW) for the Atlantic Ocean circulation and the global thermohaline circulation. Of particular interest is the temporal variability of the MOW and the mechanism(s) responsible for such variability on interannual and decadal scales. Specifically, we seek to determine the extent to which MOW variability is driven by buoyancy forcing changes within the Mediterranean Sea and/or determined by variability in the properties of the entrained waters. To answer this question, we investigate the variability of the MOW using a 1/3 North Atlantic configuration of the Hybrid Coordinate Ocean Model (HYCOM) forced by NCEP atmospheric forcing. The Mediterranean overflow is parameterized using the Price and Yang (1998) boundary condition, which allows for an accurate representation of the outflow properties. The MOW representation in experiments where the T/S properties are either fixed in the Atlantic and/or the Mediterranean are contrasted to a control experiment where the overflow properties are free to adjust.
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DEVELOPMENT OF ESCAPE AND FREEZE RESPONSES IN JUVENILE COPEPODS

The ontogenetic escape development of escape responses of Eurytemora affinis, an estuarine copepod ubiquitous in Northern Hemisphere coastal waters, was studied with a focus on comparisons of behavior between nauplii and copepodite. Responses to brief hydrodynamic stimuli were recorded with high-speed 3-dimensional video micrographs. The lengths of stages from early nauplii (<.5 h post hatching or p.h.) to adult copepods (7-9 h.p.). Escape jumps and freeze responses were observed in all stages. These were quantified in comparison to normal, non-escape swimming behavior. Behavioral analysis showed a sharpening in sensitivity to stimuli to elicit an escape from early stage nauplii to early copepodite. Tenebrosa in freeze was much higher in deal stages and was observed in all stages at distances similar to non-responses, such as prior swimming patterns and orientation, in the animal’s discrimination between freezing and non-response. The retention of this freezing behavior over the life of the copepod implies some evolutionary benefit in predator avoidance.

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WHICH FACTORS SHAPE BACTERIAL COMMUNITY STRUCTURE IN COASTAL PERMEABLE SEDIMENTS? Bacteria play important roles in the biogeochemistry of coastal sediments. However, factors governing benthic bacterial community composition are scarcely studied. We used automated rRNA intergenic spacer analysis (ARISA) to investigate seasonal and depth-related variability of the whole bacterial community structure on a shallow subtidal flat in the German Wadden Sea. The relationships between bacterial community data and associated sediment parameters were analyzed by redundancy analysis. ARISA community data revealed significant assemblage variations along sediment depth and over the entire sampling period. Sediment at 10-15 cm depth exhibited higher species richness than sediment at 0.5 cm or 5-10 cm depth. Time, depth, chlorophyll a, NO3, wind speed, P. glaucosidase activity and bacterial abundance accounted for 85.5% of the total variation in bacterial community structure. Partitioning of the biological variation revealed strong covariation of the factors depth, P. glaucosidase activity and sediment chemistry (NO3 and chlorophyll a). Also, a considerable part of the seasonal variation could be attributed to changes in total carbohydrate concentrations. Hence, sediment mixing and labile organic matter availability were the major drivers of bacterial diversity in this study.

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THE OPTICAL PROPERTIES OF CDOM IN THE MEDITERRANEAN BASIN: EXPLORING THE ROLE OF PHYSICAL AND BIOLOGICAL FORCING. Chromophoric Dissolved Organic Matter (CDOM) regulates the radiative transfer of solar radiation in the water column and is the natural substrate for microbial communities. Data related to the ultraviolet absorption of dissolved organic matter were acquired in the Mediterranean basin. CDOM absorption (10 cm quartz cuvette) was modelled by a bi-aliquot analysis of absorption spectra. Higher spectral slope values were observed in the Mediterranean basin. CDOM absorption (10 cm quartz cuvette) was modelled by a bi-aliquot analysis of absorption spectra. Higher spectral slope values were observed in incoming freshwater. An empirical regression equation, using the percent cover of four different land cover types (coniferous forest, turf, agriculture and developed land), predicts 45 percent of the observed variability in freshwater CDOM concentration in these estuaries. This is nearly the same fraction attributed to cross-site variability. CDOM concentrations were linearly correlated with salinity in the shallow estuaries studied here, but the slopes were not constant over time in any of the estuaries examined. This makes salinity a poor proxy for CDOM over times scales of days or longer. Freshwater CDOM concentrations entering estuaries were highly variable, both among sites and over time within one site, while the seaward end members had fairly uniform CDOM concentrations. Although incoming CDOM concentration is highly variable over time, it is not well predicted by freshwater inflow and no seasonal pattern is apparent.

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VERTICAL MASS EXCHANGE ACROSS SUBMERGED AQUATIC VEGETATION CANOPIES USING A NEW EDDY CORRELATION METHOD Hydrodynamics exert an important control on vertical nutrient and oxygen exchanges across submerged aquatic vegetation canopies. Field studies that quantify and parameterize the exchange dynamics are lacking because simultaneous measurements of the controlling physical variables and the mass fluxes are difficult to acquire. Eddy correlation methods are used extensively in the terrestrial science community to model the vertical exchange of heat, water vapor and CO2 fluxes across plant canopies. Here we present an eddy correlation method for measuring vertical mass transport across submerged canopies using injected Rhodamine dye as a tracer. High frequency measurements of the dye concentrations entering and exiting the canopy were obtained with a fiberoptic spectrometer with the probe mounted adjacent to the control volume of an Acoustic Doppler Velocimeter. We describe the method and its validation in flume experiments, method limitations and field applications.

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NATURAL FLUCTUATIONS IN COASTAL HYPOXIA: RELATIONSHIPS BETWEEN LARGE-SCALE CLIMATE DRIVERS AND OXYGEN LEVELS RECORDED IN SEDIMENT CORES FROM PUGET SOUND Coastal estuarine systems are often limited to increasing anthropogenic nutrient loading. While this cause-effect relationship holds true for many coastal regions, the Pacific Northwest also receives nutrient-rich waters from coastal upwelling. The relationship between large-scale hydrographic cycle, such as the Pacific Decadal Oscillation (PDO), and the historical record of hypoxia for circa 400 years were evaluated. Paleoclimatological tracers used to reconstruct the record included identification of diatom and foraminifera fossils, pollen, stable isotopes of carbon and nitrogen, biomarkers for terrestrial/marine carbon, and metals that are enriched in sediment during periods of low/no oxygen. Sediment core profiles indicate periods of hypoxia are recorded in the sediment as early as the 1700s. The record...
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COMPOSITION OF NEAR-SURFACE PARTICULATE MATTER IN THE NORTH SEA EXAMINED BY NANOSCALE X-RAY SPECTROMICROSCOPY
Coastal regions receive an ever-increasing input of nutrients and anthropogenically-derived organic matter as human populations have expanded along coastal regions. There is considerable evidence that inputs of plastics, combustion-derived organic materials and other contaminants have significant impacts upon coastal ecosystems. How these inputs interact with the carbon cycle, especially in regards to fate(s) of particulate organic matter, remain obscure. We examined suspended organic matter collected from a coast to open ocean transect in the North Sea to examine the influence of Anthropogenic inputs on the composition of this carbon pool. Soft-X-ray Spectromicroscopy, a technique which allows for the identification and quantification of all carbon types within samples at 50 nm resolutions, was employed to examine these samples. The results indicate that, in addition to expected contributions of marine organisms and their remains, significant amounts of micron-sized soot and plastics are found in surface organic particulates. Suchrecalcitrant phases are unlikely to be quantified by laboratory techniques commonly used by organic geochemists. Overall compositional patterns indicate that these non-biogenic organic matter phases can travel significant distances from coastal sources.

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COMBINING OCEAN COLOUR SATELLITE OBSERVATIONS WITH COASTAL OCEAN BIOGEOCHEMICAL MODELS IN THE TROPICAL FITZROY RIVER ESTUARY
In the tropical Fitzroy Estuary and Keppel Bay system (FEKB) contingent to the Great Barrier Reef lagoon, we tested how to combine ocean colour datasets with coastal ocean biogeochemical models. As the global algorithms failed for the FEKB system, a new generation of regional specific algorithm was developed for large satellite datasets of the MODIS sensor. Concurrently, a biogeochemical model was developed for the system, built upon a three-dimensional hydrodynamic and sediment dynamic model, and simulating nitrogen and phosphorus dynamics including the dynamics of dissolved organic material as well as pelagic and benthic primary production. Several methodologies for linking of remote sensing observations to model variables were evaluated over a period of one year (2004). After an initial comparison of the model output with satellite datasets using the region-specific algorithm, the effects on simulated concentrations of TSS and CHL of forcing boundary conditions using satellite data was evaluated. The satellite observations were also used to supplement in situ data to improve calibration and parameterisation of the sediment model. Combining remotely sensed observational data into biogeochemical and sediment transport models improved both the models and our ability to interpret the practical significance of the satellite data. Future work will include the direct assimilation of observational data, where available, across the model domain

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IMPROVING THE PARAMETERIZATION OF ERRORS STATISTICS FOR DATA ASSIMILATION IN A HYCOM BAY OF BISCAY REGIONAL CONFIGURATION
The SEEK filter (Brassée and Verron, 2006) filter is a sequential method used to assimilate observations into circulation models such as HYCOM. This study focuses on the parameterization of error statistics, usually estimated under assumptions that appear too irrelevant to ocean dynamics. The SEEK has been adapted to a HYCOM model of the Bay of Biscay, nested in a North Atlantic configuration (Broquet et al., 2007). An ensemble method is proposed to provide realistic model error statistics, considering that the imperfect determination of surface fluxes and open boundary conditions are the main error sources. Model error statistics, observability and controllability are characterized using representers, revealing the complex, inhomogeneous and anisotropic response to perturbations in the forcings. In addition, the SEEK filter is modified to incorporate inequality constraints during the assimilation process, assuming that the errors are distributed as truncated Gaussians. This new feature is shown suitable to maintain positiveness of model variables such as layer thickness. Data assimilation experiments with the SEEK filter using these new parameterizations show decisive statistical and physical improvements when compared to more classical schemes.


STEEL AGE AND SALINITY GRADIENTS IN SUBMARINE GROUNDWATER MEASURED IN A SMALL CHESAPEAKE BAY TRIBUTARY
Submarine groundwater discharge (SGD) into Maryland’s Chesica River estuary was investigated as part of a larger study to determine the importance of nutrient delivery to Chesapeake Bay via this pathway. Experiments performed included continuous resistivity profiling (CRP), piezometer sampling, seapage meter measurements, and collection of a radon tracer time series. Results from a detailed study site show a shallow plume of terrestrial groundwater (salinity <15) located within 2 m of the estuary floor and extending >17 m offshore, which is overlain by a thin and variable brackish zone. Deeper low-salin- ity groundwater extends >200 m offshore based on CRP data. Groundwater and surface water were sampled for analysis of nutrients, stable and radioactive isotopes, age tracers, and microbes. Tritium data indicate that young groundwater discharges near shore, but that the age of groundwater increases with depth and distance offshore. Discharge rates were highly variable and strongly influenced by astronomical and wind-driven tides. Better understanding of the distributions of age and chemical composition in groundwater discharge areas such as this could lead to improved models and mitigation strategies for estuarine nutrient over-enrichment.

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TRAPPING BOPYRID ISOPOD CRYPTONISCONS FOR TAXONOMY
The northeast Pacific bopyrid isopod crustaceans Ione cornuta Bate, 1864 and Orthione griffenis Markham, 1904 parasite, castrate and sometimes control the populations of their estuarine shrimp hosts. The epicaridian, microniscan and cryptoniscan larval stages have not been described for any eastern Pacific bopyrid because large morphological differences between bopyrid larval stages and the reproductive stage preclude taxonomy by simple, direct comparisons. The inability to distinguish species of bopyrid isopod larvae has precluded most research on their ecology, geography and dispersal. Unidentified reproductive I. cornuta and O. griffenis females transplanted in their hosts, in-situ, were used to attract and, positively identify the cryptoniscans. The trapping method for resolving cryptoniscan taxonomy opens bopyrid larvae for study in marine and estuary ecosystems.
forcing and processing of materials. Eastern Bay acts like a 'conventional' estuary with a Bay. These spatially contiguous groups of stations are the result of similar hydrodynamic
South Florida coastal ecosystems since 1991. Waters have been statistically subdivided into
values were in good agreement with these in situ  data. Regression analyses revealed RMS
Atmosphere Ocean (TAO) buoys. Within the context of a two-layer fluid, satellite-derived
Intensity Prediction Scheme for predicting hurricane intensity.  The approach follows
EASTERN PACIFIC OCEAN HEAT CONTENT ESTIMATES FROM ALTIMETRY
Mainelli, M.
Brewster, J.

VERTICAL MIGRATORY BEHAVIOUR OF DECAPOD LARVAE IN A PARTIALLY-MIXED ESTUARY: FIELD AND EXPERIMENTAL STUDIES
Vertical migratory behaviour may result in both predator avoidance and horizontal trans
We predicted that if migration was a response to both predation and dispersal press,
water column (e.g., thin layers) could alter the vertical extent of a migration. In the labora
californiensis, was most abundant during nighttime ebb tides.  Abundance, however, was
port. We predicted that if migration was a response to both predation and dispersal pres
Vertical migratory behaviour may result in both predator avoidance and horizontal trans
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port. We predicted that if migration was a response to both predation and dispersal pres
Vertical migratory behaviour may result in both predator avoidance and horizontal trans
We predicted that if migration was a response to both predation and dispersal press,
coefficient and Earth’s rotation are also important.

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FINE- TO BASIN-SCALE DISTRIBUTIONS OF CALANUS FINNMACRICUS AND ITS PREDATORS IN WILKINSON BASIN, GULF OF MEXICO DURING DECEMBER 1998 AND 1999 FROM VPR DATA

The calanoid copepod Calanus finnmacrincus diapauses in the deep basins of the Gulf of Mexico during late-summer through early-winter. During diapause, predators that co-occur in regions of high copepod abundance may reduce survivorship through predation. Consequently it is important to measure the distribution patterns of C. finnmacrincus and its predators. Two cruises were carried out during the winters of 1998 and 1999 in the Gulf of Mexico. Video Plankton Recorder (VPR) data collected in Wilkinson Basin were used to describe the fine- to basin-scale distribution patterns of C. finnmacrincus and its predators. The locations of individual zooplankton were mapped by towing a VPR, mounted on the towed-body BIOMAPER-II, across the basin. Volumetric distribution patterns were estimated by interpolated abundance data using 3D kriging. The abundance of Calanus was lower in 1998 than in 1999 and this difference is discussed in terms of the spatial distributions and abundances of ctenophores, echinoderms, and crustacean predators.

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DO NORTH ATLANTIC RIGHT WHALES COMPENSATE FOR INCREASES IN SHORT TERM AMBIENT NOISE?

Low frequency anthropogenic noise contributes to habitat degradation of the critically endangered North Atlantic right whale (Eubalaena glacialis) by masking acoustic vocalizations. Studies in other mammals have described various compensating mechanisms that allay these affects, including the Lombard effect and frequency shifts. We investigated whether the Lombard effect, an increase in vocalization intensity, and frequency shifts, where signal frequency changes to minimize spectral overlap with background noise, were present in the vocals of two North Atlantic right whale. To test for the Lombard effect, we investigated the relationship between apparent call source levels and ambient noise levels - derived from one second clips before each call. We did not find a statistically significant correlation. To test for frequency shifts, we compared the 1/3 octave bands of calls made at low, moderate, and high ambient noise levels over a range of 15 dB re 1 µ-Pa2/Hz. We found a significant amount of energy in the harmonics of the upcall, regardless of ambient noise level. Our analysis did not statistically support the presence of the Lombard effect or frequency shift as short-term compensation mechanisms, heightening the sensitivity of this species and the need to mitigate anthropogenic impacts.

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INFLUENCES OF THE ORINOCO RIVER PLUME IN THE BALANCE BETWEEN PLANKTON PHOTOSYNTHESIS AND RESPIRATION IN THE CARIBBEAN SEA

Planktonic production, respiration and ETS were measured along the Orinoco River Plume dispersal axis (10.3°N-17.6°N) during fall, its maximum outflow season. Planktonic primary production, respiration and ETS were measured along the Orinoco River Plume dispersal axis (10.3°N-17.6°N) during fall, its maximum outflow season.

Feeding occurs through much of the temperate waters of the North Pacific and undergoes zonal feeding migrations across the entire basin. Oceanic habitat accuracies and timing of immigration and emigration into the Eastern North Pacific have not been studied. We used albacore logbook CPEU data for 1999 through 2004 stratified by month, latitude, and longitude (33,662 records) along with satellite-derived environmental variables (Reynolds SST, SeaWIFS SSChl, AVISO SSH, and ERS-1 and QuikSCAT-derived wind stress curl). CPEU was mapped for the main fishing season (May–October) overlaid on environmental maps, and environmental records were extracted for each catch location where fishing occurred using both positive and zero sets. The optimum range (mean and variance) of each variable was estimated based on catch and CPEU was related to all environmental variables using GAM modeling by month. We plotted binary prediction map of distributional range of this species based on optimal habitat for each month and year. Catch varied significantly between years and all four environmental factors were related to the distribution of albacore in this region.

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PERSISTENT BEACH MEGACUSPS CONTROLLED BY HYDRODYNAMIC FEEDBACKS AROUND NEARSHORE BATHYMETRY: KITTY HAWK, NC

Understanding spatial variations in alongshore beach and nearshore morphology, such as the formation and disappearance of megacusps and shore-oblique bars, may contribute to our ability to predict anomalous shoreline change rates associated with erosional hotspots. Numerical “forced” models, driven by standing edge waves, and “free” models, driven by atmospheric forcing from random waves, however, are unable to predict 3-D alongshore variations in post-storm bar and beach evolution. Bar and Swash Imaging Radar (BASIR), a mobile x-band radar system, was used to investigate the development and evolution of megacusps in Kitty Hawk, NC. The megacusps were found to be relatively stable through varying energy conditions, and their location correlated with bathymetric features of a nearshore shore-oblique bar field. In addition, wave run-up in the swash zone and wave parameters in the nearshore were investigated to identify the spatial variations in hydrodynamics induced by the shore-oblique bar field. We suggest that the location of these megacusps in Kitty Hawk, NC is neither random nor forced, but is instead controlled by small-scale hydrodynamic alternations created by the shore-oblique bar field.

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OBSERVATIONS OF THE INTERNAL TIDE ENTERING MONTEREY CANYON

Internal tides in Monterey Submarine Canyon have been shown to propagate up-canyon from an energy source in deeper waters, but this source has remained somewhat of a mystery. Recent numerical simulations of the Monterey Bay and the nearby shelf and slope (including the canyon) suggest an internal tide source some 40 km to the south at a submarine ridge off Point Sur. We report on a 2006 field survey during the ONR AESOP experiment using a combination of ship-launched, free-falling and expendable measurements of velocity and temperature between this ridge and the canyon, focusing on the plateau midway between the two. Semi-diurnal tidal analysis reveals a northward internal wave energy flow toward the canyon dominated by the first baroclinic mode but also containing complex vertical and horizontal structure. Comparisons with tide-resolving models and ray-tracing calculations are used to investigate this structure.

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EXPLORE THE FUTURE OF U.S. OCEAN TIME SERIES

A key issue in oceanography is distinguishing between short-term seasonal or annual variations and longer-term changes in response to natural or anthropogenic forcings. To quantify the temporal variability in the ocean basins, the United States established a number of ocean time series (TS) sites. The Scientific Steering Committee of the Ocean Carbon and Biogeochemistry Program has formed a subcommittee to review three TS sites - Hawaii Ocean Time-Series (HOT), Bermuda Atlantic Time Series (BATS) and Carbon Retention In A Colored Ocean (CARIACO, in collaboration with Venezuela). The subcommittee was charged to assess the importance of TS and to facilitate communication and consistency between the three TS sites under review. Most importantly we must determine the future needs of the oceanographic community for TS observations. Do we need additional measurements at existing sites? How should new technologies be incorporated in the TS program (e.g. gliders and moorings)? Do we need additional TS sites? If yes, where should they be and how will we pay for them?
Invasive species often compete with native species for resources e.g. space, and can alter community structure. Temperature effects on the distribution of marine invasive species are often unknown yet are critical to determine their spread. We used heat rates of four colonial ascidians to associate species (Botryllus schlosseri, Didemnum sp., Botryoides violaceus, and Diplosoma liestoni) as a proxy for health and growth. Heat rates and growth rates correlated with increasing temperature for Botryllus schlosseri, Botryoides violaceus, and Diplosoma liestoni, but not Didemnum sp. Heat rate was determined to be a good indicator for health for all species, and was also a good indicator for growth within a species, but not between species. For example, Botryllus schlosseri had a higher Botryllus schlosseri, but slower growth than Botryoides violaceus. The goal of this study was to determine if increasing temperatures could facilitate the spread of invasive colonial ascidians into colder waters.

The oceanic response to the large riverine flux was examined using SeaWiFS ocean color data of river discharge. The irritation might be due to abrasion or a reaction to bottom sediments present in much of the St. Lucie estuary. Controls revealed abnormalities in gill structures suggestive of irritation from sediments. Analysis of tissues of selected abnormal fish and outwardly normal fish selected as “controls” revealed abnormalities in gill structures suggestive of irritation from sediments. The experiments, which resolves continental slopes, indicate that i) the inflow and outflow are separated in space and do not affect each other to any large degree, ii) the inflow of warm Atlantic water decreases with increasing freshwater forcing but remains, nevertheless, powerful even for very strong freshwater forcing, iii) inflow and outflow of water takes place more or less at same depth level.

The PREVALENCE OF ABNORMAL FISH AS AN INDICATOR OF ENVIRONMENTAL QUALITY

A 9-yr survey of fish in the St. Lucie Estuary system, Florida, and nearby estuarine systems indicated that the prevalence of fish with abnormalities varied by species, system, and part of the system. Prevalence was greater in the St. Lucie compared to the reference systems and greater in the estuaries compared to the inlets. Abnormality prevalence varied over time, reaching an all-time peak in the double-strike hurricane year, 2004, and declining subsequently to the lowest rate observed in the first half of 2007 during a drought. Data summarized by a 3-month period, the prevalence of abnormal fish was negatively related to salinity and negatively related to visibility. Microscopic analysis of tissues of selected abnormal fish and outwardly normal fish selected as “controls” revealed abnormalities in gill structures suggestive of irritation from sediments. These gill abnormalities were present in more than half of the fish examined. Haddock bottom trawls present in much of the St. Lucie estuary are easily resuspended by freshwater discharges and storms. The irritation might be due to abrasion or a reaction to sediment-associated contaminants.

SURPRISING RESULTS OF CDOM PHOTOOXIDATION IN THE BERING SEA: IMPLICATIONS FOR FOOD WEBS

Chromophoric dissolved organic matter (CDOM) absorbs biologically damaging UV radiation in aquatic systems and can provide organic carbon to the microbial community. In past studies, sunlight exposure decreased CDOM absorption of UV independent of source suggesting that sunlight destroys the double bonds in humic substances. On a Bering Sea cruise during the spring bloom (May 2007), we exposed temperature-controlled, water samples to sunlight while monitoring the UV-B dose ( Integrating the effect of the spring bloom, because of diminished ice, will likely alter the pelagic and benthic components of the food web in the Bering Sea.

The emergence of the Arctic Mediterranean, which has dual buoyancy forcing of the basin. The Arctic Mediterranean, which has dual buoyancy forcing, with gently sloping side walls and strong dual buoyancy forcing forms the basis of the study. The experiments, which resolves continental slopes, indicate that i) the inflow and outflow are separated in space and do not affect each other to any large degree, ii) the inflow of warm Atlantic water decreases with increasing freshwater forcing but remains, nevertheless, powerful even for very strong freshwater forcing, iii) inflow and outflow of water takes place more or less at same depth level.

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INTERPRETATION AND APPLICATIONS OF SECOND ORDER VARIABILITY IN SATELLITE OCEAN COLOR: THE ROLE OF NON-ALGAL MATTER AND BACKSCATTERING

Empirical algorithms, based on first order relationships between ocean color and chlorophyll concentration ([Chl]; mg m⁻³), are widely used, but do not explain the statistical dispersion (referred to here as anomalies) around the mean trends. We use an empirical approach that removes the first order effect of [Chl] from satellite ocean color imagery, allowing us to observe the influence of other optical constituents and their distributions, which may vary independently of [Chl]. We then present statistical and modeling analyses to interpret the observed anomalies in terms of their optical sources (i.e. absorption and backscattering). With this information, we can examine the global distribution of anomalies in non-algal colored matter, particularly colored dissolved organic matter, and backscattering by particles, which displays significant regional and seasonal trends. We also estimate the backscattering coefficient of particles, and compare our results with other published studies. Potential applications of our results include independent comparisons with inverse models of ocean color and simple corrections for empirical [Chl] algorithms.

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BAY OF BENGAL - SEASONAL BIO-OPTICAL PROPERTIES AND THE INFLUENCE OF RIVER DISCHARGE

The oceanic response to the large riverine flux was examined using SeaWiFS ocean color imagery. A 2-year time series of bio-optical properties such as chlorophyll concentration, absorption by colored dissolved organic material, and backscatter from river sediments tracked the zone of river influence. Given the predominance of the Ganges-Brahmaputra River, we expected to see its influence spread far into the central Bay. Instead, we found that high, positive correlations of these properties with river discharge were limited to the

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The oceans are the dominant source of atmospheric methyl iodide (CH$_3$I), however mechanisms responsible for its production are poorly understood. Experiments were conducted in the laboratory to determine whether Prochlorococcus marinus is a significant global producer of CH$_3$I. CH$_3$I production was measured over time (approximately 30 days) in sealed culture vessels containing P. marinus using purge and trap methods in combination with gas chromatography mass spectrometry (GC/MS). During lag phase, high light adapted P. marinus species (CCMP1986) produced 1.8 x 10$^{-11}$ pmol CH$_3$I cell$^{-1}$ day$^{-1}$, while low light adapted P. marinus (CCMP1427) produced 3.2 x 10$^{-11}$ pmol CH$_3$I cell$^{-1}$ day$^{-1}$, with the lowest CH$_3$I production measured during log phase. The results of this study indicate that Prochlorococcus marinus is a significant global producer of CH$_3$I in the ocean and should be considered in models of CH$_3$I production and atmospheric concentrations.
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MAPPING OF HYPOXIC ZONE IN THE MISSISSIPPI RIVER IN THE SUMMER OF 2006 Based upon detection of near-hypoxic waters in early August 2006, two cruises were conducted mid-August to sample a grid of 22 sites south of the Mississippi barrier islands. The prime objectives were to map the extent of the hypoxic region along with the physical environment (temperature, salinity, and currents), Profiles of dissolved oxygen, temperature, pressure, conductivity, turbidity, and currents were measured at each station. Oxygen was measured using YSI 6300 and Sea-Bird SBE 43 probes. Salinity and dissolved oxygen concentrations were measured with a YSI 6820. Bottom-water hypoxia was detected by hydrocasts at seven stations, extending seaward to ~20 m water depth near artificial fishing reef FH2 and extending along the 10-m isobath from Ship Island to Petit Bois Pass. Winkler analyses confirmed hypoxia at four of these stations, with the other three having values ~2.8 mg/L. Eleven stations had values ~3.0 mg/L. The water column was highly stratified throughout the region in some cases with several pronounced pycnoclines consistent with isolation of bottom waters from the oxygenated surface waters.

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OCEAN LITERACY ALLIANCE - HAWAII: ESTABLISHING A FRAMEWORK FOR COLLABORATION

The ocean environment is central to many science, technology, engineering, and mathematics (STEM) education initiatives in Hawaii. To ensure the greatest possible success for these activities and to minimize duplication of efforts, we must create new avenues for collaboration among key stakeholders, including scientists, educators, and government-organized programs. Toward this end, we recently founded the Ocean Literacy Alliance - Hawaii. Sponsors include the federal Interagency Working Group for Ocean Education (IWG-OE), National Science Foundation, National Oceanographic and Atmospheric Administration (NOAA), and numerous partners from the University of Hawaii. Our overarching goal is to establish a framework for collaboration in ocean science education in Hawaii. At the inaugural workshop (November 2007), participants review ongoing efforts, strengthen existing collaborations, and develop strategies to build new partnerships. A key outcome will be a resource guide for ocean science education in Hawaii, which we offer as a national model.

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COMBINING FLOW CYTOMETRY AND REAL-TIME PCR TO DEMONSTRATE PHAGOTROPHY IN THE TOXIC HAPTOPHYTE PRYMNESIUM PARVUM Studies with phagotrophic organisms are limited by a series of methodological constraints. To overcome problems related to the detection and enumeration of prey fed upon by mixotrophic and heterotrophic organisms, we combined flow cytometry with the sensitivity and specificity of a real-time PCR assay. Flow cytometry was used to detect and score feeding Prymnesium parvum cells based on the fluorescence of the prey (Rhodomonas sp.) as well as for detection of food vacuoles labelled with a pH dependent acidotropic dye, Rhodamine 123. In addition, flow cytometry was used to separate and sort Prymnesium parvum cells from Rhodomonas sp. cells. The sorted cells were collected for DNA extraction and a TaqMan real-time PCR assay: The Ct (cycle threshold) values of Rhodomonas sp. signal from the sorted Prymnesium parvum cells decreased over time, corresponding with the decrease in the ingestion rates calculated based on the flow cytometry results, suggesting that flow cytometry and real-time PCR is a powerful and fast method to confirm phagotrophy among mixotrophic algae.

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THE GLOBAL OCEAN TRANSIT TIME DISTRIBUTION COMPUTED WITH AN EDDY RICH GENERAL CIRCULATION MODEL Transit time distributions (TTDs), or age spectra, provide a powerful conceptual framework for evaluating and interpreting the advective-diffusive transport properties of geophysical flows. Most calculations and practical applications of TTDs to date have considered only the case of steady circulations with parameterized turbulent mixing. We are computing the global ocean TTD for the unsteady, but statistically stationary, flow using an ensemble of impulse boundary propagators in an eddy-rich general circulation model. In this presentation we provide an overview of the structure of the computed TTD, consider the convergence properties of the TTD as a function of ensemble size and time-space coarsening, and consider the utility of TTDs as a metric for testing eddy mixing parameterizations in coarse resolution models.

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AN OPERATIONAL ARRAY FOR MONITORING THE ATLANTIC MERIDIONAL OVERTURNING CIRCULATION AT 26Â°N The first objective of the RAPID programme is to establish a pre-operational prototype system to continuously observe the strength and structure of the Atlantic meridional overturning circulation (MOC). Observing the Atlantic MOC is the fundamental observational requirement of a programme of research into the Atlantic thermohaline circulation (THC) in climate. The Rapid-MOC array measures: 1. Gulf Stream transport through Florida Strait by cable and repeat direct velocity measurements; 2. Ekman transport by satellite scatterometer; 3. deep western boundary currents by direct velocity measurements; 4. basin-wide interior baroclinic circulation from moorings measuring vertical profiles of density at the boundaries and on either side of the Mid-Atlantic Ridge; and 5. barotropic (reference level) fluctuations using bottom pressure recorders. The system first became operational in late March 2004 and is expected to continue until at least 2014. We show that the zonally integrated meridional flow tends to conserve mass, with the fluctuations of the different transport components largely compensating at periods longer than 10 days. We take this as experimental confirmation that the Rapid array is measuring the MOC.

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IRON AND SILICON CO-LIMITATION IN THE EQUATORIAL PACIFIC The roles of Si and Fe as limiting nutrients in the equatorial Pacific were investigated in December 2004 and September 2005 between 100Â°W and 140Â°W longitude. The results of nine mesocosm experiments showed that additions of silicon augmented diatom production and cell division. However, in the Fe-enriched cultures Si uptake was limited, which suggests that the addition of Si to iron-limited cultures may have a stronger effect on phytoplankton growth than addition of Fe. Baines et al. (2007) also found that iron and silicon co-limit growth in some regions of the equatorial Pacific. We conclude that iron and silicon co-limit growth in the equatorial Pacific.

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OPERATIONAL OCEAN MODELING AT THE NAVAL OCEANOGRAPHIC OFFICE The Naval Oceanographic Office (NOAVECOANO) provides the Navy with a suite of operational circulation and wave forecast products ranging from the global ocean through the coastal regions to the surf zone. These models forecast ocean properties in 3 dimensions over 27 hours, and all products are updated daily. A number of observation data sources, including sea surface temperature and alitimetry; fixed and floating buoys; aircraft, autonomous profiling systems; and a rowing fleet of gliders, provide real-time data for model assimilation and assessment. NOAVECOANO models rely on atmospheric forcing from Fleet Numerical Meteorology and Oceanography Center (FNMOC). They run on high-performance mainframe computers managed by the DoD’s High Performance Computing Management Office. We will discuss how NOAVECOANO receives, formats, quality controls, archives, and delivers these data; the infrastructure at NOAVECOANO to moves data and products; the resources required; and some of our products. Our tasks extend beyond
Aerosol iron solubility continues to be the subject of intense research because of its importance to the biogeochemical cycling of iron. There have been a variety of analytical methods employed to measure iron solubility producing a wide range of results while evidence of an overarching factor governing iron solubility remains elusive. The goal of this research is to determine what relationship exists between particle size and aerosol iron solubility. The samples described here were collected during summer 2003 over the North Atlantic. Also reported are samples collected from the North Pacific Ocean during summer 2004 and spring 2006. A Multi-Orifice Uniform Deposition Impactor (MOUDI) was deployed during these cruises to collect size-fractionated aerosol samples using a low-volume sampling system. The samples were leached with ultrapure water and the leach solution analyzed by high-resolution ICP-MS to determine the soluble iron fraction. The filters were subsequently analyzed by energy dispersive x-ray fluorescence to measure the insoluble iron fraction. In general, most of the soluble aerosol iron is found on particles between 1 and 3 microns in diameter. Samples collected from within the Saharan Dust Plume do not show any clear increase in the fractional solubility of iron with decreasing particle size. This work will also report the fractional solubility of iron for samples collected in other regions of the North Atlantic, as well as from the North Pacific.

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THE BIOGEOCHEMISTRY OF IRON AND COPPER IN ANTARCTIC PENINSULA SHELF AND ANTARCTIC CIRCUMPOLAR CURRENT WATERS IN THE SOUTHERN DRAKE PASSAGE

Samples for dissolved and leachable particulate iron and copper concentrations, as well as for iron and copper speciation, were collected in austral winter 2006 from the southern Drake Passage. These sites were chosen as they document an intensive exchange of watermasses out into low iron Antarctic Circumpolar Current (ACC) waters. Complementary incubation experiments were employed to investigate sources, bioavailability, and photoactivity of strong iron-organic complexes using 57Fe as a stable isotope tracer with added strong organic ligands. The physico-chemical speciation of dissolved iron and copper in all samples and through the entire iron and copper system was examined using competitive ligand and adsorptive cathodic stripping voltammetry (CLE-ACSV) with the added ligand salicylaldehyde. Dissolved and leachable particulate metal concentrations were measured using high-resolution inductively coupled plasma mass spectrometry (HR-ICP-MS) techniques.

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VERTICAL STRUCTURE OF MASS AND TURBULENCE IN SEDIMENT-LADEN CHANNEL FLOWS

Suspension-laden flows affected by buoyancy stratification occur in rivers, lakes, and coastal regions during episodic floods, storm surges, and spring tides. We report new observations of the vertical structure of sediment mass and fluid momentum in laboratory channel flows transporting high-density suspensions, and which are thus subjected to buoyancy stratification. Thus far, we have conducted three series of experiments at flow speeds of up to 1.0 m/s in a paddle-driven, open-channel flume: 1) clear-water flows, 2) under-capacity flows with average concentrations of up to 35 g/l of 37-micron silicon carbide, and 3) capacity flows with average concentrations of up to 56 g/l of 75-micron silicon carbide and 52 g/l of 37-micron silicon carbide. Results of our experiments indicate that sediment-laden flows, at undercapacity and thus not significantly affected by bedforms, have a higher velocity, a reduced Reynolds stress, and a reduced vertical velocity fluctuation (w') than clear-water flows at the same nominal paddle speed. These results are consistent with existing notions that high-density sediment suspensions reduce bed friction and suppress vertical turbulent mixing in transporting channel flows.
The portraits of oceanic transport patterns in the Indo-Pacific have been a subject of considerable interest. The zonal (IODZM) and meridional (ENSO) variations have been the focus of much research. In this study, we aim to better understand the internal wave generation mechanisms, local beam overturning, and far field low vertical modes in the Luzon strait. For this purpose, experiments conducted in a laboratory are compared with solutions of the non-hydrostatic version of the Regional Ocean Modeling System (ROMS). In the laboratory experiment a Gaussian mount, representing Lam Yu ridge in the Luzon strait, is oscillated horizontally in a stratified water body. In the ROMS experiment a Gaussian mount is also used, however with real-world dimensions. To facilitate a better comparison between the experiments, non-dimensional parameters such as the excitation parameter, slope parameter, and Froude number are equalized. The experiments are conducted for single and multiple forcing frequencies, various tidal amplitudes, different stratification, and varying bathymetries. Preliminary results indicate a relatively good agreement between the experiments in the locations of the internal wave beams and the phases of the velocities along the beams.

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ESTIMATING DECadal CHANGES IN ANTHropogenic CARBON in the INDIAN OCEAN using FCFS and SULFUR HEXAFLUORIDE

As part of the CLIVAR Global Repeat Hydrography Program, a meridional hydrographic section was occupied in the Indian Ocean in 2007, nominally along 85-95oS from 65oS to 26oN. The 2007 section repeated a section occupied in 1995 as part of WOCE. In addition to the suite of WOCE physical and chemical measurements made on both occupations, measurements of dissolved sulfur hexafluoride (SF6) were made coincident with the Chloufrosorubins (CFCs) on the 2007 section. The tracers provide information on the rates and pathways of ventilation in this region, and changes in surface forcing (e.g. anthropogenic carbon dioxide, temperature, salinity) can propagate into the interior of the ocean on decadal time scales along this section. The use of two complementary tracer transients provides information on the impacts of mixing on tracer-derived ages, and on changes in tracer ages. Significant changes in CFC concentrations, CFC-derived ages, and dissolved inorganic carbon (DIC) concentrations were observed between 1995 and 2007 along the section. We used the SF6 measurements and a simple modeling approach to estimate the impacts of mixing on observed tracer-derived water mass ages and changes along the section. The combined CFC and SF6 data also were also used to constrain the transit time distributions (TTDs) and uptake of anthropogenic CO2 in the waters of this region.

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INTERNATIONAL VARIABILITY OF SEA SURFACE SALINITY from ARGO PROFILES and HYCOM SIMULATIONS in the TROPICAL INDIAN OCEAN

The Argo salinity profiles and the 1/12° global Hybrid Coordinate Ocean Model (HYCOM) simulations during January 2002 - February 2007 are analyzed to understand the interannual variability of Sea Surface Salinity (SSS) in the tropical Indian Ocean. We have selected 2 boxes located in the eastern equatorial Indian Ocean (EIO: 5 S-5 N, 90 -95 E) and Southeastern Arabian Sea (SEAS: 5 -9 N, 72 -76 E). The HYCOM SSS at the Argo float's location compared well with Argo SSS in each box. HYCOM SSS lies within the range of Argo SSS in all the years, except in 2006 when the positive Indian Ocean Dipole/Zonal Mode (IODZM) event developed off Sumatra. In the EIO box, Argo SSS dropped sharply from April to December 2006 giving rise to peak interannual Sea Surface Salinity Anomaly (SSA) of -4.9 in December 2006. This anomalous SSA is related to the advection of low salinity waters from the eastern Bay of Bengal into the EIO due to the anomalous surface circulation during IODZM 2006. In the SEAS box, more freshening (negative SSA) is noticed during January - February 2006 prior to the IODZM 2006 that developed off Sumatra coast during July - December 2006. In contrast to the negative SSA variation in the EIO box, the SSA is more positive in the SEAS during IODZM period.

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ASSESSMENT OF INDICES OF INTERANNUAL and INTERDECADAL VARIABILITY in the EQUATORIAL PACIFIC

The equatorial Pacific is vast and few long monthly records of climate variability exist. One record is the more than 150 year long record of the sea surface temperature (SST) index NINO3.4, based on the analysis by Kaplan et al. (1998). Another, since 1883, is the Tahiti minus Darwin Southern Oscillation Index (SOI) and a third is the O19, coral proxy of NINOS3.4 SST from Palmyra (Cobb et al. 2003). These records are closely related physically and therefore should be highly correlated. Decadal and longer variability of NINOS3.4 and SOI indices agrees well after 1950 (r=0.92), but not before 1950 (r=0.12). The correlation, which does not care about imprecise measurements before 1950, shows that both the NINOS3.4 and the SOI decadal indices may be in error before 1950 because both individually are well correlated with the coral after 1950, and less so before 1950. We have used an improved data set (Rayner et al. 2005) and constructed equatorial SOI and night time air temperature series over the NINOS3.4 region to obtain better agreement before and after 1950.

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EVIDENCE FOR ATMOSPHERIC VARIABILITY OVER THE PACIFIC ON DEcadAL TIMESCALES

An index of Pacific decadal variability (PDV) based on a multivariate empirical orthogonal function (EOF) analysis of NCEP reanalysis is used to extract associated signals in satellite-based measurements of atmospheric parameters. This index captures the 1975-1977 ENSO-like warming shift of sea surface temperatures (SST) as well as a more recent transition of opposite sign in the 1990s. Utilizing satellite measurements of water vapor, wind, precipitation, long-wave radiation, as well as surface observations, our analysis evidences evidence of the atmospheric changes that accompanied ENSO-like inter-decadal SST changes. Our analysis suggests changes in atmospheric circulation, forced in the tropics, effect near-southern subtropical SSS via changes in water vapor, clouds, and radiation, with no indication in the wind speed that these changes are due to changes in the regional heat flux. Together, these results suggest that there are decadal-scale changes in the atmosphere involving circulation, water vapor, clouds and radiation that may play a role in PDV, and are worthy of further study.

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COMPARISON of TIDAL CURRENTS in the H UDSON RIVER DURING SPRING and FALL 2006

NOAA's National Current Observation Program deployed 20 bottom-mounted acoustic Doppler current profilers at 10 stations during both the spring and fall of 2006. Moorings spanned the length of the upper river from Poughkeepsie to the locks at Troy at 15 to 30 river kilometers spacing. Data collected was used to investigate the influence of freshwater flow on tidal currents in the Hudson River as requested by the Hudson River Pilots. A long-term station was placed at the George Washington Bridge to determine tidal forcing near the mouth of the river. Tidal currents were semidiurnal and rectilinear. In the spring, the flow tends to decrease flood speeds and increase ebb speeds by about 15 cm/s on average at 5 meters depth. This results in delaying the slack before flood and advancing the slack before ebb 15 to 45 minutes. These speed and timing effects increase from the midriver to the locks. Results of the harmonic analyses and the nonlinear influence on the variability of the resultant harmonic constituents are presented.

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ASSESSING the DRIVING FORCES of Submarine GROUNDWATER DISCHARGE

Submarine groundwater discharge (SGD) represents an unquantified pathway for nutrients and other dissolved constituents from land to the coastal ocean. It is now recognized that a considerable amount of seawater, in addition to terrestrial freshwater, is also recirculated through coastal aquifer systems. However, we still lack an adequate understanding of the relative importance of SGD driving processes. Predictive capabilities require a higher level of insight than is now available. We have been evaluating SGD forcing parameters at the Northwest tip of Mexico by a combination of long-term radionuclide measurements, hydrogeological/geochemical investigations, and numerical modeling. Our results indicate that tidally-driven seawater recirculation accounts for ~95% of the fluid flow through these sediments. Numerical modeling and field assessments show that the total (fresh and saline) 24-hour average flow per meter width of shoreline ranges from ~5 to 85 m3/day
with higher flows during spring tides and wet periods. If SGD nutrient fluxes from this site are extrapolated to the Florida Gulf coast, they are comparable to regional rivers, although SGD likely accounts for only a small amount of "new" nutrients.

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MANAGING MANGANESE IN DRINKING WATER: AN ASSESSMENT FOR MICROBES AND METALS

Manganese can be released and cause aesthetic problems in the drinking water systems worldwide. The relationships between metals and microbes; at the sediment-water interface; have already been established to assess microbiological implications in natural water systems. Studies have been conducted on the oxidation and reduction of manganese by microbes, but their implications in drinking water systems have not been understood thoroughly. Five microbial strains that were recovered from the filtration and sedimentation basins of a water treatment plant in Blacksburg, Virginia were selected to conduct this research. The strains were found to be capable of performing oxidation of Mn (II) to Mn (IV) when inoculated in a Mn-oxidation selective broth medium. Mn (II) present at concentrations equal or less than 0.05 mg/l in the broth medium used for this study had no effect on the growth of the five strains evaluated. Mn(II) inhibited growth of these strains when present at a concentration of 0.08mg/l. The results from this research suggest that microbial manganese oxidation takes place in drinking water systems and that it could encourage manganese being released and deposited.

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ROLE OF SALINITY ASSIMILATION IN A HYBRID COUPLED MODEL FOR THE TROPICAL PACIFIC

With the ever-increasing number of Argo data, the targeted launch date of Aquarius in March, 2009 and the soon-to-be available Soil Moisture and Ocean Salinity (SMOS) satellite observations in fall 2008, important work still needs to be done to investigate the impact that salinity will have on ENSO forecasts. In previous work, we have shown that assimilation of salinity along with other key variables improves the initial state and the ENSO prediction (e.g. Hackert et al., 2007). For example, retrospective hindcasts of subsurface temperature along the thermocline, sea level in the western Pacific, and SST in the NINO3 region are all improved when assimilating salinity. Here we will present results that show that Ensemble Reduced Order Kalman Filter (EROKF) data assimilation of salinity leads to more accurate ocean forecasts using a Hybrid Coupled Model (Zhang et al., 2006). In particular, we will show results of sea level, SST and zonal wind stress for recent El Nino cases (1997, 2002 and 2006).

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CARBON DIOXIDE AIR-SEA FLUX PATTERNS IN THE NORTHEAST PACIFIC: 1993-2007

Air-sea carbon dioxide flux estimates for the coastal Northeast Pacific have been highly variable and uncertain. By analyzing data collected over the last 14 years in a region extending from Vancouver Island to the Baja California Peninsula and extending out 300 km from the North American coast, we will attempt to reduce this uncertainty and explain the patterns and variability seen in sea surface pCO2 measurements. This is the most comprehensive set of pCO2 measurements gathered for this area, taking data from fixed moorings and shipboard observations. Seasonal variability within 150 km of the coast is largely dominated by wind-driven coastal upwelling, while seasonal temperature cycles are primarily responsible for offshore variability. Multi-year variation is primarily due to the El-Nino Southern Oscillation. Additionally, we expect that the North-South gradient of pCO2 can be partially explained by the level of preformed nitrogen in upwelling source waters resulting from lateral differences in initial water mass formation. Despite periods of high sea to air CO2 fluxes in the Northeast Pacific coastal region, the overall net air-sea CO2 flux appears to be nearly balanced.

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SATELLITE-BASED MEASUREMENTS OF OCEAN CLIMATE VARIABILITY IN THE AGULHAS CURRENT SYSTEM

Interzone leakage from the Agulhas Current constitutes an important pathway in the Atlantic meridional overturning circulation. As this Indian Ocean source of thermocline and intermediate water is saltier and warmer than Pacific Ocean waters entering via the Drake Passage, the characteristics and volume of the Agulhas leakage will influence global salt and heat balances; it thus constitutes a significant benchmark of ocean climate. Occurring over fairly large spatial scales, the Agulhas leakage demonstrates significant temporal and spatial variability on the mesoscale, presenting difficulties for in situ sampling programs. Satellite altimetry provides one of the most promising sources of observations for monitoring such oceanic variability and its long-term trends. We investigate the Agulhas leakage and evaluate our ability to measure it with satellite altimetry. Our study synthesizes information from the Jason and T/P altimeter missions and profile data. Historic profiles are combined into a streamfunction climatology, allowing heat, salt, and mass transports to be estimated from steric height in the study region. These are compared with in situ estimates from a recent field program, the Agulhas-South Atlantic Thermohaline Transport Experiment (ASTTEX).

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UNLOCKING ROLE OF THE EAST CHINA SEA CURRENT SYSTEM IN THE COCHLODINIUM POLYKRIXIOIDES BLOOM CONUNDRUM OF THE SOUTH EAST OF KOREA

The first severe Cochlodinium polykrikoides harmful algal bloom occurred in the coastal waters of the South Sea of Korea in 1995. Surprising this red tide started offshore, unlike most algal blooms which commonly start in eutrophic coastal waters. Its subsequent development and movement towards the shore caused US$95.5 million losses in the Korean aquaculture industry, including the devastation of coastal fin-fish and shellfish farms, and devastating natural ecosystems. Recent red-tide blooms have become an annual summer-mertime event since the 1995 outbreak, causing massive marine organism mortalities and considerable financial losses. In this study, we suggest a possible hypothesis for the mechanism responsible for annual summertime Cochlodinium polykrikoides red-tide bloom outbreaks in the South Sea of Korea (SSK). We explain the main outbreak processes in the SSK through a large-scale understanding of the summer current circulation system of the East China Sea from observed data and a model simulation combined with information on the ecological and physiological characteristics of C. polykrikoides.

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MECHANISMS OF INTERANNUAL VARIATIONS OF THE MERIDIONAL OVERTURNING CIRCULATION OF THE NORTH ATLANTIC OCEAN

We investigate the nature of the interannual variability of the meridional overturning circulation (MOC) of the North Atlantic Ocean using an ECCO (http://www.ecco-group.org) assimilation product for the period of 1993-2003. The time series of the 1st Empirical Orthogonal Function (EOF) of the MOC is found to be correlated with the North Atlantic Oscillation (NAO) index while the associated circulation anomalies correspond to cells extending over the full ocean depth. Model sensitivity experiments suggest that the wind is responsible for most of this interannual variability, at least south of 40N. A dynamical decomposition of the meridional stream function allows us to look further into the mechanisms. In particular, we examine the contributions associated with (1) the Ekman low and its depth-independent compensation, (2) the vertical shear low, (3) the barotropic gyre lowing over zonally varying topography. The Ekman dominates shorter time scales (1.5 - 3yr) while vertical shear is important for longer time scales (>10yr). The latter is primarily caused by heaving of the pycnocline in the western subtropics associated with the stronger wind forcing.

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POPULATION DYNAMICS AND NUTRITIONAL VALUE OF EPHITIC ALGAE IN ARTIFICIAL REARING PONDS ASSOCIATED TO THE REINTRODUCTION OF THE PUERTO RICAN CRESTED TOAD

Bufo lemur is the endemic toad of Puerto Rico. This species was declared endangered in 1987. To assist in its recovery, five rearing ponds were built during 2005-2006 as part of the species reintroduction program. Three rearing ponds are located in the north (Arecibo) and two in the south near Coamo and Guimimas, Puerto Rico. This research focuses on the nutrition requirements of Bufo lemur’s tadpoles during rearing. We will assess the nutritional value of periphrayan, the major observed food source of the Bufo lemur tadpoles. For a period of two months, four of the five artificial rearing ponds will be examined for algal biomass growth (as ash-free dry mass and chlorophyll a) and community composition. Nutritional analyses of the periphyton (dry matter, fiber, crude protein, amino acids, fat, pigments, fatty acids, macro and micro minerals) will also be performed. The results from this study could be used to improve the feeding of B. lemur tadpoles raised in captivity and could also improve the environmental conditions of the rearing ponds in Puerto Rico.
SURFACE AND SUBSURFACE GEOSTRICTIC CURRENT VARIABILITY FROM ALTIMETRY

Satellite altimetry data from TOPEX/POSEIDON and Jason-1 were used in conjunction with GRACE geoidal data as well as historical hydrographic profiles from the World Ocean Atlas 2009 to calculate the mesoscale and submesoscale currents at the surface and subsurface levels in the Indian Ocean basin during Indian Ocean Dipole periods: 1994-95, 1997-98, 2002-03 and 2006. The results of this method were validated with currents measured with Acoustic Doppler Current Profiler (ADCP) moorings. The measured and computed currents compared reasonably well. Seasonal features such as the Wyrtki Jets and Equatorial Undercurrents are visible in the computed currents. The purpose of this study is to observe the influence of the Indian Ocean Dipole on subsurface circulation.

THE EVOLUTION OF COASTAL OPTICS ASSOCIATED WITH A TURBID PLUME AND FEEDBACKS ON NEARSHORE PHYSICS

The optical properties associated with a turbid coastal plume and their feedback on nearshore physics and ecosystem dynamics are examined using a three-dimensional bio-physical model.Visible satellite imagery of the New York-New Jersey Bight in April 2005 shows distinct regions of highly turbid water of differing optical properties associated with the Hudson River plume, bulge and coastal current circulation driven by a freshwater discharge event in excess of 4000 m$^3$ s$^{-1}$. Water types characteristic of the river plume and open shelf are parameterized as variable light attenuation length scales, and simulations of April 2005 conditions are evaluated against field observations in terms of upper ocean temperature structures, baroclinic circulation and biological productivity. Increases in chlorophyll concentration in the upper water column decrease the transmission of light and result in a change in water temperature. Compared with the open shelf, the river plume simulations result in a deeper and warmer surface mixed layer (~1 m), a sharper temperature gradient, colder bottom water and enhanced productivity, highlighting the importance of biogeochemical feedbacks on nearshore physics in coastal systems.

SPATIAL AND TEMPORAL VARIABILITY OF CARBON DIOXIDE SIGNALS AND THE BIOGEOCHEMICAL CONTROLS IN THE SOUTH ATLANTIC BIGHT

The US South Atlantic Bight is shallow and the water column is generally vertically well mixed. The system has abundant inputs from rivers and salt marshes on the landside and active exchanges with the Gulf Stream on the seaside. We synthesize the inorganic carbon records based on six cruises of regional measurements of pH, pCO$_2$, DIC, TALK and DIC-δ13C. pCO$_2$ show dramatic seasonal and spatial variability, particularly in the inner shelf, as results of sharp changes in temperature and terrestrial inputs. DIC production as a result of organic carbon remineralization in the inner shelf and its biological removal in the mid and outer shelf as well as in the surface slope water also show large seasonal and spatial variability. We discuss the seasonal, cross-shelf, and alongshore variability of surface water pCO$_2$, DIC dynamics, and the underlying biogeochemical controls using field data and simple model analysis. The carbon cycling pattern and the underlying bio-geochemical driving forces revealed here may have broad implications to research in other western boundary current shelves.

QUANTITATIVE DETERMINATION OF COLLOIDAL ORGANIC PHOSPHORUS IN RIVER WATER AND SEAWATER FROM THE GULF COAST REGION

The abundance and variations of colloidal phosphorus (both inorganic/organic) in natural waters remain largely unknown. Samples were collected from the Mississippi River (MR), Pearl River (PR, Mississippi), and Bay of St. Louis (BSL) for ultrafiltration and measured. The concentration of inorganic phosphorus (CIP) was negligible in the MR and BLS (3%), although CIP became significant in the PR, a forested, black water river (~3%). In contrast, CIP dominated in the bulk DOP pools as high as 50-87% with the highest abundance in the PR, followed by BSL and MR. Measurable CIP in the PR likely resulted from pedogenic sources. High CIP abundance in both freshwater and seawater points to the importance of colloidal phase in the biogeochemical cycling of phosphorus in aquatic environments.

DEVELOPMENT OF A PALEO-ICE DURATION PROXY IN THE BERING SEA: PRELIMINARY RESULTS BASED ON DIATOM ASSEMBLAGES AND SEDIMENT GRAIN SIZE

The dramatic reduction in ice extent seen this summer in the Arctic Ocean highlights the need to understand natural rates of change of declining sea-ice extent and duration. To address this, we are developing a quantitative proxy for paleo-ice duration in the Bering Sea. A suite of surface sediments taken onboard the USCGC Healy 0601 and 0702 expeditions from a grid of stations across a gradient of sea-ice duration (historically ranging from four to nine months of ice cover per year) were analyzed for sediment grain size and diatom assemblages. These sites were then combined with a diatom assemblage dataset of surface sediments previously taken from the Bering Sea (Sancetta, 1982). This combined dataset now includes sites representative of a full sea-ice duration gradient (zero to twelve months of ice per year). Several methods of machine based learning will be applied to the dataset to correlate these and other surface sediment variables (including diatom assemblages and morphometry, sediment grain size, and the concentration of an organic compound associated with sea ice diatoms) with mean annual duration of sea ice.

A CHARACTERIZATION OF BENTHIC MACROFAUNAL COMMUNITIES PRESENT AT ANTRHOPOCENICALLY IMPACTED ENVIRONMENTS WITHIN NARRAGANSETT BAY, RI

Benthic communities were examined over a six year period along a gradient of anthropogenic stress in Narragansett Bay, RI. Historic models of faunal succession describe predictable changes in the structure of benthic assemblages with spatial or temporal distance from a disturbance. These models have been repeatedly tested and appear to be universally applicable for most physical, chemical, or biological disturbances in littoral soft-bottom habitats. Benthic infaunal communities present at four depositional environments within the upper Narragansett Bay were characterized and inter-station differences in species composition and abundance were examined. Our analysis has identified significant anthropogenic impact on the structure of benthic macrofaunal communities of Narragansett Bay. The magnitude of this impact was greatest in Mt. Hope Bay where exposure to multiple stressors has resulted in persistent low faunal diversity characteristic of early stages of species succession.Mirroring what was expected based on historic models; the successional status of benthic assemblages in Narragansett Bay was found to be inversely proportional to the gradient of anthropogenic stress and this relationship appears to have persisted over time.

FEATURE-ORIENTED REGIONAL MODELING AND SIMULATIONS (FORMS) FOR THE WESTERN SOUTH ATLANTIC, SOUTHEASTERN BRAZIL REGION

The multi-scale synoptic circulation system in the southeastern Brazilian (SIBRA) region is presented using a feature-oriented approach. Prevailing synoptic circulation structures, or “features”, are identified from previous observational studies. These features include the southward flowing Brazil Current (BC), the eddies off Cape Sapo Tome (CST) and off Cabo Frio (CF), and the upwelling region off of CST. Their synoptic water-max (T-S) structures are characterized and parameterized to develop temperature-salinity feature models. Following the Gangopadhyay et al. (2003) methodology, a synoptic initialization scheme for feature-oriented regional modeling and simulation (FORMS) of the circulation in this region is then developed. First, the temperature and salinity feature-model profiles are placed on a regional circulation template and then objectively analyzed with available background circulation data. These initialization fields are then used for dynamical simulations via the Princeton Ocean Model (POM). A combination of different feature models and climatology fields were then used to dynamically understand the relative importance of baroclinic and barotropic instability mechanism for the growth of the BC meandering. Our future plan includes the application of these feature models with satellite, in-situ data and advanced data assimilation schemes.

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Benthic communities were examined over a six year period along a gradient of anthropogenic stress in Narragansett Bay, RI. Historic models of faunal succession describe predictable changes in the structure of benthic assemblages with spatial or temporal distance from a disturbance. These models have been repeatedly tested and appear to be universally applicable for most physical, chemical, or biological disturbances in littoral soft-bottom habitats. Benthic infaunal communities present at four depositional environments within the upper Narragansett Bay were characterized and inter-station differences in species composition and abundance were examined. Our analysis has identified significant anthropogenic impact on the structure of benthic macrofaunal communities of Narragansett Bay. The magnitude of this impact was greatest in Mt. Hope Bay where exposure to multiple stressors has resulted in persistent low faunal diversity characteristic of early stages of species succession. Mirroring what was expected based on historic models; the successional status of benthic assemblages in Narragansett Bay was found to be inversely proportional to the gradient of anthropogenic stress and this relationship appears to have persisted over time.
ited to coarse size particles having the material properties of quartz immersed in water. However, in the grain size analysis of coarse to fine sand the grain-grain interactions transition from being best described as inertial to viscously damped. As grain size is decreased further to clay-size particles, electrostatic forces of attraction and repulsion become dominant. Additionally, one might include the influence of biogeochemical effects from polymers and polysaccharides, among others. Likewise, shear induced lift forces need to be accounted for to produce suspended loads with fine grains. Here we propose a new modeling framework based on DPM for sediment transport in heterogeneous environments that uses a multi-scale, multi-physics approach. Specific improvements include adding a shear induced lift term and modeling viscous dissipation at grain-grain contacts through an effective coefficient of restitution as a function of Stokes number. Comparisons are made with laboratory U-tube measurements for bulk transport rates and time-dependent concentration profiles.

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GENERATION OF SUBMESOSCALE VORTICITY FILMMENTS AND THEIR IMPACT ON PRIMARY PRODUCTIVITY IN AN ISLAND WARE

Strong mesoscale eddies are characteristic in regions of large Eddy Kinetic Energy. Elongated submesoscale filament are generated by the straining of the eddying flow and affected by their interaction with the wind field and topographic features. Such filament are associated with large vertical velocities and can act as important pathway for the vertical exchange of fluid between the nutrient-rich waters below the euphotic zone and the sun-lit upper ocean. The steep topography of the Hawaiian Island chain, located in an oligotrophic region far from the inshore influence of strong spatially varying and temporally varying wind forcing, make it an ideal site for a systematic study of the generation of submesoscale features and their environmental impact. Previous model results show an asymmetric behavior between cyclones and anticyclones (Calil et al. 2007). Cyclones break down into vorticity filaments as they evolve while anticyclones maintain their coherence and strength for longer times. Large strain and relative vorticity rates, as well as nonlinear Ekman and advective effects, play an important role in such behavior. Model simulations at higher resolutions and subject to different forcing fields will be used to investigate the potential role of environmental factors in generating submesoscale vorticity filaments. Implications for mixing will be evaluated through the use of Finite-Size Laxunum Exponents. Coupled biological models will be used to understand the potential effects on the Biology.

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RESPONSES OF BENTHIC MACROFAUNA AND BIODIGEOCHEMICAL FLUXES TO VARIOUS LEVELS OF MUSSEL BIODEPOSITION: AN IN SITU BENTHOCOSM EXPERIMENT

An in situ experiment was done to determine the influence of differing levels of mussel biodeposition on the structure of sandy benthic communities and bicochemical fluxes. Natural benthic communities within sediment cores (benthocosms) were exposed in situ over 50 days to 7 different levels of mussel bio-deposition. Although bio-deposition rates increased linearly with mussel density, sediment % organic matter was not correlated to mussel density. Despite the high variability between replicate samples, macrofaunal community showed trends in relation to increased bio-deposition. Important increases in the abundance and biomass of opportunistic species (Capitella sp.) were observed in the benthocosms exposed to the greatest bio-deposition. Sensitive species (e.g. Tellinula ovalis) tended to decrease in abundance and biomass with increasing mussel density. Benthic organisms may have contributed to the recycling of organic biodeposits. Oxygen consumption, ammonium, phosphate and nitrite fluxes did not vary significantly between treatments. Only the flux of silica was positively correlated to bio-deposition. This study presents some useful information on the dose-response relationship (bio-deposition - benthic communities and bicochemical fluxes) to help set mussel production density limits to ensure that the environmental carrying capacity are not surpassed.

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NUMERICAL MODELING OF CROSS-SHORE SEDIMENT TRANSPORT AND SEASONAL BAR MIGRATION EVENTS

The cross-shore sediment transport on a barred beach is studied by a numerical model. The goal is to make simulations of morphological evolution on a seasonal time scale for onshore and offshore bar migration events. The numerical model consists of a spectral wave driven, REF/DIF/S - a quasi-3D nearshore circulation model, SHORECIRC, and a generic energetics based sediment transport model. Simulations are based on a series of nearshore field tests conducted near Grays Harbor, WA in which monthly nearshore bathymetric surveys show the onshore migration of the sandbar during spring 2001. The model is used as a profile model by excluding the longshore variations and successfully replicates the behavior of the bar between monthly surveys. We have shown in a previous study that wave skewness is one of the mechanisms contributing to onshore bar migration. This study extends the analysis for the effect of wave skewness to much longer time scales. The model is also used to help understand the mechanisms of sediment transport causing the migration of the bar by analyzing the effects of waves, currents and bed slope.

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SYNOPTIC ANALYSIS OF CORAL HABITATS AND COASTAL OCEAN CHEMISTRY TO INFORM REEF CONSERVATION IN PACIFIC PANAMA

Pacific coral habitats were surveyed to chemically characterize euphotic zone water masses while studies of naturally occurring patterns of reef architecture, diversity, and benthic morphology. Multi-scale, spatially contiguous data were collected in the Gulf of Chiriqui using conventional SCUBA methods in concert with a towed chemical sensor platform and a stereo camera dive sled. Acoustic bathymetry, 3-D optical imaging, in-situ underwater mass spectrometry, CTD, chlorophyll, and CODM, coupled with precision navigation, enabled high resolution comparisons of coastal and island habitats. Salinity/ CDOM / CH4 / CO2 relationships suggest abrupt, complex mixing of terrigenous and anthropogenic input near oligotrophic waters being mitigated by cold, hypsalsine pulses that potentially affect sessile assemblages. Spatially dense chlorophyll data collected over 300km transects permitted thorough SeaWiFs ground-truthing. Chemical measurements and reef mosaics were integrated into a GIS to create thematic water chemistry and benthic habitat maps for the Republic of Panama. Ecological information was extracted in order to identify threatened areas and prioritize conservation objectives for surrounding islands and coastal marine provinces outside of the protective domain of Coiba Island National Park, a UNESCO World Heritage Site.

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TRAINING THE NEXT GENERATION OF OCEAN SCIENTISTS: AN UPDATE ON THE MASTER OF GEOSCIENCES CERTIFICATE IN OCEAN OBSERVING SYSTEMS AT TEXAS A&M

Many important global issues facing oceanographers, such as climate change, maintaining healthy ecosystems, and sustainable use of marine resources, require long-term observations. Therefore, there is a need for trained professionals knowledgeable in oceanography, in situ ocean observations, remote sensing technologies, data analysis and display (including geographic information systems and remote database administration), analytical techniques and modeling tools, and who can and do operate the ocean observing systems of today and the future. The mission of the Master of Geosciences-Ocean Observing Systems Certificate program at Texas A&M University is to provide a fundamental understanding of oceanography and the statistical and technical training. The two-year 24-credit-hour program consists of five foundation courses and three elective courses. The training program in Ocean Observing Systems is interdisciplinary and includes: in situ ocean observations, remote sensing technologies, data analysis and display, geographical information science (GIS), as well as numerical modeling. To date, we have graduated our first class of students. The program offers the student scientific and technical expertise, thereby targeting a major obstacle in recruiting, and retaining U.S. workers for technological and operational careers, such as ocean exploration.

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A COUPLED AIR/OCEAN/WAVE MODELING SYSTEM - DEVELOPMENT AND CASE STUDY

Using the Earth System Modeling Framework (ESMF) a coupled air/ocean/wave modeling system has been developed. The system integrates the atmospheric model from the Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS®) together with the NRL Coastal Ocean Model (NCOM) and WAVESATIVIII into a single executable application. The exchange of fields between the components, which execute on non-overlapping sets of processors, is handled by the reordering and inter-processor communication methods provided by ESMF. Details of the implementation of the coupled system are presented along with results for two region test cases.

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VORTEX DYNAMICS AND ENERGY DISSIPATION IN OSCILLATORY FLOW PAST COMPLEX BOUNDARIES

The interaction of oscillatory flows with obstacles is a predominant scenario in coastal hydrodynamics. Coherent vortical structures are ubiquitous in these flows, and their dynamics affect fundamental problems such as sediment transport, wave energy dissipation and pollutant dispersal. In this study, the transition towards three-dimensionality and turbulence is investigated experimentally in the moderate Reynolds number regime, 100
CALDEIRA, K.

Comparison of the theoretical and simulation results shows a good agreement.

Meso-scale topography conditions, mean currents and surface forcings. The numerical experiments were performed in a channel with a wide range variability in the mesoscale kinetic energy (and therefore, mesoscale diffusivity) reaches its maximum in mesoscales in the ML is a critical problem for coarse resolution OGCMs. In the ML, Eddy-resolving computations by Oschlies (2002) show that mesoscale eddies affect the... potential to provide insights about the biogeochemical sources, transformation, and fate of organic matter, which are critical for understanding the effects of natural and human potential to provide insights about the biogeochemical sources, transformation, and fate of organic matter, which are critical for understanding the effects of natural and human-induced environmental change. In this session, we will present a review of recent advances in the development of new biomarker tools including: (1) the use of intact polar lipids for tracing microbial sources of organic matter; (2) the use of δ7D, δ13C and δ15N stable isotopes with organic biomarkers, and new methods for characterizing polar constituents associated with dissolved organic matter. Additionally, we will describe new applications of classical biomarkers to research questions in the fields of ecology, biogeochemistry, geochemistry and paleo-studies.

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NEW BIOMARKERS AND NOVEL APPLICATIONS OF CLASSIC BIOMARKERS IN AQUATIC SYSTEMS: AN OVERVIEW

Organic biomarkers are useful tools in earth science and have widespread applications in limnology and oceanography. Biomarker applications have provided numerous insights about present and past aspects of Earth history including: (1) food and energy sources available to microbes and higher organisms, (2) microbial chemotaxonomy, (3) sources of fossil fuels, and (4) evolution of life on Earth. Additionally, biomarker studies have the potential to provide insights about the biogeochemical sources, transformation, and fate of organic matter, which are critical for understanding the effects of natural and human-induced environmental change. In this session, we will present a review of recent advances in the development of new biomarker tools including: (1) the use of intact polar lipids for tracing microbial sources of organic matter; (2) the use of δ7D, δ13C and δ15N stable isotopes with organic biomarkers, and new methods for characterizing polar constituents associated with dissolved organic matter. Additionally, we will describe new applications of classical biomarkers to research questions in the fields of ecology, biogeochemistry, geochemistry and paleo-studies.

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MODELING MESOSCALES IN THE MIXED LAYER

Eddy-resolving computations by Oschlies (2002) show that mesoscale eddies affect the depth of the mixed layer (ML) by inducing a strong re-stratification. Thus, modeling mesoscales in the ML is a critical problem for coarse resolution GCMs. In the ML, the mesoscale kinetic energy (and therefore, mesoscale diffusivity) reaches its maximum which makes the widely used tapering schemes unphysical. We have developed a dynamical mesoscale model for the ML as an extension of the mesoscale model previously developed for the deep ocean, and which has no adjustable parameters. The new ML model was validated using fine resolution (4km horizontal, 40-50 vertical levels) simulations with more than 40 numerical experiments under different conditions and situations. Most of the numerical experiments were performed in a channel with a wide range variability in initial, lateral and bottom topography conditions, mean currents and surface forcings. Comparison of the theoretical and simulation results shows a good agreement.

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OCEAN ACIDIFICATION, CORAL REEFS, AND CO2 STABILIZATION

When atmospheric CO2 dissolves in the ocean, it increases the concentration of hydrogen ion (H+ or pH), which acts to decrease the concentration of carbonate ions. This decrease in carbonate ion concentration decreases the saturation state of calcium carbonate minerals including aragonite, the material of which coral skeletons are made, posing significant risks to their survival. Here we predict ocean chemistry conditions for existing coral reef locations and conclude that the chemical environment associated with pre-industrial coral reefs is disappearing rapidly as atmospheric CO2 concentration increases. Before the industrial revolution, more than 98% of corals reefs were found in waters that were >3.5 times saturated with respect to aragonite. If atmospheric CO2 is stabilized at 550 ppm, there will be no place left in the ocean with such aragonite saturation levels. Temperature, light, and other environmental factors affect coral growth. Nevertheless, the loss of ocean water with high aragonite saturation is cause for concern.

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Spatial and Temporal Variation in Primary Production in the Lower Mississippi River

Although the Mississippi River is the largest river in North America, relatively little is known about the potasposkinni community metabolism. This research investigated temporal and spatial patterns in phytoplankton biomass, primary production, and plankton respiration in the Lower Mississippi River. The study occurred over a twenty month period at two locations approximately 420 river km apart. Every 2-4 weeks, we measured primary production at a series of light levels from which production versus irradiance (P-I) curves were generated. From these P-I relationships, and data for photic zone depth, surface light intensity, biomass, and algal and bacterial respiration, we created a model for autotrophic and respiration and production for a representative segment of river water. Variations in phytoplankton carbon flux across time and location are compared.

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Role of Frontogenesis in Energy Transfers at Ocean Surface

Recent observations have shown that surface oceanic flows at mesoscales are associated with an inverse kinetic energy (KE) transfer, which contradicts standard arguments of quasi-geostrophic turbulence. Here we demonstrate that Surface Quasi-Geostrophic dynamics (SQG) may explain this behavior. SQG is the QG representation of mesoscale flows near vertical boundaries. In this system, the nonlinear transfers of surface KE promote an inverse cascade. However, they are locally compensated for by a KE source. This source can be linked to the surface frontogenesis mechanisms and to conversion of potential to kinetic energy at smaller scales. We provide evidence from numerical simulations of SQG and primitive equations models that this mechanism is relevant for the ocean.

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DIATROPHS AND DIATROPH OF THE MEDITERRANEAN DYNAMIC SITE Nitrogen fixation has been implicated as a factor leading to anomalies in nitrogen stable isotope distributions and nitrate and phosphate ratios in the Mediterranean basin. However, there are relatively few studies which have provided direct observational data for the presence and activity of diatrophs. During three cruises to the central Mediterranean DYNAMED time-series station between Nice and Corsica, in Oct 06, Jan and Jul 07, we collected samples to enumerate and identify diatrophs by microscopic and molecular methods and to calculate rates of nitrogen fixation at several depths and in different size fractions in the upper water column. An experiment testing the response of nitrogen fixation to phosphate additions was also carried out. Nutrient concentrations were generally low (about 1 uM in Jan) to unmeasurable in the upper water column in July. nifH sequences were amplified from about half the samples and are being sequenced for identity. The distributions of diatrophs will be considered in relationship to the observed rates.

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USING QUIKSCAT SURFACE WIND MEASUREMENTS TO UNDERSTAND WIND SPEED VARIABILITY AND SURFACE FLUX IMPLICATIONS

Surface momentum and energy fluxes are non-linearly dependent on wind speed and are thus sensitive to its distribution. Our sensitivity studies have detected large momentum flux increases from using wind speed PDFs versus means. When accounting for feedbacks, significant surface flux changes are realized. Thus, neglecting to represent sub-grid scale winds within a GCM can lead to surface flux and climate biases. We have conducted an unprecedented wind speed PDF comparison between QuikSCAT and a state-of-the-art GCM. Our findings include positive mean wind speed biases in the northern hemisphere trades and southern hemisphere storm tracks. Seasonally-persistent negative shape and mean wind speed biases were found along the ITCZ. Parameterizing...
wind speed variability using an empirical formulation reduced these GCM biases. A wind speed PDF converted from this formulation has a high degree of stability from one wind speed categorical improvement. Thus, the breadth of this physically-based wind speed PDF will be a function of turbulence kinetic energy. We hope to improve the modeled PDF with respect to observations in regions where modeled and observed mean wind speeds agree.

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ENHANCED OPTICAL COMMUNICATION THROUGH THE SEA-AIR INTERFACE

For Homeland Security, AUVs have been developed with advanced sensors to acoustically and optically inspect our ports, harbors, and infrastructure. Optical and acoustic imagery from such systems must be rapidly classified, implying that high-rate data streams are required. Target ports can be frequency-saturated in the radio frequency (RF) spectrum, but optical communications may be effectively employed to provide data links in port-security operations. For an optical link to be practical in such an application, it must support communications with both above water and underwater systems. Maintaining reliable optical communications through the air-sea interface is challenging due to ever-changing surface characteristics. We present one option for establishing an optical data link which mitigates the effects of waves diverting optical beams, with an aerial platform relaying signals to the home base. We discuss a beam-redundancy method that has demonstrated an improvement in data transmission rates across the sea-air interface by a factor of three during daylight. We also discuss a spatial-filtration method that is expected to increase the signal-to-noise ratios, and thus data rates, by at least another factor of ten.

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PRELIMINARY ASSESSMENT OF STREAM GEOCHEMISTRY IN WEST CENTRAL NICARAGUA DURING BASEFLOW CONDITIONS

A series of water samples was collected from streams in west-central Nicaragua at the end of the dry season in April, 2007. Filtered samples were analyzed, using ion chromatography and ICP-OES, for major cations, anions and nutrients. Streams in volcanic watersheds had lower mean Ca2+ and Mg2+ concentrations and slightly higher Ca/Mg ratios than streams in marine carbonate rocks. Dissolved Si concentrations averaged 1.12 mM L-1 in the 15 streams sampled, indicating a very high degree of silicate mineral weathering. Mean Si, Ca, and Mg concentrations in these streams are higher than those measured in volcanic rock dominated watersheds in Panama and in first and second order streams flowing through basaltic in Costa Rica. These differences may reflect the lithologies and the ages of the rocks. N/P molar ratios vary from 6.4 to 1 in the Nicaraguan stream waters, suggesting these streams may be N-limited. In general, the highest phosphate concentrations were associated with lower CI values, implying that at least a portion of the P is derived from chemical weathering sources, although anthropogenic sources cannot be ruled out.

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CORAL BARIUM/CALCIUM RECORDS OF INCREASED SEDIMENTATION ON THE MESOAMERICAN REEF

Cores of the massive coral Montastrea faveolata were collected from four sites across the Mesoamerican Reef: Turneffe Atoll and the Sapodilla Cays in Belize, and Utila and Cayos Cuchillos in Honduras. Honduras and Guatemala are largely agricultural and have steep mountainous terrain in watersheds draining into the Caribbean Sea and affecting the southern Mesoamerican Reef. Ba/Ca, a proxy for terrestrial runoff, was measured in 15 streams sampled, indicating a very high degree of silicate mineral weathering. Mean

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A NEW GLOBAL CLIMATOLOGY OF OCEAN TEMPERATURE AND SALINITY STATISTICS FOR DATA ASSIMILATION

A global ocean temperature and salinity climatology was developed as a replacement for the Navy's GDEM and MODAS climatologies. Designed to cover both shallow shelves and deep water, the new climatology is constructed from both temperature-only profiles (XBTs and AXBTs) and profiles having both temperature and salinity and is designed to minimize errors in vertical gradients caused by construction of historical profiles having a large range of terminal depths. Used operationally, it supports explicit construction of profiles as functions of geographic position, depth, time of year, and any subset of the following: mixed layer depth, surface temperature, surface salinity, and geopotential anomaly. It also provides the required statistical relationships and fields of expected errors to support data assimilation by optimum interpolation or 3-D variational methods. Robust
The Arctic climate has changed dramatically within the last several decades, but the effects of these changes on Arctic marine ecosystems remain largely speculative. Observation of ecosystem responses to decadal-scale climate variations (i.e., oscillations) may help elucidate the impact of climate change on the structure and function of these ecosystems. We analyzed annual growth and shell mineral contents (Mg, Sr, Ba, Mn) of the circumpolar Greenland cockle, Serripes groenlandicus and linked their patterns to environmental variations in the Norwegian-Russian Arctic area of the Barents Sea. The dataset comprises 53 individuals from different regions of the Barents Sea and Svalbard and spans 117 years (1878–1995). Absolute growth rates differed among regions, reflecting overall differences in environmental conditions, but at all sites growth had an oscillatory pattern alternating between above and below average growth on a decadal scale. Mineral ratios elucidate seasonal and interannual patterns, reflecting different ecological controls. Preliminary analyses reveal that growth rates of bivalves in the Pechora Sea are strongly and negatively correlated to the North Atlantic Oscillation Index (NAO), indicating mechanisms of bio-physical coupling in the region.

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COASTAL TRENDS ISSUES AND THE FORMATION OF SCIENCE-EDUCATION PARTNERSHIPS

From catastrophic storms to sea level rise and rapidly eroding shorelines, to harmful algae blooms, expanding dead zones and declining fisheries, we are becoming increasingly aware of our changing coastal oceans and how they impact our lives. Although we find these and other disturbing trends in the coastal ocean featured every day in news articles all around us, their causes and consequences are still poorly understood by the general public. Research scientists are increasing understanding of these processes, however, the science associated with these issues often does not reach the broader community. A New Center for Ocean Science Education Excellence, is addressing issues facing our changing coastal oceans through unique partnerships among research scientists, formal and informal educators, students and science communicators. We use a visual approach to communicate these key messages, and develop resources which will be available on the web for educators to use in a variety of formats. To develop these communication resources, this program utilizes a team approach to formulate “coastal trends modules for the K-12 classroom and for the general public through research-based activities.

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IS THE UPPER OCEAN WARMING? COMPARISONS OF 50-YEAR TRENDS FROM DIFFERENT APPROACHES

Ocean temperature trends at depths from 50 m to 1000 m are examined, based on observations gridded on a 3° x 3° latitude grid. Most of the ocean does not have 50-year trends that are significant, even at the 90% confidence level (CL). In fact only 30% of the ocean at 50 m has >90% CL trends, and the percentage decreases significantly with increasing depth. There is much spatial structure in 50-year trends, with areas of strong warming and strong cooling. These trend results are compared with trends calculated from data interpolated to standard levels and from a highly horizontally interpolated version of the dataset that has been used in previous nutrient content trend studies. The regional trend results can differ substantially, even in the areas with statistically significant trends. Trends based on the more interpolated analyses have more warming. 20-year trend variability is also high in all datasets. These results suggest that upper ocean heat content integrals and integral-trends may be substantially more uncertain than has yet been acknowledged. Further exploration of uncertainties is needed.

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EFFECTS OF A LARGE-SCALE EUTROPHICATION AND OLGOTROPHICATION EXPERIMENT IN DANISH ESTUARIES AND COASTAL WATERS

The Danish monitoring program was established with the aim of identifying trends and drivers for a variety of ecosystem variables, particularly with respect effects of nutrient inputs from land. After 30 years of monitoring covering periods of both eutrophication and oligotrophication there should be sufficient data and variation to link drivers and impacts, but the trends are also confounded with signatures of global warming and potential regime shifts in addition to the large variations inherent to all ecosystem data. Despite large intra-system differences generic relationships can be obtained by pooling data from several coastal ecosystems. Reductions on land-based nitrogen inputs by almost 50% and phosphorus inputs by more than 80% have resulted in some ecosystem recovery for the pelagic variables, whereas benthic vegetation has stronger resilience to nutrient reductions. Highlights from a long-term analysis of a regional ecosystem undergoing both increases and reductions in nutrient inputs are presented.

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THE EFFECTS OF INLET CHANNEL MODIFICATION ON THE BENTHIC INFANNA IN THE VICINITY OF BOGUE INLET, NORTH CAROLINA

Infuna are useful bioindicators of natural and anthropogenic disturbances. In this study we examine responses of benthic infuna to inlet channel modification. Sampling data is assessed using a BACI design for identifying seasonal trends and changes in the population dynamics of the benthos following dredging activities. Sites were core sampled for three years to determine macrourviverte community structure in the Bogue Inlet complex. Four baseline monitoring events provided pre-construction macrourviverte community structure data including spatial and temporal fluctuations. Inlet channel realignment occurred in March and April 2005, followed by seasonal monitoring at each site throughout 2006 and 2007. Results show the abundance of both taxa and organisms as significantly higher post-construction. Diversity was significantly lower at one year post-construction. By use of multivariate analysis, the effects of inlet relocation on the macrourviverte community are assessed, as well as the inherent temporal and spatial variation occurring within these communities. Patterns of succession are also evaluated.

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AN INVERSE MODEL TO SEPARATE MIXING FROM GAS EXCHANGE IN THE REGION OF AAW FORMATION

Intermediate and mode waters have the potential to operate as rapid feedbacks to climate change via entrainment of greenhouse active species due to their comparatively fast turn-over times. Estimating the gas exchange that occurs during formation of these masses is complicated by biological activity and the complex mixing of the source waters during subduction. In this study we estimate gas exchange using hydrographic data collected on a cruise to a region of suspected intermediate and mode water formation (the region contained by 62° S, 105° W and 45° S, 75° W) during the late Austral winter of 2005. An optimum multiparameter inverse model with Redfield-type biology, simple mixing, and no parameterization for gas exchange was used to obtain a modeled distribution of properties. The difference between this modeled distribution and the observed distribution then provides our estimate for the net effect of gas exchange over the timescale of mixing. Average rates of exchange are thus determined for deep mixed layer waters and waters representative of AAIW over this timescale.

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FORTNIGHTLY VARIATIONS IN BAROCLINIC TIDAL FLUXES AT THE HAWAIIAN RIDGE

A high-resolution primitive equation model is used to study the temporal variation in semidiurnal baroclinic tidal dynamics due to astronomical forcing. The one-hundredth of a degree domain covers a region of the Hawaiian Ridge from Niihau to Maui, including one of the three main internal tide generation sites along the Hawaiian Ridge. The domain-integrated barotropic to baroclinic conversion increases from 1 GW at neap tide to 5 GW at spring, with flux divergence and dissipation varying by approximately a factor of three. The fortnightly range of baroclinic flux is spatially variable, with range being proportional to the magnitude of the M2 flux. The model output is used to place flux measurements from the Absolute Velocity Profiler (AVP), taken as part of HOME, in context of the fortnightly cycle. Although the AVP measurements were taken in a relatively small area south of the ridge (<50km X 50km), the spring/neap variation at the survey locations varies by a factor of eight.

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NAVY OCEAN MODEL COMPARISONS IN THE GULF OF OMAN

NAVOCEANO deployed 4 profiling floats in the Gulf of Oman (GOO) during summer 2007 to improve our understanding of oceanographic processes and evaluate the forecast models in the region. The area, which is important to Navy operations, is quite complex with sub-surface salinity related to the Arabian Gulf, temperature inversions, and a complex eddy structure. The models we are evaluating include the Navy’s Modular Ocean Data Assimilation System (MODAS), Shallow Water Analysis and Forecast System (SWAFS), and Global Navy Ocean Model (GNCOM). A 2-month study to comparing observations with model products will help us better understand model skills and weaknesses and improve our ability to support Navy activities in this challenging environment.

The approach is to compare modeled temperature, salinity and sound speed profiles with float observations. Analysis and forecast skill scores are assigned and the results are discussed in terms of important features, locations, and times. We will provide a statistical assessment of these comparisons. For example, it was immediately determined that more levels were needed to represent the complex ducting system in the GOO.

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SALINITY, FRESHWATER FLUX, AND CLIMATE

This is a study of year-to-year sea surface salinity (SSS) variations -- their causes and their connection to climate. While observations from remotely sensing instruments together with an expanded suite of in situ observations are expected to provide global estimates of SSS anomalies in the near future, our current understanding is limited. Why, for example, do SSS and SST in the subtropical North Atlantic vary in phase on decadal timescales, while they vary out of phase in the tropical Pacific? This study presents results from a suite of IPCC AR4 GCAMs together with an ocean reanalysis to diagnose the complex relationship between salinity, freshwater flux, and the overlying atmospheric circulation on sub-seasonal timescales.

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REMOTE SENSING OF INTERNAL WAVES IN THE MID-ATLANTIC BIGHT

Both satellite synthetic aperture radar (SAR) and electro-optical (EO) sensors image internal waves on the ocean surface. From July through September 2006, both EO and SAR imagery were collected from the SpotImage satellites, Radarsat-1, the European Remote Sensing Satellite (ERS-2) and Envisat-1 ASAR satellites. These satellite observations provided good temporal coverage for tracking the propagation of internal waves. A total of 58 SAR and 68 EO images were acquired and used to identify 2901 internal waves grouped into 472 packets. The data show persistent and repeated presence of internal waves parallel to the bathymetry. The images show refraction of internal waves over the shallower bathymetry and complex patterns arising from wave-wave interactions and reflections. The images are used to characterize the distribution, wavelength, number of oscillations and propagation speed of internal waves. The satellite observations were complemented by two research vessels equipped with WAACO marine radar systems and environmental moorings that measured near-surface and wave properties perpendicular to the bathymetry. The ship and mooring measurements were used to calibrate the radar backscatter measurements.

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UPTAKE OF PHOSPHATE AND ATP BY FLOW-SORTED CYANOBACTERIA, PICOCYRKYAROTIDES AND NANOEUARYOTES IN THE SUBTROPICAL WESTERN NORTH ATLANTIC

Orthophosphate and ATP are biologically labile sources of phosphorus, a macronutrient known to seasonally limit primary production in the oligotrophic North Atlantic and Pacific gyres. While information on bulk community assimilation of these two compounds is common, there is very limited information on specific cyanobacterial and eukaryotic assimilation. Radioactive phosphorus tracers were used in conjunction with Fluorescence Activated Cell Sorting to quantify average cell-specific phosphorus uptake rates in Prochlorococcus, Synechococcus, and pico- and nano-eukaryotes in the western North Atlantic Subtropical Gyre. While information on bulk community assimilation of these two compounds is common, there is very limited information on specific cyanobacterial and eukaryotic assimilation. Radioactive phosphorus tracers were used in conjunction with Fluorescence Activated Cell Sorting to quantify average cell-specific phosphorus uptake rates in Prochlorococcus, Synechococcus, and pico- and nano-eukaryotes in the western North Atlantic Subtropical Gyre. All measured phosphorus uptake rates were greater near the deep chlorophyll maximum than at the surface, but mean cell-specific ATP uptake rates were consistently ~ 2.5 times lower than phosphate uptake regardless of depth. While average cell-specific rates increased with cell size, at the population level Prochlorococcus, Synechococcus, pico-eukaryotes and nano-eukaryotes contributed 40, 16, 24, and 20% to measured phosphate and 41, 60, 8, and 10% to measured ATP uptake, respectively. These data suggest that while Prochlorococcus can assimilate SRP and ATP equally, Synechococcus is actually a better competitor for phosphorus derived from ATP.
and estuaries in particular has been hampered by the limitations of using a few discrete
of their sampling program. Extensive sampling of shallow habitats such as coastal rivers
shed and land use characteristics requires us to be able to distinguish natural spatial pat
HI-RESOLUTION MAPPING OF THE SPATIAL VARIABILITY IN CO2/O2/N2
Conmy, R. N.

Casper, A. F.

It has also been demonstrated that by supplying different substrate areas for periphyton,
times greater when algae are presented as periphyton than when given as phytoplankton.
Casillas-Maldonado, J. I.

lateral movement of density surfaces within the subpolar gyre over the last 50 years. We
and temporal variability in the northward penetration of the MOW and the position of
westward, allowing MOW to penetrate into the subpolar gyre. We investigate the spatial
waters in the subpolar gyre block the northward flowing MOW, preventing its entry into
mid-depth property fields of the North Atlantic, questions remain regarding its influence
on subpolar waters. The salinity signature of the Rockall Trough has been conjectured
possibly linked to the NAO. It has been hypothesized that during persistent periods of strong winds, when the subpolar front moves eastward,
water in the subpolar gyre block the northward flowing MOW, preventing its entry into the
subpolar gyre. Conversely, during persistent periods of weak winds, the front moves westward, allowing MOW to penetrate into the subpolar gyre. We investigate the spatial and temporal variability in the northward penetration of the MOW and the position of the subpolar front. Using historical hydrographic data, we test this hypothesis by analyzing the temporal variability of salinity at locations north of the Strait of Gibraltar and the lateral movement of density surfaces within the subpolar gyre over the last 50 years. We present trajectories from a 1/12 FLAME model that show strong interannual variability, possibly linked to the NAO.
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EFFECTS OF INCREASING SURFACE AREA OF PERiphyton SUBSTRATES IN TILAPIA RENDALLI YIELDS IN SWINE MANURE FERTILIZED PONDS
Since over half of the operational costs in commercial aquaculture systems are related to feed, developing commercial systems that are able to produce marketable-sized fish while minimizing feed costs by incorporating natural production techniques should be interesting avenues to explore. Fertilization stimulates both the autotrophic and heterotrophic production chains, which in turn enhance fish production. Laboratory studies by Dempster, et al. (1993) have demonstrated that ingestion rates by tilapias are up to 25 times greater when algae are presented as periphyton than when given as phytoplankton. It has also been demonstrated that by supplying different substrate areas for periphyton, ponds supported fish production levels close to 70% greater than their respective controls (Azim et al., 2002). We believe an increase in substrate area may increase the amount of periphyton available as feed resulting in possible higher yields and marketable size fish. As such, we will be evaluating the effect that a substrate equivalent to 0, 100 or 200% of the surface area will have on growth in ponds fertilized with the same levels of swine manure.
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Hall, M. L., Center for Ocean Technology, U. of So. Florida St. Tampa, St. Petersburg, USA; Conmy, R. N., College of Marine Sciences, U. of So. Florida St. Petersburg, St. Petersburg, USA HI-RESOLUTION MAPPING OF THE SPATIAL VARIABILITY IN CO2/O2/N2 CDOM, & CHLOROPHYLL FLORESCENCE IN COASTAL RIVERS Monitoring and modeling the impacts of point and non-point pollution as well as water- shed driven use changes of the North Atlantic, regulations to distinguish natural spatial pat-
terns from anthropogenic ones. Yet these spatial patterns are strongly influenced the scale of their sampling program. Extensive sampling of shallow habitats as coastal rivers and estuaries in particular has been hampered by the limitations of using a few discrete grab samples to characterize large surface areas, and displaying them solely as means
and variability. We demonstrate off-the-shelf technological advances that substantially improve this situation - Integrated geographic collection and 2D mapping of chlorophyll, CDOM, dissolved gases, temperature, turbidity, and conductivity. These parameters are efficiently integrated through an inexpensive unmanned multi-instrument surface vehicle (USV), CTD/sondes, near real-time wireless multi-instrument data acquisition, GIS formatted data, and geospatial techniques. Several under appreciated natural features (i.e. tributary confluences, submarine groundwater upwelling, riparian land use patterns, and an estuarine transition) added substantial spatial heterogeneity (lateral and longitudinal) to this coastal system that might have led to mischaracterizations.
Casanor, N., Princeton University, Princeton, USA, ncasuar@princeton.edu
DiFiore, P. J., Princeton University, Princeton, USA, pdfiore@princeton.edu; Bennett, M. L., Princeton University, Princeton, USA, henderson@princeton.edu; Barnett, B. A., Princeton University, Princeton, USA, blbaurren@princeton.edu; Tilbrook, B., Antarctic Climate and Ecosystem Cooperative Research Center, and Wealth from Oceans Flagship, Hobart, Australia, Brente.Tilbrook@csiro.au AUSTRALIAN SUBANTARCTIC NET COMMUNITY PRODUCTIVITY ESTIMATES BY EQUILIBRATOR INLET MASS SPECTROMETRY
The concentration of oxygen (O2) in the surface ocean mixed layer reflects both biological and physical processes. Estimating the efficiency of photosynthesis as well as setpoint measurements of the inert gas argon (Ar). We report continuous onboard measurements of O2/Ar derived net community productivity (NCP) by equilibrator inlet mass spectrometry (EIMS) in the Australian sector of the Subantarctic zone. Based on these continuous measurements, we estimate NCP during the austral summer 2007 in the Subantarctic zone to reach around 70 mmol O2 m-2 d-1. Gross primary productivity (estimated from the oxygen triple isotope anomaly) and NCP both show significant spatial variability, with larger productivities near the Subtropical front, and a general trend of northward increase in productivity. These measurements are presented with respect to other observations which we have performed during theustral summer. We also evaluate the potential application of continuous surface ocean pCO2 measurements by EIMS based on a comparison with standard pCO2 measurements made using a sheeter type equilibrator and infrared gas analyser.
Castelao, G. P., BSMAS - Univ. of Miami, Miami, USA, gcastealo@smas.miami.edu Goni, G. J., NOAA/AOML, Miami, USA, Gustavo.Goni@noaa.gov; Song, D., NOAA/AOML, Miami, USA, Derrick.Song@noaa.gov; Chinn, P. L., NOAA/AOML, Miami, USA, Paul.Chinn@noaa.gov; Rosell, J. P., NOAA/AOML, Miami, USA, Janet.Brockett@noaa.gov; Wolfe, C., SCMIL, Terminal Island, USA, cwolfe@scmil.edu; Bringas, F., CIMAS, Miami, USA, Francis.Bringas@noaa.gov NOAA/AOML THERMOSALINOGRAPH OPERATIONS
A ThermoSalinoGraph (TSG) is an autonomous instrument designed to provide sea surface temperature and salinity along the track of a vessel when connected to the sea- water intake system of the ship. NOAA supports thermosalinograph operations on ships of the NOAA fleet and on commercial vessels participating in the Ship Of Opportunity Program. The NOAA/AOML TSG program is a collaborative effort with several other institutions. For example, in collaboration with the University of Miami one TSG is oper-
ated in the Strait of the Sea of Royal Caribbean Cruise Line. Also, and in cooperation with the Semester At Sea Program another TSG is operated in the M/V Explorer. Additionally, several cargo ships are equipped with TSGs. Most of the ships use SEAS 2000 software, developed at AOML, to acquire and transmit data in real-time. These data are quality controlled following the standard procedures recommended by the Global Ocean Surface Temperature Data (GOSUD) and disseminated globally via the GTS for climate and weather model initialization. We present here a summary of the TSG activities, relevant results, and future plans.
Castelao, R. M., Rutgers University, New Brunswick, USA, castelao@marine.rutgers.edu Glen, S., Rutgers University, New Brunswick, USA, gms@mtnrge.rutgers.edu; Scholfield, O., Rutgers University, New Brunswick, USA, osca@marine.rutgers.edu; Chant, R., Rutgers University, New Brunswick, USA, chant@marine.rutgers.edu; Wilkin, J., Rutgers University, New Brunswick, USA, wilkin@marine.rutgers.edu; Kohut, J., Rutgers University, New Brunswick, USA, kohut@marine.rutgers.edu SEASONAL EVOLUTION OF HYDROGRAPHIC FIELDS IN THE CENTRAL MIDDLE ATLANTIC BIGHT FROM GLIDER OBSERVATIONS
The first sustained glider observations in the Middle Atlantic Bight are used to describe the seasonal evolution of hydrographic fields off New Jersey. Near-surface temperatures respond to variations in insolation, while waters at depth are primarily influenced by advection of cold waters from the north in the cold-pool during spring/summer, and warming due to mixing during fall. The thermocline thickens offshore. Salinity varies pri-
marily due to river discharge and wind variations, with low-salinity waters spanning 100 km across the shelf from May to September in a 10 m thick surface layer. Surface velocity maps, satellite imagery and drifers’ trajectories revealed the existence of a jet directed offshore and to the south, from near the Hudson River mouth toward the study region, which provides a direct pathway for transporting freshwater and biogeochemical material across the shelf. Stratification increases from April through June, peaking with a maximum of 80 km from the coast. The pycnocline deepens in late summer, while the passage of storms during fall rapidly reduces the stratification. The glider high-resolution observations al-
lowed for unprecedented detailed characterization of the scales of variability.
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CONNECTIVITY IN AN OCEANIC SEAMOUNT SYSTEM: COMPARATIVE PHYLOGEOGRAPHY OF GASTROPODS WITH CONTRASTING REPRODUCTIVE STRATEGIES

Marine benthic invertebrates possess a species-specific mode of larval development. Species with planktotrophic development have larvae that spend an extended period of time in the water column, and it is commonly accepted that such species have higher levels of dispersal and gene flow than species with non-planktotrophic development. Because of the acceleration of the growth of the gastropod shell, it is possible to infer the mode of larval development of a species from the morphology of its protoconch, which is ideally retained at the top of the adult shell. For these reasons, gastropods are a good model to test connectivity between seamounts. Earlier studies have suggested that trapped water circulation generated by seamounts

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COMPARISON OF SEA SURFACE TEMPERATURE DERIVED FROM MODIS TERRA/AQUA AND SUBLITTORAL MEASUREMENTS FROM THE INNER LAGOON AND OUTER BARRIER REEFS OF SOUTHERN BELIZE

Corals are fundamental for the biodiversity and overall health of reef ecosystems. Bleaching events have occurred in the past, with widespread effects on ecosystem quality and local economy. Thermal stress has been regarded as the primary cause of bleaching in coral reef environments. In order to be able to accurately predict damaging events, it is important to have accurate data for scientific and management purposes. This study assesses the effectiveness of satellite data in providing information on the subtidal thermal environment at two distinct reef locations. Ambient seawater temperatures adjacent to corals at 3-5 m depth were measured every 15 min in the inner lagoon and outer barrier reef in southern Belize from 2002-2007. MODIS data from Terra and Aqua platforms, with a spatial resolution of 4 km, acquired during the day and nighttime, were used for comparative purposes. Our study suggests consistency in differences between remotely sensed and in situ measurements for both satellite and locations. However, daytime and nighttime satellite overpasses yield contrasting results. This study provides insights into the use of satellite versus in situ data to estimate thermal stress in corals.

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EVALUATION OF MODEL-DERIVED LOOK-UP TABLES FOR ESTIMATION OF DIURNAL WARMING IN SATELLITE-DERIVED SEA SURFACE TEMPERATURE PRODUCTS

Efforts to reference satellite sea surface temperature (SST) retrievals to a common depth and merge retrievals from multiple sensors require accurate compensation for diurnal warming effects. The use of look-up tables (LUT) derived from more detailed diurnal warming models provides a method for estimating the warming from a limited set of input fields. This paper explores the applicability and accuracy of this approach. Two different numerical models are used to generate LUT relating the surface and subsurface temperature as a function of conditions such as wind speed and insolation. The models include the warm layer portion of the COARE flux model and a version of the Kantha and Clayson parameterizations as a function of conditions such as wind speed and insolation. The models include numerical models are used to generate LUT relating the surface and subsurface temperature as a function of conditions such as wind speed and insolation. The models include numerical models are used to generate LUT relating the surface and subsurface temperature as a function of conditions such as wind speed and insolation.

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THE FATE OF THE RHONE RIVER DELIVERY TO THE COASTAL OCEAN: BOTTOM WATER AND SEDIMENT RECYCLING COUPING

Actual carbon budgets in the Rhone prodelta show large uncertainties about the fate of the particulate river inputs, especially about the processes occurring in intermediate and bottom water. Indeed, most particles undergo a rapid deposition in the sediments near the river mouth and secondary transport occurs very frequently during wind surge and river flow variations which promote resuspension. The concentration and fate of the unconsolidated sediments. These processes create a strong coupling between sediments and the lower water column and play a key role in biogeochemical transformations of Rhone river particulate inputs. In April and September 2007, oxygen profiles were measured in the sediments of the Rhone river mouth using an in situ microprofiler unit. At the same time, Suspended Particulate Matter (SPM), Particulate Organic Carbon (POC) and Dissolved Organic Carbon (DOC) measurements were performed in bottom water together with core incubations and DCR (Dark Community Respiration) experiments. All the data show a South-Western gradient reflecting the intense organic matter degradation near the mouth and the particle dispersion through the main South-East current.

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CAN KILL MIX THE OCEAN?

Previous in situ microstructure profiles of turbulent dissipation rate and estimates based on krill swimming speeds, suggest that krill-generated turbulent flow motions make a significant contribution to local and global mixing of the ocean. In the current study, we measured the velocity fields around free swimming individuals of two species of krill, Euphausia pacifica and Euphausia superba, using an infrared Particle Image Velocimetry (PIV) system. The velocity field data are used to directly calculate the turbulence characteristics in krill-generated flow fields. The krill-generated flow is characterized by a jet directed downward and to the rear with relatively large velocity magnitude in the vertical flow and smaller velocity magnitudes in the horizontal directions. This study focuses on the wake of the krill at a maximum value of 1.5 W-m-3 for Euphausia superba and 1.0 W-m-3 for Euphausia pacifica. Estimates of the turbulence generated by krill will be used to make comparisons to previous in situ observations.

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THE ROLES OF REGIONAL CONNECTIVITY, CLIMATE CHANGE AND BIOGEOGRAPHY IN SHAPING THE CORAL REEF COMMUNITIES OF THE FLORIDA KEYS

Biogeographically, the Florida Keys are situated in a crossroad between the warm-temperate waters of the Gulf of Mexico and the tropical waters of the Caribbean. While this environmental setting has set the stage for higher biodiversity in the Keys, as compared to the other major parts of the Caribbean, these same environmental conditions have made the Keys coral reef community more vulnerable to natural and anthropogenic impacts. While the overarching threat to the coral reef community of the Florida Keys has been increasing sea surface temperatures due to climate change, the affect of thermal stress on the coral reef community of the Keys has been exacerbated by secondary sources of anthropegenic pressure on the ecosystem. However, some coral reef habitats in the Keys have resisted major change in living coral cover, diversity and recruitment as compared to other coral habitats. This paper will describe how the biogeographic distribution of coral reefs in the Florida Keys have been recently influenced by a changing climate, in a region where connectivity is a major force in shaping the biodiversity of the area.

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INTEGRATING CLIMATE AND ECOSYSTEM DYNAMICS: CIRCUMPOLAR ANALYSES OF SOUTHERN OCEAN ECOSYSTEMS

Integrating Climate and Ecosystem Dynamics in the Southern Ocean (ICED) is a new multidisciplinary international programme, launched to address the challenges of integrating research on Southern Ocean ecosystems, biogeochemistry and climate at the circum-polar scale. This decade-long programme will initiate, coordinate and integrate three main areas of activity: historical data synthesis, fieldwork and model development. The ultimate goal of ICED is to improve predictions of ecosystem dynamics, including responses to climate change and harvesting. This will be achieved by developing a hierarchical set of models of ocean circulation, biogeochemical cycles and the end-to-end operation of foodwebs with differences in spatial, temporal and trophic resolutions. Understanding the processes driving ecosystem responses to climate change and harvesting is of fundamental importance in both developing management strategies for the Southern Ocean and elucidating the role of the Southern Ocean in the Earth System. For the duration of the International Polar Year ICED is operating as ICED-IPY and will provide a legacy for large-scale understanding of Southern Ocean ecosystems.

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THE IMPACT OF DISSOLVED ORGANIC MATTER (DOM) ON THE GROWTH OF ALEXANDRIUM TAMARENSE IN LABORATORY CULTURES

Several algal species responsible for harmful algal blooms (HABs) have recently been found to mixotrophic under certain environmental conditions. One such organism, Alexandrium tamarense, is found in red tide blooms which cause paralytic shellfish poisoning (PSP) in the Gulf of Maine. The ability to switch between photosynthetic and hetero-
trophic modes of nutrition may play a role in the timing and severity of HABs in coastal regions. Studies up to this point have linked increases in inorganic nutrient concentrations to HABs, but have been unable to develop a consistent method of predicting HABs and PSP outbreaks based solely on inorganic nutrient inputs. In this study we looked at the impact of nutrients found in dissolved organic matter (DOM) on the growth of Alexandrium tamarense cultures. DOM is a reservoir of organic forms of nutrients, like nitrogen and phosphorus. It is ubiquitous to all natural waters and plays a role in global nutrient cycling. Based on changes to DOM character in laboratory cultures, we hypothesize that Alexandrium uses DOM to enhance growth in the coastal zone during HAB events.

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CROSS-SHORE DIFFERENCES IN MESOZOOPLANKTON EXAMINED USING DIGITAL IMAGE ANALYSIS
As part of the California Current Ecosystem Long-Term Ecological Research (CCE-LTER) site, mesozooplankton samples were analyzed along a cross-shore transect off of Point Conception, California to determine if there are predictable spatial patterns in assemblage composition, size distribution, and/or abundances. By understanding spatial differences in mesozooplankton, we hope to be able to better interpret and predict how patterns may change through time, including over climate scales. Preserved samples were analyzed using a digital scanner (ZooScan) combined with image analysis software to define regions of interest (ROIs), make morphometric measurements, and classify images. A training set was created by manually classifying more than 10,000 images. This training set was used in a Random Forest algorithm to classify all scanned images. Preliminary results suggest that there are changes in cross-shore abundances, although patterns differ among taxa and between years. Copodops are the most numerically abundant organism at all stations along the transect. However, they make up a lesser portion of each sample when compared by relative biomass. The use of digital imaging leads to more efficient analysis of plankton samples.

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A COUPLED WAVE-CURRENT MODEL FOR STORM SURGE PREDICTION
The storm surge generated by a hurricane can cause significant flooding at the coastal areas as megarides. Waves are to be considered as the storm surge if the essential conditions to produce them exist. One such case was during the peak surge period of Hurricane Isabel when the surface wave was propagating with the flood currents and the significant wave height was as high as the surge height, reaching up to 2 meters, with a period of 5 seconds at York River. Forecasting inundation and flow conditions during such a complex incident will require modeling the interactions between waves and currents. In order to accomplish this goal, the unstructured three-dimensional hydrodynamic model UnTRIM is coupled with the third generation unstructured wave model UnK-Model. The effect of waves on wind stress, bottom shear stress, and radiation stress is accounted in storm surge and inundation modeling while the effects of water levels and currents are included in the wave model with a two way coupling. The ability of the coupled model is tested with a rare dataset taken during Hurricane Isabel.

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MIXING INDUCED IN OCEANIC OVERFLOWS AND DENSE GRAVITY CURRENTS: A NEW ENTRAINMENT PARAMETERIZATION
This study proposes a new empirical parameterization for entrainment in dense currents that has been obtained using a data set which includes oceanic and laboratory data. The proposed parameterization presents two novelties compared to the present available parameterizations. First, it depends on both the Froude number, Fr, and Reynolds number, Re, of the flow and it accurately predicts both ocean and laboratory estimates of mixing. Second, it takes into account subcritical (Fr>1) mixing. The subcritical mixing observed in previous laboratory experiments could be of fundamental importance when determining the final water mass characteristics of a dense current descending the continental slope. A weak, but non zero entrainment can substantially change the final density and location in the open ocean water column of important water masses, such as the North Atlantic Deep Water. To test this new entrainment parameterization, we used a stream tubemodel employing both the new and classical parametrizations. The stream tube model predictions are consistent with previous laboratory observations when the new entrainment parameterization is used.

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NUTRICLINE DEPTH, MIXED LAYER DYNAMICS, AND THE BALANCE BETWEEN DIATOMS AND COCCOPLATHOPHORIDS IN THE OCEAN
Over the past fifty millions of years, the balance between diatom and cocolithophorid production has played a key role in marine biogeochemical cycles, controlling the rate of carbon transfer between the atmosphere and the ocean, and contributing to stabilize long-term atmospheric carbon dioxide levels. Here we analyze phytoplankton community composition across latitudinal gradients in the Atlantic Ocean to show that the balance between diatoms and cocolithophorids is dependent upon the nutrient depth, a proxy of nutrient supply into the euphotic layer. We find a clear shift from diatom- to cocolithophorid-dominated assemblages as water column stratifies and nutrient deepens in the ocean (i.e., increasing nutrient stress). Consistent with their divergent life-histories, our analysis reveals that this compositional shift is a result of dramatic changes in diatom biomass and diversity with cocolithophorids exhibiting a reduced response to environmental variability. These findings highlight a strong mechanistic linkage between upper ocean turbulence, nutrient exchange dynamics, and phytoplankton community composition with profound implications on Earth’s climate.

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SUBANTARCTIC MODE WATER AND ANTARTIC INTERMEDIATE WATER FORMATION
The formation of Subantarctic Mode Water (SAMW) and Antarctic Intermediate Water (AAIW) is analyzed using WAM淋al analysis for years 2005 and 2006. Air-sea heat fluxes in the Southern Ocean (SO) are not well known. Therefore we examine several heat flux estimates (HF) and ECMWF products. Coastal mixing and the effects of SOCE and ECMWF input variables as well as HF from the Southern Ocean State Estimate (SOSE; Mazloff, Heimburg and Wunsch, 2007). For the sea surface density field we use NCEP ECMWF and Advanced Microwave Scattering Radiometer SST and the best available surface salinity estimates (combination of float data and climatology). SOSE provides its own sea surface density. SAMW is formed on the equatorward flank of the Subantarctic Front by progressive cooling in winter months. Global formation rates obtained from WAM淋al analysis for 805 to 2055 at 14 deg C, 10 - 11 deg C and 4-5 deg C, corresponding to SAMW in the Atlantic, Indian and Pacific respectively: SOSE formation rates are 3 Sv (36 Sv) of 14 deg C water, 15 Sv (2.5 Sv) of 10 - 11 deg C and 15 Sv (5.25 Sv) of 4-5 deg C in years 2005 (2006). Both NCEP HF with SOSE SST and Coare with NCEP input variables have similar peaks as SOSE; Coare and SOSE formation rates are comparable, but NCEP HF formation rates are much higher due to excessively high heat loss during intense cooling episodes. Formation of progressively colder waters is apparent in the monthly analysis for the Atlantic and Pacific.

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THE PATHOGENIC EFFECTS OF VIBRIO SPECIES ON CLONAL SYMBIODINIUM
Genetically similar Vibrio strains coupled with thermal stress are pathogenic in Caribbean and Pacific coral species, causing an impairment of the relationship between coral host and its endosymbiotic zooxanthellae. Vibrio isolated from corals with yellow band disease (YBD) specifically target isolated clones of zooxanthellae. Symbiodinium clade subtypes C1, D, and B1 were inoculated with four yellow-band causing Vibrio spp and a single Vibrio str. Toxicity during thermal stress and Vibrio infection was highest in CLADE C1 when compared to D1 and B1. These data suggest that initially, V. strain K has a stimulatory effect on the cell cycle zooxanthellae compared to the Vibrio consortium in this in vitro study. However, over time the toxicity of these Vibrio strains are severely impairing to the cell-cycle of all Symbiodinium CLADE sub-types in vitro. Cytological examinations of all treatments show a decrease in chlorophyll, cell size, cell lysis, degenerative cells are more evident in heat treated zooxanthellae, compared to controls. These data suggest that metabolically weakened symbiotic algae are not more susceptible to Vibrio infection coupled with thermal stress and that toxin production and pathogenicity is further evident within a Vibrio consortium.

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AN ENERGY-CONSTRAINED PARAMETERIZATION OF EDDY BUOYANCY FLUX
A parametrization for eddy buoyancy fluxes for use in coarse-grid models is developed and tested against eddy-resolving simulations. The development is based on the assumption that the eddies are adiabatic (except near the surface) and the observation that the flux of buoyancy is effected by barotropic, depth-independent eddies. Like the previous parametrizations of Gent and McWilliams (GM) and Visbeck et al. (VMHS), the horizontal flux of tracer is proportional to the local large-scale horizontal gradient of tracer, through a transfer coefficient assumed to be given by the product of a typical eddy velocity scale and a typical mixing length. The proposed parametrization differs from GM and VMHS in the selection of the eddy-velocity scale, which is based on the kinetic energy balance of baroclinic eddies. The three parametrizations are compared to eddy-resolving computations in a variety of forcing configurations and for several sets of parameters. The VMHS and the energy-balance (EB) parametrizations perform best in the tests considered here.

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AN ENERGY-CONSTRAINED PARAMETERIZATION OF EDDY BUOYANCY FLUX
A parametrization for eddy buoyancy fluxes for use in coarse-grid models is developed and tested against eddy-resolving simulations. The development is based on the assumption that the eddies are adiabatic (except near the surface) and the observation that the flux of buoyancy is effected by barotropic, depth-independent eddies. Like the previous parametrizations of Gent and McWilliams (GM) and Visbeck et al. (VMHS), the horizontal flux of tracer is proportional to the local large-scale horizontal gradient of tracer, through a transfer coefficient assumed to be given by the product of a typical eddy velocity scale and a typical mixing length. The proposed parametrization differs from GM and VMHS in the selection of the eddy-velocity scale, which is based on the kinetic energy balance of baroclinic eddies. The three parametrizations are compared to eddy-resolving computations in a variety of forcing configurations and for several sets of parameters. The VMHS and the energy-balance (EB) parametrizations perform best in the tests considered here.
CIRCULATION AND DEMOGRAPHIC MODELING OF THE STRUCTURING OF MARINE POPULATIONS ON REGULAR COASTLINES

Headlands in alongshore coastal flows create filaments and downstream recirculations advecting planktonic larvae away from or retaining them over suitable habitat. Coastal circulations and larval dispersal were modeled using the Regional Ocean Modeling System along Gaussian shaped headlands patterned after the Central California coast with larvae characterized after the larval life history traits of kelp bass. Numerical simulations are used to understand how unidirectionally seeded fish larvae disperse and settle around headland locations. For small, 5 km headlands, we find no preferential settlement distribution around headlands. For larger, 10 km headlands, spatial patterns of enhanced settlement around headlands emerge. The spatial settlement patterns continue to change with larger amplitude headlands. The impacts on marine populations of the spatial settlement patterns induced by the flow are explored with a demographics model parameterized to consider abiotic (settlement patterns) and biotic (density dependence, harvest, fecundity) factors.

Meeting Abstracts
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BLENDED SEA SURFACE TEMPERATURE DATA SET FROM MULTIPLE SATELLITES AND IN-SITU OBSERVATIONS FOR COASTAL OCEANS

A two-dimensional variational (2DVAR) method for blending sea surface temperature (SST) data sets from multiple observing platforms is presented. The method produces globally continuous fields and has the capability of blending multiple satellite and in-situ observations together. The method allows specification of individual characteristics and background correlations, which are a common feature of coastal ocean regions. The blended SST fields for August 2003 covering the central California coastal region at high spatial (6 km) and temporal (6 hours) resolution were produced to demonstrate and evaluate the methodology. A comparison of these fields with independent observations revealed root mean squared errors of less than 1°C, comparable to the errors of conventional SST observations. The blended SST fields clearly reveal the fine-scale spatial and temporal structures associated with coastal upwelling in this region, demonstrating their utility in the analysis of fine-scale flow structures. In addition, we will produce a 5-km SST data set using this method and compare it with the existing the Global Ocean Data Assimilation Experiment (GODAE) merged product from the UK Met Office. Plans to produce a higher resolution SST product on the order of 1-km will be discussed.

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EFFECTS OF SHORT TERM STABILITY VARIABILITY ON WATER COLUMN AND NEAR BOTTOM BIOCHEMICAL PROPERTIES OF THE WESTERN LOUISIANA SHELF

We present observations of water column stability, current velocity profiles, and hydrographic parameters taken at several long-term (12-36 hours) stations on the western Louisiana shelf during spring and summer of 2005 and 2007. The stations were in 20 m total depth and at locations historically known to experience hypoxia. Richardson number estimated from a bottom mounted RDCP and lowered CTD system show considerable station to station variability and super-inertial temporal variability related to physical forcing. On several occasions, oceanographic fronts associated with freshwater plumes emanating from the Mississippi or Atchafalaya Rivers passed over the observation location and dramatically changed the water column stability. Subynophycous dissolved oxygen concentrations fell and nutrient concentrations increased, consistent with local benthic oxygen demand and nutrient remineralization. Stations were observed to go from non-hypoxic to hypoxic and back to non-hypoxic in just a few hours. Longer term moored observations confirm these results and show significant variance and stability-bottom oxygen coherence at diurnal and higher frequencies. The results can have implications and impact on management and monitoring strategies for the Louisiana Deadzone.

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Using QRT-PCR of the FE STRESS RESPONSE GENE ISIB TO RELATE N FIXATION RATES AND GROWTH UNDER DIFFERENT FE CONDITIONS IN TRICHODIEMUM

To aid in defining the threshold of iron (Fe) required by Trichodesmium in situ, we have developed a molecular diagnostic for Fe stress using quantitative reverse transcription PCR (qRT-PCR) of the Fe stress response gene isiB. Trichodesmium sp. are the dominant nitrogen [N] fixing cyanobacteria in the tropical and subtropical oceans, regimes frequently characterized by low Fe concentrations. Trichodesmium sp. have been shown to require higher amounts of Fe than other non-diazotrophic photoautotrophs, and Fe-limited laboratory culture experiments have shown that Fe availability can affect N fixation rates. Despite these data, there is limited information about the mechanisms and controls of Trichodesmium Fe acquisition and what levels of Fe in the ocean correspond to a reduction in N fixation capabilities. Using qRT-PCR analysis of isiB expression we have shown that detected gene expression levels correspond to specific reductions in N fixation rates in Trichodesmium.

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TRACE METAL BIOGEOCHEMISTRY IN KARSTIC SOUTHERNFLA ESTUARIES

Despite being a major vector for the land–ocean transport of materials, the role of groundwater in oceanic elemental mass balances has been poorly characterized. And where groundwater has been explicitly considered, most studies have not quantified the importance of chemical transformations that occur during the mixing of meteoric water with saline pore water (the subterranean estuary or STE) prior to surface water discharge. Here we examine the importance of karstic coastal hydrogeology on the flux of trace elements from STEs. Data from two field sites will be presented: the Yucatan Peninsula and southwest Florida. There exists an interesting contrast with aluminosilicate-dominated STEs where the freshwater discharge is high enriched in labile anions with evidence for removal during mixing with ocean water. These subterranean karstic systems tend to be reducing environments, which appears to be a common thread among many other STEs regardless of the aquifer lithology; the geochemistry of uranium, iron, and other redox sensitive trace metals will also be discussed. Lastly, radium isotopes and radon-222 will be used to quantify the potential oceanic fluxes of these elements that may be occurring due to submarine groundwater discharge.

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HOW DO PLANETARY WAVES INFLUENCE THE PRIMARY PRODUCTION IN THE NORTH ATLANTIC OCEAN?

Planetary waves play a major role in the dynamics of the oceans, but their role is not limited to the physics. In fact, several studies (e.g. Machu et al., 1999; Copilotti et al., 2001; Uz et al., 2001; Charría et al., 2006) have shown that these waves have a distinct signature on surface chlorophyll concentrations. These observations, made possible by the advent of remotely sensed ocean colour data, prompt several important questions: How do planetary waves influence surface chlorophyll concentrations? Which vertical or horizontal coupled processes are involved? Have planetary waves a measurable influence on primary, new and exported production? Is that influence significant within the global ocean carbon cycle? The aim of this study is to quantify the impact of these waves on primary production; to this purpose, a 3D coupled physical/biogeochemical model is implemented in the North Atlantic. Results so far show local primary production increases associated to the chlorophyll wave crest at different latitudes. The net impact of these waves on primary production is estimated by filtering out the planetary waves in the coupled simulations.

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GLOBAL OCEAN PREDICTION WITH THE HYBRID COORDINATE OCEAN MODEL (HYCOM): AN OVERVIEW

A broad partnership of institutions has been collaborating over the past few years in developing and demonstrating the performance and application of an eddy-resolving real-time global and basin-scale prediction systems using HYCOM. The partnership is addressing the Global Ocean Data Assimilation Experiment (GODAE) goals of three-dimensional depiction of the ocean state and real-time and provision of results for regional conditions for coastal and regional models. This presentation will highlight the achievements made by the HYCOM consortium and summarize the lessons learned along the way.

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INTER-ANNUAL VARIABILITY AND SHELF WATER ENTRAINMENT OF GULF STREAM WARM-CORE RINGS

An analysis of satellite-derived sea surface temperature observations of Gulf Stream warm-core rings (WCRs) has been completed between 75° and 50°W from 1978 – 1999 to understand (1) inter-annual variability of WCRs occurrences, and (2) role of WCRs in entraining shelf water from the outer continental shelf to the Slope Sea (SS). Results indicate a significant response between WCR formation and large-scale atmospheric variations related to the state of the North Atlantic Oscillation (NAO). Adjustment to NAO-induced wind forcing is hypothesized to impact the eddy kinetic energy distribution and related baroclinic instability structure of the Gulf Stream, thus affecting WCR formation rates. A quasi-geostrophic approximation of the potential vorticity equation is used to determine volume fluxes of shelf water entrained by WCRs into the SS. The total mean annual shelfwide WCR-induced shelf water transport is 23700 km³ year⁻¹ (0.75 Sv), which accounts for 25% of the total transport in the SS region adjacent to the outer continental shelf. Results suggest that increased (decreased) occurrences of WCRs observed during positive (negative) phases of the NAO create higher (lesser) WCR-induced shelf water fluxes.

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OBSERVATIONS OF STRONG SUBMESOSCALE ANTICYCLONE AND ASSOCIATED FRONTogenesis NEAR AN ISLAND

Observations of surface currents by high-frequency radio current meters, and satellite altimeters, scatterometers and radiometers, are used to document the generation and evolution of a strong submesoscale anticyclone west of Oahu, Hawaii in October 2002. It may have been caused by Ekman pumping associated with island orographic effects on the trade winds, or by boundary layer shear along the coast due to the mesoscale jet. Within three days, the anticyclone reached an extremum negative surface vorticity of 1.5 × 10⁻⁵ s⁻¹, with a solid-body core of 17 km radius and azimuthal velocity of u ≈ 35 cm/s. It slowly decayed to less than 5 days later, possibly as a result of centrifugal instabil- ity. It was in cyclogeostrophic balance to first order. During this period, the anticyclone was trapped between the coast and a larger cyclone to the west, and a second cyclone to the southeast. A front developed between the western cyclone and the anticyclone, as warm water from the southwest was advected northward, and cold water from the north- east southward. The front was divergent (u = 0.2 m/s) and anticyclonic (u = 0.25 m/s) on its warm side, and convergent (u = 0.25 m/s) and cyclonic (u = 0.15 m/s) on its cold side, counteracting the production of density gradient by eddies straining the temperature field. Finally, as the western cyclone drifted westward, the front disappeared and the anticyclone broadened and weakened.

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BREAKING NEW GROUND: USING REMOTE SENSING AND MODELING IN OPERATIONAL FORECASTING OF FISHERIES

Ecological forecasting of fishery yields in the face of climate variability has eluded resource managers for decades. Recent advances in observing systems, computational power and understanding of ecosystem function offer evidence that the variability of the ocean eco-system and its impact on fishery yield can be forecast with enough lead time to be useful to society. Accurate and timely forecasts can provide the information needed to maintain the long-term sustainability of fish stocks and protect the ecosystem, while maximizing social and economic benefits and preventing wasteful overinvestment of economic resourc-es. In this contribution we present efforts to enhance the current decision support system for the small pelagic fishery and upwelling ecosystem in the coastal ocean off Peru with remote sensing information and state-of-the-art coupled physical-biogeochemical three-dimensional ocean models. This region has the world's largest single-species fishery, the Peruvian anchovy, which is supported by the world's most variable ocean ecosystem. No other ocean region has this combination of environmental observations, fish resources, fisheries monitoring and well validated climate forecast models for forcing high-resolution operational ecosystem models.

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EFFECTS OF HIGH CO2 ON OTOLITH GROWTH OF A MARINE FISH

Otoliths are sensory bones in fish and made of alternating layers of aragonite and protein. We hypothesized that otoliths of fish grown from egg through yolk-sac stage in seawater with 380 (control) and 2500 (treatment) µatm CO2 levels if our results are appear consistent with those described above. We

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AN UNSTRUCTURED GRID, FINITE-VOLUME COASTAL OCEAN MODEL (FVCOM): APPLICATIONS TO MULTI-SCALE COASTAL AND ESTUARINE SYSTEMS

A team of University of Massachusetts-Dartmouth and Woods Hole Oceanographic Institution researchers has developed a new prognostic, unstructured-grid, Finite-Volume, free-surface, 3-D primitive equation Coastal Ocean circulation Model (called FVCOM) for physical and coupled physical/biological studies in coastal and estuarine regions char-acterized by complex coastlines and bathymetry and diverse forcing. Both hydrostatic and non-hydrostatic versions of FVCOM have been applied to study multi-scale dynamical processes observed in coastal oceans and estuaries. Several examples will be presented here to illustrate how well an unstructured-grid model can capture complex dynamics and kinematics characterized by multi-scale interaction in realistic settings. An integrated interdisciplinary-atmospheric-ocean model system including WRF/AMM, FVCOM, un-structured-grid, finite-volume versions of SWAN, CICE (ice model), generalized biologi-cal model, and sediment transport model as well as advanced data assimilation modules will be introduced along with hindcast validation experiments in the Gulf of Maine/New England Shelf region. Some critical issues relevant to data assimilation, model assessment, and hindcast time forecasting that we have learned from the development of the Northeast Coastal Ocean Forecasting System (NECoFS) are also discussed.

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ESTIMATES OF SPREADING IN A NEAR-FIELD RIVER PLUME FROM OBSERVATIONS AND MODEL SIMULATIONS

Data collected from the near-field region of the Merrimack River (Massachusetts) plume were analyzed to examine the plume spreading. Estimates of the plume spreading rate were derived from the CTD and ADCP data using a control volume method, and a direct assessment of the spreading of clustered surface drifters. Additionally, plume spreading...
It has been previously shown that saxitoxin resistance in bivalves is linked to a single experimental data. Implications of the results for the improvement of ocean simulations

...ary model that acts as an functional domains of the protein. This insertion is very close to an "IFM" or "MFM" mutation, one (type 1) has a three-amino-acid insertion between the third and the fourth functional domains of the protein. This insertion is very close to an "IFM" or "MFM" (Isoleucine, Methionine, Valine), Phenylalanine and Methionine motif that acts as an inactivation gate, opening and closing the channel. The insertion may change the position of this motif when it is plugged in the channel, thereby affecting the sodium ion flow into the cell, and accounting for toxin resistance. If so, this mutation represents a different mechanism of resistance from that found in bivalves.
A simple conceptual analysis indicates that the existence of a horizontal density gradient develops Rossby waves dynamically and vertically. For the stratified northern RG, we find the eddy dissipation effect to be important as well.

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AXIAL WIND EFFECTS ON STRATIFICATION AND LONGITUDINAL SALT TRANSPORT IN IDEALIZED, PARTIALLY MIXED ESTUARIES

A 3D hydrodynamic model (ROMS) is used to investigate the axial wind control on stratification through straining of longitudinal density field and the associated longitudinal salt transport. The model mimics a straight, 400km-long estuarine channel connecting to a shelf sea. Modifying the horizontal Richardson number by incorporating the Wedderburn number (2\sigma/\rho g H), the ratio of wind stress to baroclinic pressure gradient, to include wind straining effects is shown to better represent the subtidal variations in stratification. When \( W < \sigma(1) \), axial wind has negligible effects on stratification. When \( W – O(1) \), down-estuary wind strain enhances stratification, whereas up-estuary wind reduces it. At the onset and end of the wind events, the subtidal cross-sectional averaged volume fluxes resulting from barotropic adjustment drive strong transient salt fluxes. During a down-estuary wind event, subtidal shear dispersion increases due to enhanced stratification and vertical shear. The opposite effect occurs during an up-estuary wind event. The adjustment time for the salt structure is much longer than the event time scale. Supporting observations from upper Chesapeake Bay are provided.

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2DH MODELING OF WAVES, CURRENTS AND SEDIMENT TRANSPORT AT FRF DURING HURRICANE ISABEL

Hurricane Isabel is regarded as the most significant storm event in the 27-year history of the USACE Field Research Facility (FRF) at Duck, North Carolina. Large waves together with high suspended and nearshore currents and significant morphological changes at the FRF. The bathymetric changes during the storm event were estimated from the pre- and post-storm profile measurements and indicated a 2D feature of bathymetric evolution. In this study, we developed a 2D modeling framework that couples the wave model SWAVE, a quasi-steady nearshore circulation model STCIRC and a sediment transport model for simulations of nearshore waves, currents and sediment transport at the FRF during the storm. The coupled nearshore model is nested in a large-scale storm surge model, supplying large-scale forcing such as wind-induced currents and tidal currents as boundary conditions for the nearshore model. The sediment model is based on the transport algorithm developed recently by Kobayashi (2007). It presents the basic mechanics of sand suspension and bedload movement on beaches and calculates bedload and suspended load sediment transport by waves and currents. The model is applied to a 7-day simulation of the storm event. The model results are compared with available data at the FRF.

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DETECTION OF HARMFUL ALGAL BLOOMS FROM SPACE: A METHOD USING ARTIFICIAL INTELLIGENCE AND MODERN REMOTE SENSING

There has been considerable amount of effort attempting to identify harmful algal blooms (HABs) using satellite remote sensing, whose synoptic and repeated coverage provides unique and timely information for HAB studies. Due to uncertainties associated with the satellite data products and algorithms, however, the results are not always satisfactory. In particular, it has been fundamentally difficult to estimate chlorophyll-a concentrations (Chl), an index for phytoplankton bloom, in optically complex coastal waters. Using fluorescence line height (FLH) and spectral reflectance data from the MODIS satellite sensor as well as Karenza brevis concentration data from in situ survey on the west Florida shelf, we find a fuzzily developed and improved a fuzzy clustering algorithm. MODIS FLH can effectively differentiate phytoplankton blooms from non-biogenic waters (e.g., waters rich in colored dissolved organic matter or CDOM), while the spectral reflectance data are used to differentiate highly turbid waters caused primarily by sediment resuspension. The validity of the method is tested against in situ sampling results.

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IMPACT OF TEMPERATURE AND SALINITY ASSIMILATION ON THE GLOBAL BIOGEOCHEMICAL PARAMETERS DISTRIBUTION

This is a study examining the impact of data assimilation on multidecadal timescales. The model we examine is the NCEP CSM ocean General Circulation model with Donny et al. (2003) biogeochemistry. The experiments presented span the 20 year period 1985-2004. The problem we consider is determining the impact of data assimilation, which clearly improves representation of physical processes, on the evolution of biogeochemical processes. The results show that the assimilation (based on SODA) has considerable impact, including increases in surface chlorophyll concentration in the North Atlantic during the spring bloom due to mixing across the thermocline, as well as increases in the tropical Pacific and Indian Oceans in response to enhanced upwelling. CO2 uptake in the North Atlantic is reduced, but outgassing in the eastern Pacific increases. On decadal timescales near surface total carbon varies strongly due to increasing in vertical exchange in the extratropics and increasing upwelling near the equator. Further experiments are being carried out to elucidate these processes.

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A SYNOPSIS VIEW OF THE VORTICITY BALANCE OF THE SUBANTARCTIC FRONT IN THE SOUTHEAST PACIFIC

In late austral winter 2005, the formation of Subantarctic Mode Water (SAMW) and Antarctic Intermediate Water (AAIW) was observed in deep mixed layers adjacent to and north of the Subantarctic Front (SAF) in the southeast Pacific. The SAF presents a relatively strong barrier to meridional exchanges, but it provides a salinity cutoff for SAMW and AAIW from the Pacific to the Atlantic through the Drake Passage. The regional dynamics of the SAF in the southeast Pacific are diagnosed through its vorticity structure. The SAF is characterized by meanders of wavelength about 300 km over the relatively smooth to rough topography upstream of Drake Passage. The barotropic or depth-averaged vorticity exhibits a balance between advection of planetary vorticity and relative vorticity, as would be seen in a Doppler-shifted short barotropic Rossby wave in a mean flow. The depth-dependent vorticity balance implies a surface divergence which is balanced at depth by a divergence of the opposite sign.

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HYDRODYNAMICS OVER HOLLOW IN ESTUARIES

Observations of flows over the hollow (bathymetric depressions) in the lower Chesapeake Bay showed that current speed increases during flood tides and decreases during ebb tides.

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RECENT ADVANCES IN REMOTE SENSING OF ESTUARINE WATER QUALITY: AN EXAMPLE IN TAMPA BAY, FLORIDA, USA

Using Tampa Bay as an example, we present some latest advances in the remote assessment of several key water quality indices (turbidity, colored dissolved organic matter (CDOM), and water clarity) in estuarine waters using MODIS and SeaWiFS. After proper calibration and data quality control, MODIS remote sensing reflectance (Rrs) at 645 nm (250m) showed high correlation with in situ turbidity (0.8-0.8 NTU), with RMSE of ~ 28% in the modeled turbidity. Res ratios of 469/555 (500m) and 488/551 (1km) were highly correlated with in situ CDOM or PCU color measurements. Application of a semi-analytical algorithm to SeaWiFS data significantly improved estimates of the attenuation coefficient at 490 nm (Kd(490)) over the traditional band-ratio algorithm, as indicated by the high correlation with in situ Secchi Disk Depth. In addition, light penetration depth was also estimated reliably from SeaWiFS using a novel algorithm. These algorithms are robust and consistent for most of the Bay waters in all seasons, and thus greatly facilitate time series analysis for monitoring environmental changes. However, estimating chlorophyll concentrations in Tampa Bay is still a challenging task.

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The document does not appear to contain any relevant content for the task at hand.
buoy and biological/chemical tracers) are assumed. Such an inverse Lagrangian prediction problem is difficult to solve due to: uncertainty in current and wind fields, chaotic trajectories over convergent and divergent flows, deployment constraints, and multi-modal drift characteristics. We seek a solution using an ensemble of simulated trajectories describing a set of possible deployment locations/times. A simple ensemble of backward trajectories often leads to a distribution too diffuse to be practical, due in part to deficiency in the number of trajectories to sample the true distribution adequately. We propose a method that constrains the ensemble's spread sequentially and show that it can lead to a multi-modal distribution of several hot spots that may be more practical to base a deployment strategy. Demonstration based on actual problems (e.g., search-and-rescue) will be given.

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REDUCED EQUATIONS FOR QUASI-3D LANGMUIR TURBULENCE

"Langmuir turbulence" is a wind and wave driven flow that dominates vertical transport within the ocean surface mixed layer. Observations suggest that Langmuir turbulence is constrained, in that vertical structures elongated in the wind direction are preferred. By exploring the Craik–Leibovich (CL) model of Langmuir circulation in the strong wave-forcing limit, we identify the source of this slow downwind variability. We leverage this limit using multiple-scale asymptotic analysis to derive a reduced set of PDEs governing quasi-3D Langmuir turbulence. Linear and secondary (i.e., nonlinear) stability analyses show that the reduced equations economically capture the key 3D instabilities. The derivation of this reduced model is a first step in an effort to investigate the interaction of mesoscale eddies with mixed-layer turbulence.

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DEGRADATION OF DISSOLVED ORGANIC CARBON IN PERMEABLE SEDIMENTS

Coastal sea water is characterized by high concentrations of dissolved organic matter (DOM) and is pumped by bottom currents through the upper layers of permeable sand sediments that cover large portions of the continental shelf. Within these sediments, DOM is exposed to enzymes of a large and diverse microbial community that colonize the sand grains. We tested the hypothesis that a fraction of the DOM is degraded while passing through the sediment. Through a combination of in-situ measurements in the Gulf of Mexico and laboratory column reactor experiments, we examined the role of filtration process on DOM transformation. Our results suggest that filtration through permeable shelf sediments promotes the degradation of DOM.

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EULERIAN AND LAGRANGIAN STATISTICS AND DISPERSAL IN NUMERICAL MODELS

Dispersion in the ocean is intimately bound up with Lagrangian and Eulerian timescales. Thus implicit in numerical methods for simulating larval dispersal in the ocean is the assumption that the time and length scales of currents in the models reflect reality. We compare Lagrangian and Eulerian statistics from two models (a numerical model and a ‘hybrid’ model, where currents are derived from satellite altimetry) with direct observations from Global Drifter Program surface drifter and Topo-Poseidon altimeter data to see how well the models reflect reality. Middleton (1985) suggests that under certain conditions the Lagrangian and Eulerian velocity autocorrelations and spectra are linked by simple transformations in terms of the ratio of Lagrangian to Eulerian timescales. The ratio of Lagrangian to Eulerian timescales is a measure of eddy length scales in the ocean. Our previous work has suggested that this ratio is about 0.1 in the Tasman Sea. We find that the ratio of Lagrangian to Eulerian timescales in the models tends to be higher than in reality, but that overall dispersal is not too different from the real ocean.

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DYNAMICS AND INTERNAL STRUCTURE OF THE CROSS-SHELF CIRCULATION DURING WIND-DRIVEN COASTAL UPWELLING

A two-dimensional theory of wind-driven coastal upwelling is developed that is comprised of a surface Ekman layer; an interior frictionless layer, and a frictional bottom boundary layer. The theory is built upon the Lentsh-Chapman upwelling theory, which has been used to demonstrate the importance of nearshore cross-shelf momentum flux divergence during upwelling. The new model retains spatially-varying structure in the interior density and velocity fields. The dynamical model for the interior flow is based upon the nonlinear upwelling theory of Pedlosky, which maintains thermal wind balance between the cross-shelf density gradient and the vertical shear in the alongshelf velocity while retaining the cross-shelf advection of density and alongshelf momentum. The structure of the cross-shelf circulation is studied as a function of alongshelf wind stress and Burger number $N = \alpha / \xi$, where $\alpha$ is the topographic slope, $N$ is the buoyancy frequency, and $\xi$ is the Coriolis parameter. Predictions of the dynamical model are compared with two-dimensional numerical model simulations. During upwelling winds, the dynamical model predicts interior onshore flow high in the water column for large Burger number, and offshore flow in the bottom boundary layer for small Burger number, consistent with the numerical model and with observations.
Leg 171, Site1049) or core photos. Our exercises illustrate essential Earth and Physical Science concepts, and the hope is to allow students to make the connection between the concept and the evidence observed in the sediment. These include the relationship between climate and sediment type, isolation, classification of grain size, and the Cretaceous A Tertiary boundary. The target ages range from middle and high school, to early undergraduate, although all can be adapted for use at any level.

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OPTIMAL SPECTRAL DECOMPOSITION (OSD) FOR RECONSTRUCTING SURFACE OCEAN CIRCULATIONS FROM SATELLITE ALTIMETRY

The Ocean Surface Current Analyses - Real Time (OSCAR) data for world oceans (59.5 S to 59.5 N) are derived from satellite altimeter (JASON-1, GFO, ENVISAT) and scatterometer [e.g., QuikSCAT] for various uses including research and operations. The methodology for OSCAR combines geostrophic, Ekman and Stommel shear dynamics, and a complementary term from the surface buoyancy gradient. A major weakness of the OSCAR dataset is its inability to represent the currents near the lateral boundary. The most evident western boundary currents such as the Gulf Stream and Kuroshio are missing. Besides, the data are quite noisy. To improve the OSCAR data, the optimal spectral decomposition (OSD) method is used to reconstruct the OSCAR data. The basis functions are the eigenfunctions of the Laplacian operator with the given boundary conditions. A cost function used for poor data statistics is introduced to determine the optimal number of basis functions. After the OSD analysis, the reconstructed OSCAR data show realistic surface circulations including western boundary currents such as Gulf Stream, Kuroshio, Brazil Current, Somali Currents, and eastern boundary currents such as California Currents, Peru Currents, etc. Comparison of the reconstructed OSCAR data to in situ current measurements and OGCM model results is also provided.

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LATERAL EXPORT FLUX OF ORGANIC CARBON IN THE EAST CHINA SEA

The East China Sea (ECS) has been regarded as a potential sink for carbon dioxide. Simply speaking, the adsorbed carbon must be exported from the ECS to maintain a carbon balance of the ocean. Several studies have revealed that the lateral carbon transport is significant in the ECS. Corresponding to particulate organic carbon (POC), dissolved organic carbon (DOC) and POC export flux were measured along several cross-shelf transects in 2006 and 2007. Strong spatial carbon gradient across-shelf was found in both summer and winter suggesting that carbon in the ECS can be exported via horizontal transport. Vertical export flux of POC in the ECS is estimated from 0.1 to 0.8 gC/m²/d. In addition, both size-fractionated particulate and dissolved organic carbon (POC and DOC) export fluxes of Th-234 and carbon were measured in the ECS and the results demonstrated that the ECS may be exported via horizontal transport. Vertical export flux of POC in the ECS was estimated from 0.1 to 0.8 gC/m²/d. In addition, both size-fractionated particulate and dissolved organic carbon (POC and DOC) export fluxes of Th-234 and carbon were measured in the ECS and the results demonstrated that the fraction of small particles accounted for at least 50% of total Th-234 and carbon fluxes. The estimated lateral POC flux in the ECS was about 5 Mm²/yr if the fraction of small particles (<0.5 mm) is assumed to be long-distance transportable particles. The result implies that the lateral carbon transport is significant in the East China Sea.

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VIGOROUS GROWTH OF SYNECHOCoccus spp. IN THE EAST CHINA SEA DURING AN ASIAN DUST STORM EVENT

Investigations focused on the effects of dust storms on the ecology of phytoplankton have been limited. The aim of this study was to reveal the succession of pico-phytoplankton in the oligotrophic waters of the East China Sea during Asian dust storms. According long-term observation, Synechococcus is dominant in the water columns over the continental shelf, and Prochlorococcus is restricted to the outer edge of the East China Sea where the Kuroshio Current flowed-through. In spring, 2007, we conducted cruises to a station located at the shelf break of the East China Sea (25°05′N, 123°15′E). We found that vigorous growth of Synechococcus from 1.4 × 10⁴ to 1.0 × 10⁶ cells ml⁻¹ occurred during Mar. 16 to Mar. 18, and then decreased to 4.1 × 10⁴ cells ml⁻¹ at Mar. 19, 2007. Phylogenetic analysis of 665 rRNA sequences revealed that the most of these newly appeared Synechococcus belonged to Clade II. Furthermore, all of mRNA levels of 3 nutrient stress markers including idaA (Fe stress marker), mtcA (N stress marker), and psP (I stress marker), decreased from prominent values to non-detectable levels during the dust storm. These results suggested that the contribution of Fe, N, and P by the dust deposition from dust storm or by turbulence jointly promoted the growth of Synechococcus on the outer edge of the East China Sea.
correlated to temperature anomalies within the mixed layer during the summer. The winter-to-winter recurrence of surface temperature anomalies is also confirmed using an independent SST dataset.

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MICROBIAL SYMBOYSIS OF SPORES AND QUORUM SENSING

Bacteria release a wide range of chemical compounds, some of which function as signals. These chemical signals are often involved in monitoring and responding to microbial population density, a process described as quorum sensing. Acylated homoserine lactones (AHLs) are well-studied quorum sensing signals, usually produced via AHL synthases of the LuxP family. LuxR-type transcription factors usually recognize the AHLs and in turn regulate target gene expression. Tissues of marine sponges are densely colonized by diverse bacteria which may play important nutritional and protective functions for the host. A significant portion of the sponge microbiota from the strawberry vase sponge and the black ball sponge produce AHL signals. Members of the Silicibacter-Ruegeria (SR) subgroup of the Roseobacter clade are the most prominent AHL-producing microbes. There are at least two different LuxR-type genes we have isolated from the SR sponge isolate KL1H11. These genes, designated saxl and sbbl, direct synthesis of different AHLs, and are adjacent to genes encoding LuxR-type proteins, saa1 and sbbl, respectively. Sha1 activates expression of the saxl gene via interaction with a conserved DNA binding site upstream of this gene. Mutation of saxl in KL1H11 leads to loss of all detectable AHLs in laboratory culture, while an sbbl mutation does not change the AHL profile. One of the regulatory targets for these systems in the SR symbionts appears to be flagellar motility.

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PRETTY IN PINK: SURFZONE DYE DISPERSION IN VARYING CONDITIONS DURING THE HB06 EXPERIMENT

Terrestrial runoff containing bacteria and human viruses often drains directly onto the shore where it is entrained in the surfzone and spread by nearshore waves and currents. Tracer dispersion is key to understanding the fate of polluted surfzone water, however dispersion rates and mechanisms are poorly understood. During the HB06 experiment at Huntington Beach, California, high-resolution surfzone dye dispersion observations were combined with extensive in situ measurements of the waves and currents thought to control dispersion rates. The evolution of plumes and patches of fluorescent dye (Rhodamine W-T) was observed on 8 days during the experiment, in wave conditions ranging from low energy with weak alongshore currents to moderate energy with strong alongshore currents. Recently adapted dye sampling techniques, including fixed (frame mounted) and mobile (jet ski mounted) fluorometers, were used to sample dye within and seawards of the surfzone. shore. Show more samples were acquired simultaneously at 7 or more alongshore locations. Observations with these techniques will be compared. Surfzone dye diffusivity estimates in varying conditions will be contrasted.

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SIMULTANEOUS N-ASSIMILATION, NH4+ REGENERATION AND NITRIFICATION IN THE EUPHOTIC ZONE: IMPLICATIONS FOR NEW PRODUCTION ESTIMATES USING THE F-RATIO

Using 13N methods, rates of N-assimilation, NH4+ regeneration and nitrification were measured simultaneously at 55% N of the Spanish Iberian Peninsula. Stations ranged from coastal upwelling to oligotrophy with day-time and night-time measurements. NO3- and [NH4+] peaked at 700 and 150 ng-at-N L-1 in upwelling stations, decreasing to < 4 and < 80 ng-at-N L-1 at oligotrophic stations respectively. N assimilation rates were consistent with those described as quorum sensing. Nitrification rates peaked at 700 and 150 ng-at-N L-1 in upwelling stations, decreasing to < 4 and < 80 ng-at-N L-1 at oligotrophic stations respectively. Nitrification rates were consistent with those described as quorum sensing. LuxR-type transcription factors usually recognize the AHLs and in turn regulate target gene expression. Tissues of marine sponges are densely colonized by diverse bacteria which may play important nutritional and protective functions for the host. A significant portion of the sponge microbiota from the strawberry vase sponge and the black ball sponge produce AHL signals. Members of the Silicibacter-Ruegeria (SR) subgroup of the Roseobacter clade are the most prominent AHL-producing microbes. There are at least two different LuxR-type genes we have isolated from the SR sponge isolate KL1H11. These genes, designated saxl and sbbl, direct synthesis of different AHLs, and are adjacent to genes encoding LuxR-type proteins, saa1 and sbbl, respectively. Sha1 activates expression of the saxl gene via interaction with a conserved DNA binding site upstream of this gene. Mutation of saxl in KL1H11 leads to loss of all detectable AHLs in laboratory culture, while an sbbl mutation does not change the AHL profile. One of the regulatory targets for these systems in the SR symbionts appears to be flagellar motility.

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PLANETARY WAVE PROPAGATION OFF CALIFORNIA AND ITS EFFECT ON ZOOPLANKTON

Analysis of CalCOFI daily temperature and SeaDoo sea level data shows that the dynamic height propagates westward at 4.1 cm/s, about double the speed of the large-scale, low-frequency Rossby wave (2.2 cm/s). Internally filtered along-track TOPEX/Poseidon/Jason sea level height verifies the westward propagation (4.3 cm/s). Because of the westward propagation, interannual variations in alongshore geostrophic surface current are proportionate to the time-derivative of sea level. The anomalous alongshore flow advects particles, the anomalous northward alongshore particle displacement being proportional to sea level. Since nutrient concentration is lower in the south, the anomalous alongshore particle displacement results in lower nutrient concentration when the sea level is anomalously high and higher nutrient concentration when the sea level is anomalously low. Vertical displacement also results in a similar relationship between nutrients and sea level, so we expect that negative sea level anomalies are strongly related to fluctuations in zooplankton population. Consistent with the westward propagation, the logarithm of the zooplankton population averaged over the CalCOFI region is well correlated (r=–0.67) with coastal sea level anomalies and lags it by 2 months.

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INTERACTIVE HABITAT DATABASE FOR THE PACIFIC COAST OCEAN OBSERVING SYSTEM (PACOOS): AN ECOSYSTEM OBSERVING TOOL FOR THE CALIFORNIA CURRENT

Recognizing the need to develop an ocean observing system covering the entire California Coastal Ocean System (CCES), NOAA and its partners are establishing PACOOS as a west coast observing ecosystem "backbone" for the U.S. Integrated Ocean Observing System (IOOS). PACOOS long-term objective is to develop and maintain an integrated distributed data access, transport, and analysis system serving data and products and meeting research and management needs for multiple users in the CCE. Building on databases assembled for the development of an Essential Fish Habitat Environmental Impact Statement for west coast groundfish, we have developed a data portal that links several remote servers and delivers a variety of habitat relevant data including benthic, biological and oceanographic data, and allows multilayer query and reporting and query comparisions (http://pacoos.coas.oregonstate.edu/). The data portal provides for data discovery, direct client access to data, custom/interactive view environments, as well as developing integrated decision support tools for Ecosystem Based Management. Our long-term goal is to bring the 2-D geospatial world and the 4-D oceanographic world closer to seamless exploration by examining interoperability between these two inherently different data structures.

CLASTRE, H., Laboratoire d'Océanographie de Villefranche, Villefranche sur mer, France, clastre@ocean-lab.fr; Niewiadomska, K., Laboratoire d'Océanographie de Villefranche, Villefranche sur mer, France; D'ORIENTZIO, F., Laboratoire d'Océanographie de Villefranche, Villefranche sur mer, France; PRIEUR, L., Laboratoire d'Océanographie de Villefranche, Villefranche sur mer, France; SUBMESOSCALE PHYSICAL-BIOGEOCHEMICAL COUPLING ALONG THE LIGURIAN CURRENT (NORTHWESTERN MEDITERRANEAN) USING A BIO-OPTICAL GLIDER

A bio-optical/biogeochemical glider was developed with the purpose of characterizing the signatures of biogeochemical processes at physical forcing at submesoscale. The glider was deployed across the permanent Ligurian current (North western Mediterranean Sea) allowing unprecedented observations of the tight physical-biogeochemical coupling to be recorded. Among the various biogeochemical variables, three of them (backscattering, Chlorophyll a concentration, CDOM) have completely independent behaviour with regards to meso and sub-mesoscale dynamics. Near-isopycnal tongues of elevated Chlorophyll a/Oxygen concentration are recorded down to a depth of 180 m and are the likely signature of a converging horizontal and downwelled water flow. Intrusions of elevated CDOM concentrations together with signatures of smaller particles are the likely features of a local divergence and upwelled waters from subjacent aphotic layers. These tongues are a recurring feature which is observed at various seasons. Such biogeochemical signatures clearly allow the identification of upwards and downwards physical motions not observed by current technologies, reinforcing the need for coupled high-resolution physical-biogeochemical studies, not only for investigating biogeochemical processes themselves but also for resolving physical process at these scales.

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SMALL CHANGES IN MORPHOLOGY LEAD TO LARGE CHANGES IN MOVEMENT AND TRANSPORT IN TURBULENCE FOR LARvae OF THE SAND DOLLAR DENDRASSTER

Larval swimming mechanics are determined by larval morphology, interacting with small-scale flows such as shear within turbulent eddies. Empirical and theoretical approaches were used to examine effects of morphology on swimming performance of larvae in shear flows. Movement of various larval morphologies (stages) of the sand dollar Dendraster excentricus in shear was quantified experimentally by simultaneously tracking and mapping the flow field around each larva. Sensitivity of larval swimming performance to changes in water flow is to bring the 2-D geospatial world and the 4-D oceanographic world closer to seamless exploration by examining interoperability between these two inherently different data structures.
changes in certain morphological characteristics was examined theoretically by embed-
ning a hydrodynamic model of plankton larvae in simulated shear flows. Experimental and
model results both indicate that larvae exist in a very sensitive part of parameter space,
where small changes to larval morphology lead to large differences in larval movement.
Because larval morphology responds to environmental conditions, environmental changes
(e.g. eutrophication, acidification) may affect larval movement. Model predictions also
indicate that changes in larval movement strongly influence vertical positions of larvae.
Because environmental factors, including horizontal currents, vary with depth, effects
of morphology on vertical position can influence growth, survivorship and dispersal through
the planktonic larval period.

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AN OVERVIEW OF SEAFLUX: NEW SCIENCE AND METHODS IN AIR-SEA FLUXES

In this talk I will present an overview of the SeaFlux program and its history and goals.
Methods and comparisons of satellite-derived air-sea fluxes with in situ research vessels,
buoys, and numerical weather prediction models will be described. Comparisons with
global climate models and future directions for cross-cutting research will be discussed.
New methodologies that are being explored with respect to improved global high-resolu-
tion air-sea fluxes suitable for climate analyses will be detailed, including improved surface
flux models, improved sea surface temperature fields, and possibilities for improved fluxes
in coastal regions and at high wind speed regimes will be explored.

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ON THE PROCESSES CONTROLLING SHELF-BASIN EXCHANGE AND OUTER SHELF DYNAMICS IN THE BERING SEA

We use a 9-km pan-Arctic ice-ocean model to better understand the circulation and
exchange in the Bering Sea, particularly near the shelf break. Only limited observations
exist for this region, which is why very little is known about how water from the deep
basin reaches the Bering shelf. To address this issue we examine the relationship between
the Bering Slope Current (BSC) and exchange across the shelf break as well as resulting
mass transports onto the shelf. Previously, it was thought that the BSC advected
amounts of deep water northward via a branch near the Siberian coast. Our model results
indicate a significantly different circulation scheme whereby water from the deep basin
is periodically moved onto the shelf by mesoscale eddies, along the shelf break. We find that
submarine canyons are prone to high eddy activity and, therefore, show higher rates of on-shelf transport. In addition to eddy activity, the sea ice cover greatly influences
the dynamics on the Bering Sea shelf through interannual variability in its extent, distribu-
tion, and timing of melt/freeze.

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CONSTRAINING THE TROPICAL ATLANTIC OCEAN CURRENT BY ASSIMILATING SATELLITE ALTIMETRIC OBSERVATIONS: INSIGHTS FROM OBSERVING SYSTEM SIMULATION EXPERIMENTS

Two main issues are developed here regarding our capacity to monitor the tropical
Atlantic Ocean variability. First, the data assimilation system poses specific challenges
especially because of the importance of the wind forcing error in the tropics. Secondly, we
will wonder how much observational information is required for an accurate representa-
tion of the circulation. To evaluate how errors due to wind forcing may be corrected, we
performed twin experiments using an ocean general circulation model (OgCM). Resolution
is 1/4 on a 20 S to 17 N domain, with radiative boundaries. The assimilation model is
based on a reduced order Kalman filter (Brasseur and Verron, 2006). To build the covari-
ance error matrix, a specific strategy, based on a step by step ensemble approach, is highly
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BRINGING OCEAN SCIENCE RESEARCH TO THE MIDDLE SCHOOL CLASSROOM

An ongoing collaboration between ocean scientists at the Coastal Observing Center at the
University of New Hampshire and teachers at King Middle School in Portland, Maine has

resulted in the implementation of a hands on ‘Unit Expedition’ that includes a field study
program focused on understanding fluxes. We will provide an overview of methods and
students will be introduced to the work on climate change. The UNH science team has lead customized teacher trainings and participated in
learning team brainstorming sessions to help create and test ideas that are now being used with
in local schools unique to the marine science curriculum framework. Students are now using
field protocols that UNH and other regional plankton programs use and get to work with
UNH scientists directly during visits to the classroom. This successful partnership has created
new opportunities for both middle school teachers and students and UNH scien-
tists and educators through the sharing of information, ideas and experiences. This ‘unit
expedition’ is now in its second year.

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DYNAMICS OF CDOM AND CARBON IN THE GULF OF MEXICO

The Gulf of Mexico receives CDOM and DOC inputs from one major and minor
tidal rivers. The traditional approach to prediction of river inputs in coastal regions has been to
determine river endmember concentrations of dissolved constituents and model distribu-
tions of these in nearshore areas based on salinity observations. Satellite observations
extend modeling efforts to the use of CDOM color signature with greater spatial and tem-
poral resolution. Modeling efforts require an understanding of variability on both small and
large temporal scales, and thus require long-term regional studies for best results. We
have conducted ongoing studies in the eastern Gulf of Mexico for the past ten years, and
characterized river signatures for CDOM, chlorophyll, and DOC. Regional summer
CDOM intensities generally increase from the Mississippi River to the dark waters of the
SW Florida coast. Distributions are dominated by river discharge, and thus show a
strong negative correlation with salinity most of the time. However, a large variability in
color, concentration and optical properties is observed due to climatic events such as
wet and rainy seasons and between flood and drought years. Chi and DOC concentrations
also vary regionally, and are only strongly correlated with river discharge during high flow
periods.

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THORIUM-234 AND POC FLUXES AND EXTRACELLULAR ENZYMATIC ACTIVITY IN THE LAPTEV SEA

We have used the water column 234Th deficit, coupled with measurements of the POC/234Th ratio on filterable particles >70 µm, to estimate late summer POC fluxes at two shelf stations in the Laptev Sea. Fluxes at an outer shelf station (270 m) showed an attenuation factor of ~2 between 25 and 100 m. Fluxes were higher with less attenuation in the upper 60 m of a station (112 m) closer to the Lena River delta. Particles >70 µm at the outer shelf station also were characterized by a greater fraction of marine organic matter (estimated from 8D). Rates of extracellular enzyme (protease and glucosidase) activity in the >70 µm fraction were greater at the outer shelf station by factors of up to ~7 and ~25 (respec-
tively). The weakly related negative correlation between protease and glucosidase activity, suggesting that protease activity is linked to preferential loss of N from the particles. These results generally support the hypothesis that extracellular enzyme activities contribute significantly to attenuations of POC flux in the Arctic.

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MAPPING SUSPENDED SEDIMENT CONCENTRATION ON A FRINGING CORAL REEF USING AIRBORNE MULTISPECTRAL REMOTE SENSING AND IN SITU SAMPLING: MOLOKAI, HAWAII

A major threat to the coral reef on the south coast of Molokai is the large amount of fine
sediment delivered to the reef from the uplands due to land-use changes. Sediment is
introduced to the reef through erosion and storm runoff, and is then resuspended in a
daily cycle influenced by tides, wind, and waves. High levels of suspended sediment can
have a direct influence on coral health by inhibiting photosynthesis and smothering coral.
We investigated using airborne imaging to generate a high-resolution map of suspended
sediment concentration (SSC) levels on the reef. A multispectral camera system with
three bands (green, red, near IR) was used to acquire images with approximately 15 cm
pixel resolution, along with SSC measurements from in situ water sampling, to quan-
tify the POC fluxes from the surface sediments to the water column. The results indicate a
strong negative correlation with salinity most of the time. However, a large variability in
color, concentration and optical properties is observed due to climatic events such as
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also vary regionally, and are only strongly correlated with river discharge during high flow
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Reison, D.
Colebank, Y.

will be interpreted using theories of mixed layer dynamics and restratification.

Spice gradients, had a seasonal cycle with strongest gradients in summer. Spice gradients
1000m. Ship based observations along 158° W were made in December 2007 (23-35 N).
2007 (22-30 N), and November 2007-February 2008 (22-34.5 N) profiling the upper 600-

glider occupied a section along 158 W in December 2006 (22-26.5 N), July-September

DYNAMIC MODE VARIABILITY IN THE DEEP GULF OF MEXICO
Low frequency vertical current structure at the northern edge of the Loop Current during
edly shedding events is observed using concurrent hydrographic, moored, and satellite
alimetry data from 2005. Dynamic modes are calculated at three deep, full water-column
ings in the Gulf of Mexico. Time-series of the barotropic and first two baroclinic
odes are found using a least squares minimization that fits derived modes to moored
velops velocity data. EOF analyses show the majority of observed variance is explained by a
 oracle-trapped mode that is highly coherent with temporal amplitudes of the first baroclinic
ode, and a low percentage of variance is captured in bottom-intensified modes. The first
aroclinic mode is prevalent throughout deployment and an assessment of this mode is
es for higher order modes is quantified. Ageostrophic events are
nted to the or
ogthalan change in sea surface height to illustrate local dominance of geostrophy. When
correlation is small, energy in higher order modes is quantified. Ageostrophic events are
vestigated by correlating specific forcings to higher modes. This work is funded by the

Labynathyomycete diversity in two estuaries of Long Island, NY, USA
Labynathyomycetes are marine osmotrophic protists that may be important in
tation of particulate organic matter and in trophic upwelling. Poor-quality

cific primer (LabyY) was paired with a universal primer (PrA) to amplify ~1400 bp
abundance in natural environments inadequately explored. A Labynathyomycete-
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agrams cloned and sequenced, 21 were related to cultivated Labynathyomycetes (mainly Aplanochytrium). 22
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buildings

of these projects leverage ongoing activities and programs at each partner institution and
ects include creating interactive, digital media-based exhibits for science centers; develop

Building Education and Outreach Infrastructure for the NSF-Ocean Observatories Initiative

The Ocean Observatories Initiative (OOI) is creating new infrastructure for near real-time
data acquisition that will accelerate progress in ocean science and present new opportuni-
ty for integrating ocean research, education, and outreach. As the facility construction and
deployment phase gets underway, the Implementing Organizations are striving to create
education and outreach infrastructure that will support long-term, community-wide edu-
cation and public awareness of the OOI and observatory-enabled science. Infrastructure
components include: video/graphic documentation of the construction/deployment phase;
visualizations and animations for multiple applications; and a robust public user inter-

Project objectives include creating interactive, digital media-based exhibits for science centers; develop-
online learning modules for both classrooms and online environments; and examining
the ocean science learning environments. All of these projects leverage ongoing activities and programs at each partner institution and
those developed through national E&O networks (e.g. COSEE, GEO-Teach) thus promot-
ing integration and cooperation rather than replication of E&O efforts.

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LABYNATHYOMYCETE DIVERSITY IN TWO ESTUARIES OF LONG ISLAND, NY, USA
Labynathyomycetes are marine osmotrophic protists that may be important in
destivity by the de novo production of essential polyunsaturated fatty acids. However,
the inherent limitations of cultivation-dependent methods have left their diversity and
abundance in natural environments inadequately explored. A Labynathyomycete-
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among the Thraustochytrid Phylogenetic Group. Unfortunately, the primer LabyY is biased
against several groups of Labynathyomycetes, particularly among the Thraustochytrids.
A more realistic representation of Labynathyomycete diversity would be produced by
redesigning LabyY and/or creating more specific primers that can target groups of
Labynathyomycetes missed by LabyY.

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BUILDING EDUCATION AND OUTREACH INFRASTRUCTURE FOR THE NSF-OCEAN OBSERVATORIES INITIATIVE

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those developed through national E&O networks (e.g. COSEE, GEO-Teach) thus promot-
ing integration and cooperation rather than replication of E&O efforts.
Increasing seafood consumption will putatively improve human health and save lives. To meet the demand for seafood, there are more cultured and imported products available, but surveillance of products is minimal. At the same time, risks, or perceptions of risk, are changing because coastal areas are subject to habitat contamination by chemical and biological agents. The complexity of this situation results in a “seafood dilemma,” which may lead to reduced seafood consumption, and resultant loss of presumed health benefits. To address this, we recommend that integrated program is needed to provide: sustained and systematic monitoring of both wild and cultured seafoods; consistent regulatory and guidance criteria; increased analytical capacity, both for harmful and beneficial substances; publicly accessible and user-friendly data on benefits and risks of seafood consumption; and a seafood tracking system. This program should be advised by representatives from the seafood and aquaculture industries, environmental interest groups, and the public health community. While the development of this program will not be a trivial task, the benefits to public health and well being make such an effort well worthwhile.

The effects of oxygen, temperature, and microbial inhibition on remineralization rates of particulate organic carbon, San Pedro Basin, CA

Sedimenting material was captured in San Pedro Basin, CA throughout the late summer and fall 2007 using a floating sediment trap deployed at 100m. Our goal was to understand the controls on remineralization of Corg sinking through the oxygen minimum zone. Total mass, carbon, and biogenic silica flux measurements were made. Additionally, particles were incubated and shaken in the dark in 30L of filtered seawater at 10°C and at 25°C. Aliquots of water were sampled every 12-48 hours and TCOD was measured as a proxy for Corg remineralization rates. Average k values were calculated and ranged from 0.7 to 0.01 day^{-1}, with the 25°C experiments producing higher k values. Inhibition of bacteria by formaldehyde stopped respiration of Corg at both temperatures. Material fall ing from 100m to 500m, if decaying with a Martin function b value of -0.86, would exhibit a k value of 0.15 day^{-1}, similar to values found in our incubation experiments. Further experiments will be conducted examining the effects of low oxygen concentrations, similar to what particles experience in the oxygen minimum zone of San Pedro Basin.

SIMULATION OF FLOW AND NUTRIENT TRANSPORT FROM AN AQUIFER

Transient 3-D modeling was used to simulate ground-water flow from the top of the ground-water flow cell to a coastal embayment at Cape Cod National Seashore, Massachusetts. Simulating in the subterranean estuary also was simulated by a finely discretized 2-D model. Simulations showed that freshwater discharge from the aquifer to the embayment varied from 500 m3/d when ground-water levels were low (November to December) to 2500 m3/d when ground-water levels were high (May to June). Modeled freshwater fluxes agreed with those calculated from salinity and flow measurements made over multiple tidal cycles at a channel connecting the embayment to a larger estuary. Salinity measured in ground water in the intertidal zone used multilevel samplers detected movement of the salt/fresh interface on a tidal and seasonal basis that was consistent with simulation results. Fluctuations in simulated nitrogen loads corresponded with water flux variations. Little nitrogen loss occurred during transport in the aerobic subterranean estuary. Although most nitrogen discharging to the embayment was in the form of nitrate, most nitrogen leaving the embayment through the tidal channel was organic nitrogen. Freshwater release from the Arctic to the deepwater convective regions of the North Atlantic since the mid-1960s appears to be related to changes in the export of freshwater from the Arctic, and the persistence of a high North Atlantic Oscillation (NAO) during this period. To investigate the response of the Arctic to changes in the NAO we use a high resolution regional version of the ocean-only MITgcm forced with daily NCEP reanalysis data from 1992-2001. After creating a control simulation, we performed two calculations with repeated wind fields of two contrasting NAO years for the extreme negative and positive NAO phases of 1969 and 1989, respectively. Our results highlight a clear response in the Arctic freshwater budget to NAO forcing. Repeat NAO negative wind forcing results in virtually all freshwater being retained in the Arctic. In contrast, repeat NAO positive forcing increases the freshwater export out of the Arctic, primarily via the Fram Strait (54%) and Canadian Archipelago (29%), and results in a total loss of freshwater storage of 14,000 km$^3$. We find that the freshwater export via these two pathways increases by virtually the same amount (~700 km$^3$) between the two forcing scenarios, highlighting the important role that the Canadian Archipelago plays in redistributing the freshwater of the Arctic.

RESPONSE OF THE ARCTIC FRESHWATER BUDGET TO EXTREME NAO FORCING

The National Oceanic and Atmospheric Administration has a long history of developing operational products and services. Many of these operational products have traditionally revolved around weather forecasts but increasingly operational ecological forecasts are being developed to address critical ocean and coastal management issues. The development and transition to operations of ecological forecasts however present additional and unique research and institutional challenges to the agency which must be addressed before these valuable management tools can be fully realized. Some of these challenges include, modeling complex physical, biological, chemical and behavioral interactions; characterizing uncertainty in forecast products; communicating forecast results to users; and testing, validating, running, and improving developed forecasts. This presentation will discuss these challenges from the perspective of ongoing efforts to develop new operations of forecasting tools and products related to harmful algal blooms. Also discussed are lessons learned which may be applicable to other ongoing ecosystem forecasting efforts targeted at different ocean and coastal management issues.

RESPONSE OF THE ARCTIC FRESHWATER BUDGET TO EXTREME NAO FORCING

The Association for the Sciences of Limnology and Oceanography (ASLO) AGU / TOS / ERF 2008 Ocean Sciences Meeting
Connolly, S. N., University of South Florida, St. Petersburg, USA, rconnolly@marine.usf.edu; Cole, P. G., University of South Florida, St. Petersburg, USA, pcole@marine.usf.edu

LATITUDINAL DEPENDENCY OF TERRESTRIAL CDOM: IOP DIFFERENCES BETWEEN WATERSHEDS THAT SUPPLY THE WEST FLORIDA SHELF

Given that spectral properties of CDOM are source dependent, and that CDOM is a useful proxy for chemical structure, ecosystem health, and Dissolved Organic Carbon (DOC) in coastal environments, there is a critical need to establish its spatial and temporal variability in rivers and estuaries. This is especially true for river-dominated margins, like the West Florida Shelf, where freshwater originates from numerous rivers, and the ability to understand regional carbon dynamics is necessitated by establishing CDOM variability in said rivers. Rivers that supply the shelf have latitudinally dependent terrestrial CDOM, where southernmost rivers have higher concentrations and exhibit distinct differences in optical properties compared to northern watersheds. Discussed here will be how properties, such as absorption coefficients, spectral slopes, fluorescence efficiencies, intensity, ratios and DOC vary spatially and temporally for Florida watersheds and how these properties are altered as freshwater mixes with seawater in the estuaries. Findings were also compared to historical CDOM values (1974-2005) to examine long-term trends in the color of water, where regions have experienced a tripling of concentrations during the last 30 years.

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THE POTENTIAL FOR INTERACTIONS BETWEEN ABIOTIC AND BIOTIC FORCING ON THE CONTROL OF THE FRESHWATER HUMAN PATHOGENS CRYPTOSPORIDIIUM PARVUM AND GIARDIA LAMBILIA

Recent research has shown significant negative effects of abiotic forcing through high solar ultraviolet radiation (UVR) on the infectivity of the human pathogen Cryptosporidium parvum. Further research has demonstrated a negative effect of biotic forcing, the zooplankton grazer Daphnia pulicaria, on the viability of both Cryptosporidium parvum and Giardia lamblia. Here we discuss the potential for recently observed global increases in chlorophyll biomass, water mass structure and particulate sedimentation on the sea floor to induce sedation, the duration of sedation, and the recovery time were noted by observing postural orientation and the response to touch stimuli. Anesthetizing shrimp is particularly useful for behavioral work because it allows for the identification of gender and species, as well as counting parasites, without causing damage by physically constrain the organism.

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USE OF CLOVE OIL AND CARBON DIOXIDE AS AN ANESTHETIC FOR THE GRASS SHRIMP PALEMNONETES PUGIO

Anesthetics are commonly used in aquaculture to immobilize animals in order to make handling easier. This decreases animal stress, which otherwise may result in physical injury or death. Anesthetics should be easy to administer and induce sedation quickly. Small crustaceans are rarely anesthetized; however, the constant movement of some invertebrates, particularly while assessing morphological features using a microscope, can cause injury to the animal or result in decreased observational accuracy. The purpose of this study was to determine an effective anesthetic for the daggerblade grass shrimp Palaemonetes pugio. Clove oil and carbon dioxide were tested on grass shrimp to determine a concentration range that would immobilize but not kill them. The time required to induce sedation, the duration of sedation, and the recovery time were noted by observing postural orientation and the response to touch stimuli. Anesthetizing grass shrimp is particularly useful for behavioral work because it allows for the identification of gender and species, as well as counting parasites, without causing damage by physically constrain the organism.

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FORCING ON THE CONTROL OF THE FRESHWATER HUMAN PATHOGENS CRYPTOSPORIDIIUM PARVUM AND GIARDIA LAMBILIA

The benthos of the northern Bering Sea shelf is dominated by a world-class biomass of Palaemonetes pugio. Clove oil and carbon dioxide were tested on grass shrimp to determine a concentration range that would immobilize but not kill them. The time required to induce sedation, the duration of sedation, and the recovery time were noted by observing postural orientation and the response to touch stimuli. Anesthetizing grass shrimp is particularly useful for behavioral work because it allows for the identification of gender and species, as well as counting parasites, without causing damage by physically constrain the organism.

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THE POTENTIAL FOR INTERACTIONS BETWEEN ABIOTIC AND BIOTIC FORCING ON THE CONTROL OF THE FRESHWATER HUMAN PATHOGENS CRYPTOSPORIDIIUM PARVUM AND GIARDIA LAMBILIA

Recent research has shown significant negative effects of abiotic forcing through high solar ultraviolet radiation (UVR) on the infectivity of the human pathogen Cryptosporidium parvum. Further research has demonstrated a negative effect of biotic forcing, the zooplankton grazer Daphnia pulicaria, on the viability of both Cryptosporidium parvum and Giardia lamblia. Here we discuss the potential for recently observed global increases in chlorophyll biomass, water mass structure and particulate sedimentation on the sea floor to induce sedation, the duration of sedation, and the recovery time were noted by observing postural orientation and the response to touch stimuli. Anesthetizing shrimp is particularly useful for behavioral work because it allows for the identification of gender and species, as well as counting parasites, without causing damage by physically constrain the organism.
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RECONSTRUCTING TRENDS IN HYPOXIA USING MULTIPLE PALEOECOLOGICAL INDICATORS RECORDED IN SEDIMENT CORES FROM PUGET SOUND, WA

In the last decade, the frequency and severity of fish kills associated with hypoxic events in Puget Sound has increased, resulting in unprecedented environmental and economic impacts. The relationships between anthropogenic activities (i.e., landscape alterations and increased population) and a suite of paleoecological and geochemical indicators preserved in sediment cores from the main basin of Puget Sound and the subbasin of Hood Canal were examined for the period of 120-400 years B.P. The reconstructions were slightly different between the two basins, but both showed shifts in the dominant diatom and foraminiferan fossils, pollen grains, stable isotopes of carbon and nitrogen, biomarkers for terrestrial/marine carbon, and redox-metals enriched in sediment during periods of hypoxia/anoxia. The redox-metal profiles indicate periods of hypoxia are recorded in each of the last four centuries, with a significant event in the early 1700s. These natural cycles of hypoxia do not increase in frequency in the last century; however, the other indicators record shifts in diatom species, dominant pollen grains, and carbon/nitrogen isotopes and ratios following the onset of significant basin-wide anthropogenic activities beginning in the 1900s.

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ULTRAHIGH RESOLUTION MASS SPECTROMETRY OF DISSOLVED ORGANIC MATTER: THE PATH TO GEOMICS

Electro spray ionization combined with high-field Fourier transform ion cyclotron resonance mass spectrometry (ESI FT-ICR MS) can now identify individual compounds in complex dissolved organic matter (DOM) mixtures. Such analyses provide molecular data on DOM that was thought to be “uncharacterizable” just a decade ago. This ultrahigh resolution mass spectrometry (UHR-MS) also represents a new approach to the analysis of ecosystem geochemistry. For example, UHR-MS from ice to Antarctic Bottom Water in the Weddell Sea (Antarctica) estimated control parameters reflect the limitations of this method, and can be post-processed to verify how well these models simulate surface fronts. In this presentation we compare, for 2004, the probability of finding sea surface temperature (SST) fronts in the 4-km MODIS SST product with that of finding fronts in the corresponding Hybrid Coordinate Ocean Model (HYCOM) North & Equatorial Atlantic Ocean Prediction System runs. The multi-im age edge detection algorithm developed at the University of Rhode Island was applied to the daily fields of both data sets and annual frontal probability fields were computed. The difference between the two annual probability fields provides a measure of HYCOM’s ability to reproduce the high gradient regions observed in the MODIS data. In general, HYCOM tends to overestimate the number of fronts found by approximately 50% with the exception of a band across the Atlantic at approximately 10 N and two regions near the northern model border where HYCOM underestimates the frontal probability.

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AN EVALUATION OF THE PERFORMANCE OF HYCOM IN SIMULATING SURFACE THERMAL FRONTS

Eddy-resolution ocean models depict sharp ocean fronts, however, except for comparisons with the mean path and path variability of western boundary currents, little has been done to verify how well these models simulate surface fronts. In this presentation we compare, for 2004, the probability of finding sea surface temperature (SST) fronts in the 4-km MODIS SST product with that of finding fronts in the corresponding Hybrid Coordinate Ocean Model (HYCOM) North & Equatorial Atlantic Ocean Prediction System runs. The multi-image edge detection algorithm developed at the University of Rhode Island was applied to the daily fields of both data sets and annual frontal probability fields were computed. The difference between the two annual probability fields provides a measure of HYCOM’s ability to reproduce the high gradient regions observed in the MODIS data. In general, HYCOM tends to overestimate the number of fronts found by approximately 50% with the exception of a band across the Atlantic at approximately 10 N and two regions near the northern model border where HYCOM underestimates the frontal probability.

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4DVAR DATA ASSIMILATION IN THE TROPICAL PACIFIC

A variational data assimilation system has been implemented for the tropical Pacific Ocean for an eddy-permitting regional implementation of the MIT general circulation model (MITgcm). The model uses realistic topography with parameterizations for the surface boundary layer (KPP) and open boundaries at the south and north, as well as in the Indonesian throughflow. The model uses realistic topography with parameterizations for the surface boundary layer (KPP) and open boundaries at the south and north, as well as in the Indonesian throughflow. The strong constraint 4DVAR method is used to adjust the model to observations in the tropical Pacific region using control parameters which include initial temperature and salinity, temperature, salinity and horizontal velocities at the open boundaries, and twice-daily surface fluxes of momentum, heat and freshwater. The model is constrained with most of the available datasets in the tropical Pacific, including climatologies, TAO, ARGO, XBT, and satellite SST and SSH data. The adjoint of the model is used to estimate the steepest-descent directions in a conjugate-gradient descent method which includes pre-conditioning by an approximate Hessian. The estimated control parameters reflect the limitations of this method, and can be post-processed to refine the solution without significantly increasing the cost function.

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COMMUNITY COMPOSITION, PHOTOSYNTHETIC CAPACITY, DIAZOTROPH ABUNDANCE AND NITROGENASE ACTIVITY OF PHOTOTROPHIC PLANKTON IN THE ORINOCO RIVER PLUME

We examine chlorophyll-specific, size-fractionated phototrophic plankton community biomass, photosynthetic capacity, diazotroph abundance and nitrogenase activity along the
The Kalman filter is a data assimilation algorithm that optimally estimates a system state given a model, past, and current observations. This is suitable to initialize numerical predictions. The smoothers also consider future observations in the assimilation process. Therefore, more radiation (KdPAR) is needed to build reanalyses. A smoother designed for oceanic analyses is introduced. It is derived from the Singular, Evolutive, Extended Kalman (SEEK) filter and the fixed-lag Kalman smoother. The major difficulty in the derivation lies in the management of model error. Then, extending the SEEK filter with the smoother function is straightforward. The additional computational cost is tiny, what makes the smoother suitable for applications with large data. The SEEK smoother is tested in twin experiments. The model is an ocean general circulation model in a 1/4 degree double-gyre configuration and simulated satellite observations of Sea Surface Height are assimilated. The smoother slightly but significantly improves the filter results. To conclude, an outlook to forthcoming real data assimilation experiments and reanalyses making will be presented.

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THE NUTRIENT TYPE DISTRIBUTION OF METHYLMERCURY IN THE MEDITERRANEAN WATERS: RELATIONSHIPS WITH PHOSPHATE

Methylated mercury species (MeHg) are bioactive molecules, which play the major role in the biomagnification of mercury in aquatic food webs. Sources of MeHg in the open oceans are still on debate. High definition vertical profiles of MeHg have been performed in the open waters of the Mediterranean Sea in spring 2004. MeHg concentrations ranged from 0.008 to 0.430 pm (mean: 0.171 pm, standard deviation 0.130 pm for 66 determinations). Systematically the MeHg vertical distributions exhibited nutrient type profiles with the highest concentrations occurring in the PO4 maxima. For the ionian sea the relationships between MeHg and phosphate were highly significant: MeHg(pM) = 0.996 PO4(pM) + 0.037 (R = 0.975, n=6) for the Open Northwestern Mediterranean; MeHg(pM) = 1.237 PO4(pM) + 0.034 (R = 0.993, n=10) for the Open Tyrrhenian Sea; MeHg(pM) = 1.241 PO4(pM) + 0.010 (R = 0.926, n=7) for the Open Ionian Sea; MeHg(pM) = 0.868 PO4(pM) + 0.015 (R = 0.960, n=9) for the Ionian Sea off Catania and MeHg(pM) = 1.312 PO4(pM) + 0.056 (R = 0.951, n=7) for the Strait of Otranto. The results indicate that the MeHg cycle is involved in the organic matter regeneration processes and suggest that its formation in this region of the Ocean is the result of microbiological activity in the upper part of the water column.

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HABITAT SELECTION AND COMMON HOT SPOTS OF 3 SEAL SPECIES IN THE WESTERN ANTARCTIC PENINSULA

We carried out a comparative study that examined the foraging behaviour of 30 adult female southern elephant seals, Mirounga leonina (2005, 2006 & 2007). 43 crabeater seals, Lobodon carcinophaga (2001, 2002 & 2007), two Weddell seals, Leptonychotes weddelli (2007) foraging in the Western Antarctic Peninsula (WAP). Southern elephant seals dove the deepest (356 m 20.2 min) and made the longest excursions. Some individuals remained within the WAP along the continental slope, while others foraged into the Antarctic Circumpolar Current. Crabeater seals some 5400 km west. Crabeater seals moved along the continental shelf, remaining closer to shore than elephant seals. Some moved considerable distances (666 km to northeast, 1147 km to southwest), but most remained within 300 km of their tagging location. Average dive depths were 118 m, and lasted 6.5 min. Crabeater, seals remained deep within the pack ice throughout the winter. The Weddell seals remained within 300 km of where they were tagged and made surprisingly shallow dives 89 m that lasted 12.4 min (deepest 455 m, longest 27.5 m). Our results suggest considerable differences in the foraging behaviour and habitat utilization between these 3 species and confirm significant differences between elephant and crabeater seals.

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LIGHT FROM AMAZONIAN WATERS AND HUMAN EFFECTS ON IT: A LARGE-SCALE MONITORING APPROACH

We quantify the light field from large rivers of the Amazon Basin by reporting both above and in water in situ hyperspectral reflectance, diffuse attenuation, scalar irradiance measurements and accompanying water optical constituents. Sampling was done along a 500 km transect of the Amazon River and in six of its larger tributaries in high and low water seasons. The results showed that water and white waters, the photosynthetically active radiation becomes dominated by red light as a result of high attenuation by colored dissolved organic matter and suspended particulate matter and blue radiation is non-existent below 0.5 m depth. Clear waters are markedly different with blue light penetrating to a depth of 2.5 m and the occurrence of a unique mid-spectra green light peak at depth. The
spectral light availability was analyzed together with above water reflectance measurements and CHERS satellite imagery to define a large-scale model to monitor Amazonian water affected by injection of sediment from small-scale gold mining.

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NUTRIENT CONCENTRATIONS AND N SPECIATION IN AN UNPOLLUTED TROPICAL FORESTED WATERSHED, PANAMA

Human activities have considerably increased the availability of reactive nitrogen. Now, many streams carry large nitrate loads to inland and coastal waters. Nevertheless, mass balance studies have shown that a significant portion of the terrestrial N load does not reach coastal systems, suggesting the existence of important N removal processes. Denitrification has been suggested as an important sink of N in inland waters, which is true in temperate regions of the Northern Hemisphere where most streams contain high nitrate concentrations. However, the global distribution of reactive nitrogen is far from uniform. Recent studies have shown that nitrogen loss from pristine watersheds occurs mainly in dissolved organic compounds, and that the amount of inorganic nitrogen is only a fraction of the total dissolved nitrogen. Herein we present chemistry data from streams within the upper Rio Chagres watershed, a pristine, densely forested watershed in the humid tropics of central Panama. Contrary to that observed in temperate watersheds of the Northern Hemisphere, DIN concentrations in the Rio Chagres and tributaries were low (mostly <2.6 µM), while organic nitrogen concentrations were mostly >10 µM.

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THE INFLUENCE OF GEOLOGIC FRAMEWORK ON BEACH MORPHODYNAMICS ALONG THE SOUTHEAST COAST OF FLORIDA

The Southeast Coast of Florida is characterized by the presence of relatively straight barrier islands that developed on an undulating Pleistocene substrate. Major hydrodynamic factor shaping coastal morphology in this area is the wave action which is influenced by northeasters and hurricanes. Two airborne light detection and ranging (LIDAR) datasets collected before and after the 2004 hurricane season were examined to determine the three-dimensional response of beach to storms along the 130 km coastline. The coverage of the pre-hurricane data set reached approximately 1000 m offshore, while the coverage of the post-hurricane data set reaches 600 m offshore. The results from a change analysis show a high longshore variability, which appears to be associated with relict reef tracts offshore. The size and distance to the shoreline of the relict reef tracks and lithified sand ridges determine the effect of the geologic framework on longshore variability. It was concluded that the geological framework biases the influence of contemporary dynamics onto beach morphology in contrast with traditional beach state models.

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CHARACTERIZING WAKE SIGNATURE AND DEVELOPING WAKE CLIMATOLOGY TO DETERMINE BEACH RESPONSE IN RICH PASSAGE, PUGET SOUND, WASHINGTON

In Rich Passage, Puget Sound, Washington episodic northerly wind events are observed to generate significant beach change in winter, where recovery of beach profiles in summer is in response to wave wash generated by commercial and recreational vessels operating at variable speeds. Extensive wave and wake monitoring has been conducted to characterize temporal and spatial variability of wave wash on shorelines in the study area. Time series of wave events have been extracted from wave measurements at multiple nearshore points based on GPS vessel position data, and visual observations of vessel traffic. A typical wake signature developed for each vessel class routinely transiting the passage, is characterized by temporal variations in the wave height, wave period, and shape of the wave energy spectrum. Individual wake events were summarized by wave height distributions for a specific vessel class to establish wake climates for the study area during given time intervals. Wake studies also included correlation of wave height to vessel speed and direction of transit. Comprehensive wake climates are essential to determining the overall hydrodynamic climatology for modeling of beach response.

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REACTIVE OXYGEN EFFECTS ON DISSOLVED ORGANIC MATTER AND MICROBES

We have been examining the effects of photochemical processes on dissolved organic matter(DOM) and subsequent availability to microbial flora. Our approach is to use two well-characterized DOM sources, one with a predominantly terrestrial signature (Suwannee River DOM) and another with a predominantly microbial signature (Pony Lake DOM). Although these different end-members have very different compositions as revealed by high resolution mass spectrometry, they behave very similarly when exposed to solar irradiation. With both DOM sources, singlet oxygen production represented a large proportion of the photochemical oxygen demand when DOM concentrations were high—more than 50% at 40 mg C/L. Furthermore, when exposed to singlet oxygen, both of these DOM sources produced large quantities of peroxides. Peroxide production was similar in both of these sources despite differences in composition. When singlet oxygen-exposed DOM was subsequently presented to microbial flora, growth was inhibited for approximately two days followed by biomass production similar to a non-treated control. We are examining the possibility that singlet oxygen -generated peroxides may have been sufficient to inhibit microbial growth rates.

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CARBONIC ANHYDRASE EXPRESSION IN ZOSTERA MARINA

Aquatic photosynthesis in seagrasses varies greatly from terrestrial photosynthesis mecha

nisms. From a variety of evolutionary adaptations and physiological responses to the aquatic environment. The physical chemistry of the water presents challenges in obtaining a supply of CO2 for photosynthesis that must be overcome. The rate of diffusion of CO2 in water is 1 x 104 times slower than it is in air, and at an alkaline pH (such as that of ocean water) HCO3- is the dominant dissolved inorganic carbon species. Therefore, the conversion of HCO3- to CO2 is a slow process. Since the pathway for inorganic carbon fixation involves an enzyme, ribulose-1,5-bisphosphate carboxylase/oxygenase (Rubisco), that can only utilize CO2 as a substrate, it is advantageous for a marine organism to develop an inorganic carbon concentrating mechanism (CCM) that usually involves carbonic anhydrase (CA). Photosynthetic efficiency and rates are thus limited by inorganic carbon. This research looks into the pathways of inorganic carbon acquisition in Zostera marina with emphasis on the role of carbonic anhydrase, and the response to projected increases in concentrations of dissolved aqueous carbon dioxide.

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EFFECTS OF SEASONAL STRATIFICATION ON NUTRIENT RETENTION IN A COASTAL LAGOON WITH HARMFUL CYANOBACTERIAL BLOOMS

Excess nutrient supply is a common cause of eutrophication in coastal waters, where hydrodynamics strongly modulate the relationship between nutrient loading and productivity. This study addresses the physical processes that lead to nutrient retention, and subsequently harmful algal blooms, in a shallow, tidally choked, coastal lagoon. The project site, Rodeo Lagoon, is located in the Golden Gate National Recreation Area, California, and experiences intense blooms of cyanobacteria. Monthly transects of the lagoon show it is stratified by salt in winter, when freshwater inputs from the watershed and saltwater inputs from storm surge are both large. In addition to monthly water quality monitoring via transects and grab samples, the study includes two comprehensive, multi-week field observations of lagoon hydrodynamics contrasting turbulent mixing parameters under stratified winter conditions with well-mixed summer conditions. Wind is the dominant source of mixing, leading to the expectation of well-mixed conditions for this shallow site. However, strong density gradients can seasonally reduce vertical turbulent exchange of nutrients throughout the water column. The phasing of salt-based stratification means that annual losses of nutrients via flushing are diminished.

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EFFECTS OF AG AND TIO, NANOPARTICLES ON THE SURVIVAL AND METABOLISM OF ZEBRAFISH (DANIO RERIO) EMBRYOS

Nanoparticles have numerous applications in industry and are defined as materials with one or more dimensions in the 1–100 nm size range. The release of manufactured nanoparticles into natural environments surrounding urbanized areas are likely to impact the health of organisms in aquatic ecosystems. To test potential impacts of silver (Ag) and titanium oxide (TiO2) nanoparticles, we selected zebra fish (Danio rerio) embryos as our model system. Embryos developed for 24 and 48 hours before exposure to Ag and TiO2. Lethal Dose 50 (LD50) for both 24 and 48 hour embryos exposed to Ag was 0.04 mg/ml
and the effective dose (ED) for both 24 and 48 hour embryos exposed to Ag was 0.03 mg/mL. Increases in oxygen consumption at and below the ED have been observed, and ongoing experiments to observe metabolic costs of biological responses to Ag and TiO₂ particle toxicity are underway. Results from this study illustrate the tolerances of early developmental stages in vertebrates to specific concentrations of Ag and TiO₂ nanoparticles. This research may elucidate mechanisms employed by aquatic organisms to combat possible nanoparticle contamination.

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POPULATION CONNECTIVITY IN MARINE SYSTEMS: PROGRESS AND PROMISING DIRECTIONS

The study of population connectivity has evolved over the last decade to include a broad array of approaches to assess the scales and mechanisms over which successful larval dispersal operates within marine systems. Strong interest in this topic has been stimulated by a need to provide spatial management options to resource managers. The major challenges in this effort are to provide a quantitative understanding of the processes and scales controlling successful larval dispersal and how connectivity influences the dynamics of the affected populations. Resolving the mechanisms controlling larval dispersal will involve a coherent understanding of the relevant physical processes and how organisms mediate the physical outcome. Multiple scales will be important, and therefore understanding how the processes are coupled across scales is essential. Identifying patterns will need to involve efforts that focus on a variety of species with different life histories across various environments. In concert, the problem is multidisciplinary, but one requiring interdisciplinary research effort. This talk will provide an overview of these topics and issues with the aid of literature and on-going projects as examples.

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A FULLY IMPLICIT SOLVER FOR THE SHALLOW WATER EQUATIONS ON UNSTRUCTURED GRIDS USING A PRECONDITIONED DUAL-TIME-STEPPING APPROACH

With the recent rise in affordable computing power and common employment of parallelization techniques to expand practical problem scale, grid resolution in coastal ocean simulations has been reduced to O(10m) scale. This can be problematic for explicit time-marching schemes, which are constrained by the CFL condition and can require O(10^5) time steps to integrate one period of tidal forcing. Problem stiffness arising from the disparity between gravity and convective wave speed in these low Froude number flows as well as wide ranges in mesh scales in unstructured grid and AMR approaches contribute to the inefficiency of the explicit approach. In this work, a fully-implicit solver for the shallow water equations is described. By using dual-time-stepping, an unconditionally stable scheme can be achieved with any temporal accuracy. The method presented is matrix-free and requires the solution of a coupled set of equations to obtain the flow solution at each time step. The sub-iteration process is accelerated using multigrid and preconditioning techniques. Results for a realistic coastal application are provided. This method can be extended to solution of the hydrostatic primitive and Navier-Stokes equations.

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BIO-PHYSICAL INTERPLAY BETWEEN VERTICAL GRADIENTS IN VELOCITY, PHYTOLANKTON, AND DISSOLVED ORGANIC MATTER

Planktonic thin layers typically display steep vertical gradients in particle concentration, usually in conjunction with vertical gradients in horizontal velocity (vertical shear). Less well-documented are the steep vertical gradients in dissolved constituents that occur within the same vertical profile, but not solely in association with the gradients in particles. We base our analysis on several datasets obtained over the past decade in three distinct coastal systems: Oregon Island, WA; Oregon continental shelf; and Monterey Bay, CA. Our high-resolution profiling system uses several optical instruments to characterize the particulate and dissolved fields. For particles, we measure in situ chlorophyll fluorescence, particulate absorption (ac-9), particulate attenuation (ac-9), and particulate backscattering (volume scattering function meter). For dissolved components, we measure in situ CDOM fluorescence from UV excitation. We have found that over 70% of observed particulate thin layers possessed coincident steep gradients in CDOM, but many steep gradients in CDOM were detected without coincident particulate thin layers. These CDOM gradients and layers provide an important biological/chemical signature for the discrimination of coastal water types.

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ZOPLANKTON SPECIES COMPOSITION AND ABUNDANCE IN THE EASTERN BERING SEA IN SUMMER: RESULTS FROM A WATER COLUMN STABILITY ON ZOPLANKTON COMMUNITY STRUCTURE

Recent shifts in climate toward warmer conditions may threaten commercial fisheries by altering lower-trophic level productivity and trophic relationships on the southeastern Bering Sea shelf. We examined zooplankton community structure near the Pribilof Islands and on the middle shelf of the southeastern Bering Sea in summer of 1999 and 2004. Between 1999 and 2004, the summer zooplankton community of the middle shelf shifted from large to small species with significant declines in the biomass of large scyphozoans, large copepods, armors and euphausiids, and significant increases in small copepods and small hymeodruses. Stomach analysis of age-0 pollock from the middle shelf indicated a dietary shift from large to small copepods from 1999 to 2004. This shift in zooplankton community was accompanied by a threefold increase in water column stability in 2004 relative to 1999, primarily due to warmer water above the thermocline. These results suggest that if climate on the Bering Sea shelf continues to warm, the zooplankton community may shift from large to small taxa which could strongly impact apex predators and the economies they support.

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COALESCENT AND BIOPHYSICAL MODELS OF LONG-DISTANCE DISPERSAL DYNAMICS IN NERITID SNAILS

Marine species in the Indo-West Pacific have ranges that can span thousands of kilometers, yet studies increasingly suggest that mean larval dispersal distances rarely exceed 200 km. Gene flow across these ranges must therefore rely on some extent on 1) leptokurtic long-distance dispersal and 2) larval dispersal among intermediate “stepping stone” populations, but it is difficult to distinguish between these processes. This study addresses this problem by integrating spatially explicit advection-diffusion models of larval dispersal with gene flow estimates from coalescent analyses. We estimated gene flow among South Pacific archipelagos in two species of marine snail and two species of freshwater snails that both have pelagic marine larvae but that differ in their adult habitat. Our preliminary conclusions are that stepping-stone dynamics are important to long-distance connectivity over short time-scales and in stable populations, but non-equilibrium processes such as rare long-distance dispersal events and metapopulation dynamics may be equally as important in promoting genetic connectivity across large distances. This study provides an empirical assessment of a biophysical model that will be useful in the design of marine reserve networks.

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SURFACE FRESHENING OF THE TROPICAL PACIFIC WARM POOL SINCE THE 1950s.

An analysis of 1955-2003 sea surface temperature and salinity data collected in the tropical Pacific enables us to detect long-term trends in the tropical Pacific Ocean, with emphasis on the Warm Pool waters. The trend in the stratification of the surface layer is also studied. Since 1955, and more rapidly since the 1976-77 climate shift, the tropical central north tropical ocean, whose salinity has been significantly warming and freshening in the region. The freshening is more striking for the lower-salinity waters. One exception concerns the western Coral Sea and the central north tropical ocean, whose salinity has been increasing. Our study also indicates a significant low-frequency extension of the Fresh Pool located under the SPcz and in the eastern sub-tropical, interrupted by dual-time-scale variations. The observed salinity trends suggest an intensification of the hydrological cycle in the tropical Pacific, consistent with changes expected under global warming.

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INTERACTIONS OF CHEMOSYNTHETIC BACTERIA WITH MERCURY AT DEEP-SEA HYDROTHERMAL VENTS

Microorganisms that inhabit deep-sea hydrothermal vents have likely evolved in the presence of elevated concentrations of mercury, which is complexed with sulfur in these environments. Hence, chemosynthetic microbes, which obtain energy from the oxidation of sulfur compounds, are likely exposed to its toxicity. To test this hypothesis we collected fluids from diffuse flow vents at 9°N on the East Pacific Rise (EPR). The concentration of total mercury (THg) in the samples ranged from 2.8 to 88.7 ng/L, while the abundance of mercury resistant thiobacilli oxidizing bacteria ranged from 0.2% to 24.6% of the total thiobacilli oxidizers. A correlation between mercury resistant bacteria and THg concentration suggested acclimation of these microbes to life in the presence of toxic mercury. Mercury speciation in the medium used to grow thiobacilli oxidizing bacteria showed the exclusive presence of negatively charged complexes of mercury thioulate, which were metallothioneine-like in nature. Ongoing work on pure cultures of mercury resistant bacteria and their resistance mechanisms will lead to an understanding of the role of these organisms in mercury biogeochemistry in geothermal environments.
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SELECTIVE TIDAL STREAM TRANSPORT FOR PINK SHRIMP IN SOUTH FLORIDA
This coastal-estuarine species use selective tidal stream transport (STST) for horizontal movement. STST is thought to influence local migration, in which animals move up and down the water column during one tidal phase to promote transport in an "appropriate" direction, and remain or on near the bottom during the other phase to avoid being transported the "wrong" way. One remarkable aspect of STST is the reversal in direction of the migration at different life stages. Our research in South Florida suggests that pink shrimp postlarvae use a dark flood tide to move and last quarter moon to advance toward the western boundary of Florida Bay and into the bay's interior, and juveniles leave Florida Bay, moving in the opposite direction, by using the ebb tide on illuminated nights (full moon). An STST was detected in mysis and postlarvae migrating across the Southwest Florida shelf, suggesting earlier initiation of STST behavior in pink shrimp than other penaeids. The phase lag and attenuation of the tide accompanying their movement into Florida Bay may influence distribution of settlement-stage postlarvae on nursery grounds.

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NEAR-SURFACE SHEAR-FLOW IN THE POLEWARD BRANCH OF THE TROPICAL PACIFIC MERIDIONAL-OVERTURNING CELL
Easterly trades blowing on the equator produce poleward Ekman divergent flow and upwelling. Since ADCPs cannot measure near-surface currents, measurements of the surface poleward branch of the meridional-overturing cell typically require extrapolation above ~20 m and thus depend upon assumptions of the near-surface shear. To test these assumptions, from May 2004 through February 2005, 5 current meters were placed at 5 meter intervals between 5 m and 25 m on a surface mooring near the 26°N, 148°W TAO mooring. The data show mean shear in the zonal flow due to thermal wind, and a slab-like poleward flow due to the competing effects of southward-thermal wind shear and poleward-Ekman spiral shear. Nighttime mixing and daytime restratification result in a diurnal jet and a corresponding diurnal cycle in the near-surface shear. On tropical instability wave timescales, the shear exhibits a complex structure due to variations in the orientation of the cold tongue front relative to the trade winds, and due to variations in the stratification and mixing over the course of the tropical instability wave.

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RADON-222 AS A TRACER OF COASTAL GROUNDWATER DISCHARGE: EXAMINING CONTROLS ON SPATIAL VARIABILITY
Groundwater discharge has in recent years emerged as an important source of nutrients to the coastal ocean. Radon-222 is an excellent tracer of this discharge because it is strongly enriched in groundwater relative to surface water and is chemically non-reactive. One of the largest uncertainties in using radon as a quantitative tracer of discharge arises from the spatial variability in the radon-222 content of the groundwater. We carried out a study in West Falmouth Harbor (MA) to try to better understand the causes of this variability. A reasonably consistent two-fold increase in radon-222 activity was observed between surficial groundwater and groundwater from a depth of ~9 m in five different locations adjacent to the harbor. The surface deficit of radon-222 coincides with an increase in ‘excess air’ as indicated by the ratio of N2/Ar suggesting that both are driven by a common process. This interpretation will be checked using noble gas data, and the implications of this observation for the timing of gas equilibration in the aquifer and for the use of radon-222 as a tracer will be discussed.

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SENSITIVITY OF MERIDIONAL-OVERTURNING RESPONSE TO SWITCHED-ON SOUTHERN OCEAN WIND
Southern Ocean wind variability may cause decadal global overturning variability. In a pre-ice age ocean model, the overturning anomaly due to switched-on wind and stress was 2-3 times stronger in the Pacific than in the Atlantic. Here, model experiments test the hypothesis that this is due to the Pacific being wider than the Atlantic. Idealized experiments are run with narrow and wide Pacific basins and with different North Pacific surface forcing scenarios. The Pacific overturning anomaly P is much bigger for a wider Pacific. In the first decade, P is only modestly sensitive to the density forcing. As it nears steady state, runs with stronger North Pacific density have much bigger P and somewhat smaller Atlantic overturning anomaly. These results indicate that the basic state has a profound effect on the anomalies. They also highlight the active role played by the Pacific, in contrast to the assumption that all the wind-driven outflow from the southern hemisphere (SH) flows into the North Atlantic. Generally, a strong signal develops within decades. Shallow water theory suggests that the timescale is shorter in the SH than in the Northern, and increases with basin width. The experiments show these features, but timescales differ within hemispheres and between basins. Curiously, in a single-basin experiment, the timescale is insensitive to basin width. In the two-basin experiments, timescales have a complicated dependence on North Pacific density.

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ENGAGING UNDERGRADUATES WITH HUMAN IMPACTS
A survey of undergraduates entering an introductory oceanography course reveals that students feel a strong personal connection with the ocean, are concerned about human impacts, and are intrigued by exotic biology and cool technology. Any of these topics will help engage students in a formal oceanography course, but teaching about science of human impacts has effects that may reach far beyond the course itself. Students completing an oceanography course that includes the science of human impacts feel significantly more confident in their understanding of ocean issues, more responsible and more empowered to act for the good of the ocean. These attitudes are strongly correlated with improved attitudes about the nature and relevance of science, as well as with course grades and other measures of content knowledge. A separate survey of marine educators was used to validate the survey; the most significant difference between the educators (experts) and students (novices on pre-class surveys) is confidence in their understanding of ocean issues.

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HYDROGRAPHIC CONSEQUENCES OF FLOW OVER TWO ADJACENT SEamounts WITH DIFFERING BATHYMETRY ARE REVEALED IN WATER COLUMN PLANKTON ECOLOGY
Seasonal studies encompassing both thermally stratified and deep mixed conditions demonstrated different types of seamount hydrodynamics in Lake Michigan. A persistent southward flowing current intercepts two mounts rising out of 150m: one steep-sloped to 36m and one shallow-sloped to 38m. During mixing periods, both impart stability to the overlying water, producing a progression of vertical isotherms that are several tenths of a degree warmer than surrounding basin water during winter. During stratification, leeside eddies and thermoline displacement are much greater for the shallower seamount. Seamount characteristics include full thermoline compression over the leading edge, well-sorted bottom composition, leading edge bottom composition, doming of deep cool isotherms over the plates, and apparent downwelling and sediment deposition on the lee side are readily demonstrated, albeit to different degrees, for both. In contrast to marine seamounts, both result in consistently depilated overlying plankton, possibly resulting from interaction with dense benthic filter-feeding nematode populations. Flow over these features may expose benthos to a far greater volume of water than a stagnant model would predict, making the MidLake Reef Complex a serious component of basin-scale ecology.

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EFFECTS OF PREY AND ENVIRONMENTAL VARIATION ON SPATIAL DISTRIBUTION AND TEMPORAL VARIABILITY OF GROUNDFISH IN THE NORTHERN BERING SEA
Bottom water temperature increases are thought to be influencing northward fish range expansion and altering fish community structure in the Bering Sea north of St. Matthew Island as seasonal sea-ice becomes less prominent. During two icebreaker cruises on the USCGC Healy (7 May - 5 June 2006 and 16 May - 18 June 2007), groundfish were collected at 43 stations in 2006 (59 otter trawls), and 52 stations in 2007 (72 beam and 17 otter trawls). Arctic cod (Boreogadus saida), Bering flounder (Hippoglossoides robustus) and Snailfish (Liparidae) are the dominant fish in the northern Bering Sea. Patterns in species distribution and abundance (catch per unit area) are being analyzed in the context of prey items and environmental variables, such as bottom water temperature, salinity, and nutrient concentrations, along with sediment grain size and carbon content. Results indicate that groundfish may be competing for some of the same benthic food resources as are used by specialist benthic predators such as walrus, gray whale, bearded seals and spectacled eiders that feed on macrofauna in the rich Bering Sea sediments.

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THE HALL-BONNER PROGRAM FOR MINORITY DOCTORAL SCHOLARS IN OCEAN SCIENCE: BUILDING CRITICAL MASS.
THE OCEAN SCIENCES: BUILDING CRITICAL MASS.
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ASLO/AGU/TOS/ERF 2008 Ocean Sciences Meeting
As atmospheric CO$_2$ levels continue to rise due to the burning of fossil fuels, the oceans levels continue to rise due to the burning of fossil fuels, the oceans...
INTEGRATING REAL DATA IN K-12 ACTIVITIES: THE DEVELOPMENT OF OCEAN LITERATE STUDENTS USING SHRIMP: FLounder, AND MARSH LESSONS Ocean literacy concepts can be woven into K-12 activities ranging from animal biology to coastal processes. We present the activities that we have designed as part of a collaboration between a Savannah State University student and K-12 teachers in the community. Our activities have even been incorporated into pre-K classrooms. For example, one lesson focuses on flatfish shape and growth, as students act out the various life stages of a flounder. In another activity, we talk about how scientists sort their fish catches, which provides us with an opportunity for appreciation of fishery and fish abundance. Guess shrimp: provide a model for us to discuss the Ocean literacy concept of predator-prey dynamics; we explain how a small, commercially unimportant species has a great impact on the food web. Finally, we designed a series of K-12 activities based on marshes. The importance of sampling accuracy and precision are demonstrated through the use of student-constructed marsh models as well as field-based exercises. Given proper training, students can become reliable collectors of marsh data that can be useful to scientists.

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FORECASTING WAVE ENERGY AND SALT MARSH ELEVATION CHANGES IN STUDIES OF ESTUARINE SHORELINES Efforts to forecast estuarine shoreline erosion rates demand precise measures of the wind wave regime. We utilized our Wave Energy Model (WEMo), which incorporates fetch, user-defined wind data, and bathymetry to calculate wave energy and asked whether this can forecast sediment accretion and loss rates of fringing Spartina alterniflora marshes in North Carolina. We created digital elevation models of the sites to track meso-scale elevation changes (+/- 2cm) and used surface elevation tables (SETs) and horizon markers to calculate fine-scale (mm/year) measures of sediment accretion. Fine scale measurements were made at the upper and lower edges of paired marshes from 7 sites between 2005 and 2007. Initial results indicated no relationship between fine-scale measures of wave energy and marsh elevation change, although at a coarser scale WEMo predicted a logarithmic decline of marsh frequency with wave energy. Shoreline features such as oyster reefs and breakwaters did significantly increase marsh elevation change, particularly at the lower marsh edge, where accretion exceeded elevation change. Acute events and landscape features may ultimately control the formation and distribution of fringing marshes in this region.

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TIMING AND ATTRIBUTION OF OBSERVED NORTH ATLANTIC HEAT AND FRESHWATER CONTENT VARIABILITY Over the last fifty years, the subpolar basins and Nordic Seas exhibited a full cycle of changes in heat and freshwater content observed, to first-order, around the structure of the NAO/O ((O)) forcing. Although the freshening there between the 1960s and 1990s was long noted, it was be extra extraordinary; it was comparable in timing and amplitude to the natural variability of freshwater storage diagnosed from control runs of coupled climate models. The observed 50-year fluctuation of freshwater content can largely be accounted for as a combination of local storm track / precipitation anomalies, variability in moisture flux convergence onto the Arctic Ocean and its watersheds, and episodic accumulation and release of sea ice and freshwater from the Arctic governed by the regional atmospheric pressure patterns. Subpolar heat and freshwater content anomalies fluctuated in synchrony and were generally density-compensating. By contrast, the Nordic Seas heat and freshwater storage records diverged in the late 1980s resulting in reductions in density in the waters beneath the sill depths of the overflows. The vertical redistribution of temperature and freshwater anomalies, however, inhibited significant alterations of the density contrast that sustains the Atlantic MOC strength. Little, if any, sustained change in the AMOC is evident in the modern oceanic instrumental record.

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SEASONAL TRANSPORT OF GRAVEL ON A MIXED SAND AND GRAVEL BEACH IN A LOW ENERGY, MESO-TO MACRO-TIDAL SETTING. In this work we present direct measurements of coarse sediment (gravel) transport from a beach in Rich Passage, Puget Sound, WA that is exposed to wind waves, tidal currents, and waveak. Few studies to date have quantified the relative role of different forcing mechanisms and the corresponding time scales of morphological response in such environments. Radio Frequency Identification (RFID) Passive Integrated Transponder (PIT) technology is implemented in two yearlong track studies of sediment particles, and complemented with beach profile surveys and meteorological and hydrodynamic measurements. The sampling of the gravel tracers provides sufficient resolution to reveal the dominant transport patterns over varying wave climates. Beach response to the wind wave climate is controlled by site specific exposure to prevailing winds. In the case examined, gravel transport by wind waves is dominated by the combination of vessel wakes and tidal currents.

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THE RELATIVE IMPORTANCE OF LARVAL AND ADULT DISPERSAL IN THE ECONOMICALLY IMPORTANT GAG GROUPER MYCTEROPECA MICROLEPSIS: A GENETIC APPROACH The pelagic larvae of most marine organisms are carried by ocean currents for days to weeks at a time and serve as demographic links between geographically-separated patches of adults. Among some species, the adults also move tens to hundreds of kilometers in order to mate and spawn, and it is not immediately obvious whether larval or adult dispersal is primarily responsible for gene flow. The gag grouper (Mycteoperca microlepis) is an economically-important, slow growing, protogynous fish found throughout the Gulf of Mexico, northwestern Atlantic and Brazil. To separate the relative importance of gage dispersal at larval and adult stages, we propose to assess gene flow between Gulf and Atlantic populations. Our prediction is that migration between Gulf and Atlantic gage populations via larval dispersal could only occur in one direction (Gulf to Atlantic via the Gulf Stream), while migration by adults could occur in both directions. We have sampled 11 microsatellite loci within several hundreds of individuals of known age class in the Gulf and Atlantic, and will present an analysis of the strength and directional bias of gene flow.

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SELENIUM ESSENTIAL, TOXIC, AND INCREASINGLY BEING MOBILIZED TO COASTAL AND OPEN OCEAN WATERS Selenium is a biologically essential element, but it is also toxic depending on its chemical form and concentration. Selenium is enriched in fossil fuels, particularly coal, and therefore introduced to surface waters directly and via the atmosphere. An excellent example of anthropogenic selenium inputs to coastal waters is the San Francisco Bay estuary where fluxes from oil refineries in the 1980-90s rivaled that from the major freshwater input, the Sacramento River. The deposition of selenium from the atmosphere to the surface waters of the North Atlantic has been documented, but we now have atmospheric and water column data for the western North Pacific that show Se from coal combustion in Asia is actually elevating surface water concentrations. Interestingly, silver is also enriched in these same waters, suggesting that it too is derived from coal combustion; Se may act as a coal combustion tracer. These results will be discussed in light of the new international GEOTRACES program that will examine the biogeochemistry of trace elements and their isotopes in the world's oceans.

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RECONSTRUCTING UPPER OCEAN NITRATE CONCENTRATIONS VIA BARITE SE/S: DEVELOPMENT OF A NEW PROXY Bio-limiting nutrients such as nitrate affect C fluxes from surface waters, but paleo proxies need to be reconstructed their historical behaviors. In this respect, the accumulation rate of marine barite in sediments tracks C export, but not what’s driving it. However, other elements are incorporated into/barite that may track nutrients. Selenium as selegen precipitates with barite, but more significantly, depth profiles of selenium closely follow those of nitrate. Thus, Se/S in marine barite may at least semi-quantitatively record upper ocean nitrate concentrations. We are conducting calibrations using abiotic barite precipitation (varying selenate at constant sulfate), precipitations within decaying phytoplankton that simulate water column production, and determinations of Se/S in barites from sediments and core tops. The abiotic precipitations show an excellent correlation between barite and solution Se/S (r=0.88), light temperature dependence, and an enrichment of Se/S in barite relative to the solution of 15-30, which is similar to those seen in core tops analyzed to date. Se/S in barite formed in decaying phytoplankton behaves similarly. The discussion will include speculations on other uses for Se/S in marine barite.

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NUMERICAL STUDY OF INTERNAL TIDE BREAKING PROCESSES Internal tides generated by the interaction of barotropic tides with topography represent almost half of the total internal wave energy. Internal tide breaking is therefore believed to play a crucial role in oceanic circulation. Tidal generation of solitons is one of the main processes involved in internal tide breaking. However, our knowledge of this mechanism is still incomplete. Previous results of Gerken (J.Mar.Res. 2001, Non Lin. Process. Geophys. 2003) obtained from a weakly non linear, non hydrostatic model, have shown for instance the dramatic influence of the pycnocline strength on solitons formation and propagation. Here, we use OOF5, a fully non hydrostatic numerical code developed by K. Winters to study propagation and breaking of internal tides in 2D idealized geometry, for different
stratification strength and latitudes. Therefore, we extend Gerken's results to the fully non linear, non hydrostatic case, while accounting for the influence of parametric subharmonic instability (PSI) by varying the latitude. Ultimately, we shall use these results as a basis for parameterizing internal tide energy transferred to solitobars and to high frequency waves through PSI as a function of bulk parameters: tide energy stratification, latitude.

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DECADAL RESPONSE OF THE ATLANTIC MERIDIONAL OVERTURNING CIRCULATION TO LOCAL AND REMOTE FORCING
The MIT adjoint model in an 1 degree global configuration is used to study the variability of the Meridional OvERTurning Circulation (MOC) in the North Atlantic. The adjoint model allows the calculation of the sensitivity of the MOC to several model inputs, including initial conditions and atmospheric forcing, in a single model integration. These adjoint sensitivities are used to identify how anomalies along the western boundary and the interior, and thus the MOC, are sensitive to local and remote forcing. Our study suggests that the buoyancy forced variability of the mid-latitude MOC at a particular time is the sum of at least the last 40 years of winter-time buoyancy forcing over the subpolar gyre. This variability is characterized by a decadal oscillation, which is a robust feature of the model integrations. Positive heat loss anomalies, for example during NAO+ phases, are leading to an increased MOC for the next 10 out to a decreased MOC for the following 10 years and so on. The periods are nearly independent from latitude at which the jet function (i.e. the MOC) is defined. Whereas the decadal oscillation is a robust feature in our model runs, the sensitivity of the MOC to surface heat fluxes can also display a seasonal variation, but this is critically dependent on the formulation of the surface boundary conditions. We further discuss the utility and accuracy of adjoint models on decadal timescales.

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EFFECTS OF PROTOZOA GRAZERS AND PERIODIC SUBSTRATE ADDITION ON GROUNDWATER MICROORGANISMS
Both substrate periodicity and the presence of protozoan grazers have been shown to affect bacterial community composition. In this study we analyzed groundwater microbial communities, collected from an aquifer at Waquoit Bay, MA. In laboratory incubations, communities were subjected to periodic addition of carbon substrate (acetate) and/or removal of grazers. Terminal restriction fragment length polymorphism procedures were used to describe the diversity within the resulting microbial communities. Periodic removal of grazers did not alter the diversity of the community when compared to communities subjected to a one time addition of acetate. However, community diversity was found to be different when samples were with and without grazers were collected. Interestingly, samples incubated without grazers had significantly higher numbers of heterotrophic cells and higher dissolved organic carbon concentrations. We conclude that the removal and subsequent absence of grazers leads to proliferation and diversification of microbial communities in a groundwater setting. The loss of a control mechanism, such as grazers, on microbial proliferation could have serious consequences for the use of groundwater resources in the future.

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SAR OBSERVATIONS OF RESONANTLY GENERATED INTERNAL SOLITARY WAVES
SAR images revealed the two-dimensional propagation characteristics of short-period internal waves generated at Race Point Channel in Massachusetts Bay. The main characteristics of the two-layer flow are described based on the criticality of the Froude Number, calculated from available in situ measurements at Race Point Channel. The generation mechanism of the observed internal solitary waves is investigated. The solitary waves are generated during the ebb phase of the tide within the Channel. On some occasions, two trains of internal waves are generated presumably at the same location but at slightly different periods during the ebb tide. It is suggested that these two individual packets of waves result from flow passage through resonance. One packet is generated when the flow velocity enters the transcritical regime during the acceleration phase of the (ebb) tidal current, and another packet is generated during the deceleration phase. Both packets propagate upstream when the tide slackens, but with slightly different propagation directions.

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SELECTIVITY AND GRAZING IMPACT OF TWO DOMINANT SPECIES IN THE CALIFORNIA CURRENT ECOSSYSTEM: EUHAPUS PACIFICA AND CALANUS PACIFICUS
Grazier addition experiments were carried out using field prey assemblages from coastal upwelling conditions to offshore mesotrophy during a CCE-LTER Process cruise in April 2007. Clearance rates of Euphausia pacifica revealed plastic preferences, following the relative availabilities of prey sizes and types determined by image analysis microscopy. In contrast, Calanus pacificus showed more of a fixed size preference. Both species preferred diatoms and autotrophs other than dinoflagellates. However, preference scaled with relative carbon contributions of the different groups, and clearance rates on heterotrophs increased with their increasing biomass. Behavior plasticity results in spatial differences in the potential grazing impacts on microplankton groups, which do not scale linearly with prey abundance. Additionally, the ability to exploit variable carbon resources in dynamic environments results in spatial differences in the carbon contributions of microplankton taxa, which could have potentially significant impacts on population success.

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ONE CENTURY SEDIMENTARY RECORD OF MERCURY AND LEAD POLLUTION IN THE SAGUA ESTUARY (CUBA) DERIVED FROM 210PB AND 137CS CHRONOLOGY
Distribution of Hg and Pb were analyzed in a sediment core collected in the Sagua estuary, located in the north-centre of Cuba. This estuary receives the discharge of the Sagua River, one of the most polluted rivers discharging into the Cuban coastal environments. Depth profiles of metal concentrations were converted to time-profiles by using a 210Pb-derived vertical accretion rate, estimated 0.52 cm y-1 (0.17 cm y-2) for Hg and Pb respectively. The Hg increase is due to the incomplete treatment of industrial wastes from a chlor-alkali plant with mercury anode, present in the Sagua basin. Lead fluxes to sediments showed a gradual increase from the 20s to the present time, in good agreement with population increase in Sagua la Grande city. The transitory Pb flux reduction in the 90s is coincident with a period of Cuban economy contraction.

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THE AUSTRALIAN INTEGRATED MARINE OBSERVING SYSTEM
The Integrated Marine Observing System (IMOS) is a set of equipment distributed in the ocean around Australia and puts data and information services to facilitate research and applications. Collectively the equipment will contribute to meeting the needs of marine research in Australia in both open oceans and coastal oceans. The value from this infrastructure investment lies in the coordinated deployment of a wide range of equipment aimed at deriving critical data sets. These, in turn, become the infrastructure for a wide range of research and educational roles at a variety of scales. The infrastructure also contributes to Australia’s role in international programs of ocean observing. IMOS was initiated in 2007 with an investment of $A55.2M by the Department of Education, Science and Technology under auspices of the National Cooperative Research Infrastructure System, and a nearly equal contribution in matching funds. The range of observations includes three open ocean projects (Argo-flots, Enhanced ships of Opportunity and a Southern Ocean Mooring), three coastal physical projects (moorings, glider floats and radar towers) and three coastal biological projects (passive acoustic listening stations, acoustic screens and instrumentation of the Great Barrier Reef).

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FLOW-DRIVEN EXCHANGE OF SOLUTES AND PORE WATER AT THE SEDIMENT-WATER INTERFACE
Solute and pore-water exchange at the sediment-water interface affects nutrient availability and fate of contaminants in benthic environments. To better understand roles of sediment properties and mobility in these processes, we conducted flume experiments examining penetration of dye and salt tracers into a porous bed underlying channel flows with velocities up to nearly 1 m/s. The porous bed comprised 1.5-mm diameter glass beads and, in selected experiments, was covered with a 1-mm mesh to prevent sediment transport and development of bedforms, even when the flow speed was otherwise sufficient to mobilize individual particles in the bed. Visual measurements of the depth of dye penetration into an initially clear-bed water bed with time were made and validated with independent assessments of tracer exchange using in-bed lysimeters. We report that, for nominally flat, rippled and selected experiments, was covered with a 1-mm mesh to prevent sediment transport and development of bedforms, even when the flow speed was otherwise sufficient to mobilize individual particles in the bed. Visual measurements of the depth of dye penetration into an initially clear-bed water bed with time were made and validated with independent assessments of tracer exchange using in-bed lysimeters. We report that, for nominally flat, rippled and
PHOTOCHEMICAL PRODUCTION OF C1–C3 ALKYL NITRATES DURING GOMEC.

The photochemical production of low molecular weight alkyl nitrates (C1–C3) was observed in shipboard incubation experiments along the Gulf of Mexico East Coast Carbon Cruise (GOMEC), July 2007. This is the first time alkyl nitrate production experiments have been carried out in coastal waters using fresh samples. Seawater samples from the surface ocean at nine stations along the cruise track and spiked with varying levels of nitrite were analyzed. The concentration of alkyl nitrates increased with the addition of nitrite. The production rate of alkyl nitrates was clearly dependent upon the initial concentration of nitrite, most likely as the source for NO radicals for the reaction of ROO and NO to make alkyl nitrites. The magnitude of the production of alkyl nitrates varied between water samples and preliminary data analysis suggests that the ratios of alkyl nitrates changed significantly between water samples. This is different from previous observations in the open ocean. The implication is that the sources of organic peroxys radicals may change depending on the sample location, suggesting that it may be possible to observe alkyl nitrate formation to qualify organic matter.

ANOTHER WAY TO LOOK AT RECOVERY OF COASTAL SEDIMENTS FROM EXCESS CARBON LOADING

Boston Harbor has a long history of receiving domestic and industrial wastes, including municipal sewage. The Massachusetts Water Resource Authority (MWWA) has taken remedial actions to improve sediment and water quality of the harbor by improving sewage treatment and reducing anthropogenic inputs. Initial efforts began with the cessation of sludge discharge to the harbor in 1991. Long-term monitoring conducted by the MWWA has shown that sediment quality in the harbor has improved in response to these actions. Significant decreases in total organic carbon (TOC) and abundances of the sewage tracer, Clostridium perfringens were observed since the early 1990s. A significant downward trend was also observed in the intercept of the linear fit between TOC and percent fines over the monitoring period (p < 0.001), which reflects burn off of excess organic carbon after sewage sludge discharge was ended and decreases in the carbon load as the other interventions were completed and the sediments adjusted to the reduced carbon loading. Evaluation of the slope and intercept of the percent fines versus TOC relationship appears to provide another measure by which to assess system recovery.

REE SEAWATER CONCENTRATIONS IN THE BERING STRAIT AND THE CHUKCHI SEA

Nd isotope data from filtered samples show that Pacific water entering the Arctic through Bering Strait is significantly altered by processes on the shelf areas, gradually changing the isotopic signal of Pacific water to less radiogenic values. It is suggested that this shift is caused by interactions between sediments and exchange with re-suspended sedimentary particles. We present REE concentrations in unfiltered water samples from the Bering Strait and the Chukchi Sea. Vertical profiles were collected in the Bering Strait (50 m) and the Chukchi Abyssal Plain (1450 m). These data show the presence of suspended particles in Bering Strait, with more than 10 times higher Nd concentrations in some unfiltered samples compared to 0.22 micron filtered fractions. While total REE concentrations in the Bering Strait are similar high when compared to North Pacific seawater, dissolved Nd concentrations in Bering Strait remain at slightly enhanced levels. This indicates that the suspended fraction is largely inactive, supposedly minerogenic. However, the change in Nd-isotopic composition reveal that at least a fraction of the suspended matter is available for exchange with dissolved REE.

DECADAL TREND OF DISSOLVED OXYGEN IN THE WESTERN PACIFIC ACROSS IS6E

Japan Meteorological Agency has been conducting routine observation of hydrographic section in the top 2000m water column along 165°E between 30°N and 3°S once or twice a year since 1996. The changing parameters in the open ocean begin with dissolved oxygen (DO) analyzed by Winkler method. Data are now undergoing rigorous quality checking. Prelimnarily, we have analyzed the trend of DO on various isopycnal surfaces in the zone just to the south of Kuroshio Extension (28°N – 30°N) using the data set of WOCE P13 in 1993 as a benchmark. In general, trend of DO decrease and apparent oxygen utilization (AOU) increase were seen. They are mostly not statistically significant, but are significant in deeper layers; e.g., AOU is increasing at a rate of 3.5±1.1 μmol kg⁻¹ per decade at potential density 27.0 that does not outcrop in the North Pacific.
SATELLITE REMOTE SENSING OF THE BALTIC ECOSYSTEM AND ITS PRIMARY PRODUCTION

The Baltic Sea is of great importance to the countries surrounding it and its ecosystem is evolving as a result of human activities. This requires a regular monitoring of environmental processes in the Baltic which, together with in situ analysis at selected sites and times, can only be effective with the implementation of remote sensing technology. On the other hand the optical properties of the Baltic waters differ significantly from those of open seas, so the remote sensing of the characteristics of its ecosystem, in particular pigments and primary production (PP), has to be based on quite different algorithms, compared to those applied in the ocean waters. With this end in view, a comprehensive national project DESAMBEM - Development of satellite method of the Baltic ecosystem monitoring (PEZ KBZ-056/PO4/2001-2005) was executed in years 2002-2005. The mathematical models and algorithms for the remote sensing of the Baltic ecosystem and its primary production were developed and can be applied in the future. This work shows that the new algorithms have a strong potential in terms of monitoring Baltic ecosystems from space. Some analysis of PP data and validation of Baltic PP satellite algorithms are also provided.

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ROLE OF GRAVITY CURRENTS ON SEAFLOOR MORPHOLOGY

Gravity currents containing large concentration of silt and clay can have major role on sea-floor morphology and the dispersion of sediment to the continental shelf and beyond. To investigate the impact of gravity current on the seafloor morphology, a generalized 2.5D morphodynamic model has been developed. The model assumes that the gravity-driven flow of suspended mud is supported by the wave-induced suspension of sediment in the turbid layer and is important to the shelf morphology and sediment dispersal beyond the continental shelf. The model uses depth-averaged equations for describing the conservations of suspended and bed load sediment, as well as the momentum and turbulent kinetic energy. These equations along with the Exner equation of bed sediment continuity are solved using a predictor-corrector scheme. The model studies the interaction of extreme river flow events with the seafloor, shelf processes as well as the along and cross shore currents. Based on a number of studies from the El River Shelf project (ONR, STRATAFORM), the present study includes an idealized representation of surf zone, shoreface and shelf processes to study the whole source-to-sink system of sediment sharing components. Different scenarios are used to emphasize the relative role of the interacting sediment transport flux gradients to characterize the nature of seafloor deposition.

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OBSERVATIONS OF THE UPPER OCEAN BOUNDARY LAYER INFRONTS

The spatial structure and turbulent fluxes at strong density fronts were investigated using the high resolution of an acoustically-tracked, water-following Lagrangian float and a new towed body "Triaxus" that conducted rapid three-dimensional surveys around the float on a scale of 1-10 km. The float measured the turbulent intensity and fluxes in the boundary layer. Large eddy simulations of the boundary layer are used to help interpret these data. The presence of strong lateral gradients affects the boundary layer in several ways: The direction of the Ekman transport relative to these gradients can strengthen or weaken the front and enhance or suppress the mixed layer deepening. Several fronts have persistent regions of highly negative potential vorticity apparently sustained by wind forcing. The resulting instabilities can enhance the boundary layer turbulence, thereby providing a direct path from the geostrophic flow to turbulence and dissipation. They can also rapidly stratify the boundary layer when the wind weakens. Examples of these effects from fronts off Scotland and in the Kuroshio will be shown.

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EXPERIMENTAL INTERNAL WAVES

We study the emission, propagation and reflection of internal waves. The use of a novel internal wave generator capable to produce large amplitude internal waves will be emphasized. Results on the reflection on various topographies will be given with and without rotation.

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ON THE MECHANISMS AND TEMPORAL VARIABILITY OF HIGH-LATITUDE CHLOROPHYLL CONCENTRATIONS

Variability in global chlorophyll biomass (Z Chl) and marine net primary production (NPP) is a critical determinant of atmospheric composition and climate change. Recent oceanographic literature has developed the paradigm that stratification of the tropical and subtropical upper ocean exerts the primary physical influence on nutrient supply to
surface biota and consequently NPP. According to this view, variability in these regions dominates the global signal while observed changes in Σ C at high latitudes average the spatially and make no significant global contribution. To test this hypothesis we conduct a detailed study of the recent spatial and temporal variability in chlorophyll concentrations at high latitudes, examine its relation to changes at lower latitudes and explore linkages to local physical processes. We assess the primary physical forcing of variability in nutrient supply and NPP for cooler, seasonally stratified seas by relating Σ C to simple hydrography. We utilize satellite measurements of ocean colour and surface ocean properties as well as historical hydrographic records.

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APPLICATIONS OF THE DIAGENETIC MODEL CANDI IN PENSACOLA BAY

We explored the robustness for a sediment diagenesis model. The model, CANDI (Carbon and Nutrient Dynamics In situ) has many variables which allows the model to be adjusted for different environments. Pensacola Bay overlying water (OW) concentrations for oxygen, nitrate, total phosphate, total ammonium, and total hydrogen sulfide were inputted into the model along with literature values of other OW nutrient concentrations for which no data were available. A median relative error close to twenty percent was obtained using nitrate sample data for the first three centimeters of Pensacola Bay. CANDI’s large repertoire of variables makes the model applicable to many environments the model is more complex as a result. Usually models compromise between simplicity and accuracy. However, CANDI sacrifices simplicity for generality not accuracy.

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REMOTE SENSING OF A HARMFUL ALGAL BLOOM IN MONTEREY BAY, CALIFORNIA

The Coastal Ocean Applications and Science Team (COAST) was formed by NOAA to assess the need and utility of measuring coastal ocean color from a geostationary satellite. The first COAST experiment was conducted in Monterey Bay September 3-15, 2006. For the Monterey Bay experiment we used the Florida Environmental Research Institute’s (FERI) Spectroscopic Aerial Mapper with on-board Navigation (SAMSON). SAMSON collects a full hyperspectral dataset covering 256 bands in the VNIR (3.5 nm resolution over 380 to 970 nm range) at 72 frames per second. Monterey Bay was sampled at 5 m Ground Sample Distance (GSD) as frequently as every 30 minutes. At the time of the COAST experiment there was a Harmful Algal Bloom in the north-east corner of Monterey Bay. Extensive measurements of in-situ optics and biology were collected to characterize the bloom and its optical properties. The bloom had a distinct optical signature that was easily recognized in the remote sensing data. The dominant species in the bloom was Akashiwo sanguinea, a strong vertical migrator. The vertical migration was documented in the times series of SAMSON data.

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GLOBEC SYNTHESIS AND MODEL EXAMINATION OF PROCESSES CONTROLLING COPEPOD POPULATIONS ON GEORGES BANK

An overview of US GLOBEC synthesis will precede discussion of research on 3D model applications. Biological and physical processes that influence the distributional patterns of copepod populations were examined using a “stage-with-mean-age” model, FVCOM, a nitrogen-phytoplankton-zooplankton-detritus (NPZD) model, and an integrated modeling system that was easily recognized in the remote sensing data. The dominant species in the bloom and its optical properties. The bloom had a distinct optical signature. The Coastal Ocean Applications and Science Team (COAST) was formed by NOAA to assess the need and utility of measuring coastal ocean color from a geostationary satellite. The first COAST experiment was conducted in Monterey Bay September 3-15, 2006. For the Monterey Bay experiment we used the Florida Environmental Research Institute’s (FERI) Spectroscopic Aerial Mapper with on-board Navigation (SAMSON). SAMSON collects a full hyperspectral dataset covering 256 bands in the VNIR (3.5 nm resolution over 380 to 970 nm range) at 72 frames per second. Monterey Bay was sampled at 5 m Ground Sample Distance (GSD) as frequently as every 30 minutes. At the time of the COAST experiment there was a Harmful Algal Bloom in the north-east corner of Monterey Bay. Extensive measurements of in-situ optics and biology were collected to characterize the bloom and its optical properties. The bloom had a distinct optical signature that was easily recognized in the remote sensing data. The dominant species in the bloom was Akashiwo sanguinea, a strong vertical migrator. The vertical migration was documented in the times series of SAMSON data.

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CHARACTERIZATION OF NOVEL SPONGE-ASSOCIATED BACTERIA FROM THE GIANT BARREL SPONGE, XESTOSPONGIA MUTA

Xestospongia muta, the Giant Barrel Sponge, is a tropical marine sponge that is ubiquitous throughout the Caribbean. Molecular and culture based techniques have shown that this sponge is host to a very diverse microbial community. Several media types have been used to isolate bacteria from this sponge in an attempt to access the true bacterial diversity of cultivable bacteria present. Several novel bacteria have been cultured from this sponge and these isolates are likely to be the first representatives of new species or genera, based on initial 16s ribosomal RNA gene sequences. We are further characterizing these bacteria with methods that include full 16s ribosomal RNA gene sequencing, biochemical characterization, gram-staining, and motility assays. This work forms the basis for describing new bacterial species for these sponge-associated isolates.

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ON THE GENERATION AND USE OF PROBABILISTIC WIND FIELDS FOR THE SIMULATION OF STORM SURGE AND INUNDATION

Hurricanes are the most costly, large-scale natural disasters impacting the U.S. Strong winds remote inundations originating over the shelf or damage may exist. For purposes of emergency planning and mitigation, numerical models are used to simulate the response of the coupled atmospheric-oceanic-estuary system. For hindcast, the atmospheric state can be fairly well determined; however, accurate forecasting (especially of intensity) is still lacking. One method to address the present forecasting inaccuracies is to use a probabilistically forced ensemble of synthetic wind and pressure fields. Using historical best track and forecast model guidance from the National Hurricane Center, empirically-derived probabilistic track and intensity errors are used to assemble an ensemble of synthetic wind and pressure fields. The resulting surge and inundation response for each ensemble member is then combined to produce aggregated forecast products (e.g. Maximum of Maximum or probability of exceedance). Using data from recent hurricanes, this paper will discuss the inundation response of selected coastal regions in Florida to an ensemble of synthetic storms and its impact for forecasting during the 2004 hurricane season.

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EFFECTS OF WESTERN BOUNDARY CURRENT DYNAMICS ON THE INTERNAL WAVE FIELD OF THE SOUTHEAST FLORIDA SHELF

Shef shell internal wave fields are typically highly variable and dominated by wind and tidal forces. However, this is not necessarily true for outer shelf regions or very narrow shelves where remote physical processes originating over the slope or damage may exist. A strong influence on the internal wave climate. During the summers of 2003 and 2004 we conducted observational studies on the inner Southeastern Florida Shelf. This region experiences an energetic internal wave field and is close to the axis of the Florida Current. The data exhibit broad spectrum baroclinic energy, from f to f0, corresponding to baroclinic processes including the internal tide, cool-water internal bores, and high-frequency internal waves. Wavelet analyses of the coupled current with altimetry images of the Straits of Florida reveal the strong influence of Florida Current fluctuations on outer shelf flows. Diurnal-band instabilities in the Florida Current such as frontal eddies can modify the internal wave field on the shallow shelf and slope, at times, even more than tides. Finally, we present evidence for internal wave processes and associated processes including the internal tide, cool-water internal bores, and high-frequency internal waves. Wavelet analyses of the coupled current with altimetry images of the Straits of Florida reveal the strong influence of Florida Current fluctuations on outer shelf flows. Diurnal-band instabilities in the Florida Current such as frontal eddies can modify the internal wave field on the shallow shelf and slope, at times, even more than tides. Finally, we present evidence for internal wave processes and associated processes including the internal tide, cool-water internal bores, and high-frequency internal waves. Wavelet analyses of the coupled current with altimetry images of the Straits of Florida reveal the strong influence of Florida Current fluctuations on outer shelf flows. Diurnal-band instabilities in the Florida Current such as frontal eddies can modify the internal wave field on the shallow shelf and slope, at times, even more than tides. Finally, we present evidence for internal wave processes and associated processes including the internal tide, cool-water internal bores, and high-frequency internal waves. Wavelet analyses of the coupled current with altimetry images of the Straits of Florida reveal the strong influence of Florida Current fluctuations on outer shelf flows. Diurnal-band instabilities in the Florida Current such as frontal eddies can modify the internal wave field on the shallow shelf and slope, at times, even more than tides.
concentrations, with chlorophyll concentrations increasing with distance away from the bay. Zones of reduced oxygen tend to occur under surface layers of elevated chlorophyll.

Numerical and Theoretical Investigations of North Pacific Subtropical Mode Water and Its Role in Pacific Climate Variability

To better resolve the role of Subtropical Mode Water (STMW) in the exchange of information between the atmosphere and the ocean linked to climate variability, high-resolution MIT General Circulation Model (MITgcm) simulations are used to study the formation, evolution, and dispersal of STMW and thereby STMW's role in Pacific climate variability. During a 171-month time period (from Jan 1992 to Mar 2006), the seasonal variability is the dominant temporal pattern observed. From climatological model fields, STMW exhibits unique features in time and space. This can be seen more clearly by dividing the cycle into three distinct time periods: the formation, the isolation, and the dispersion periods. In addition to seasonality, there is also a distinct interannual signal observed in STMW. This variation pattern is connected closely to the climate shifts of North Pacific. Further investigation shows high correlation between the STMW variability and the Pacific Decadal Oscillation index. Implications of the role of STMW in decadal variability are explored as well as investigation into possible dynamics and mechanisms with the use of a Planetary Geostrophic Ocean Model.

Resolution of Bottom Boundary Layer Transports in a Model of Canyon Upwelling

The active transport of carbon out of the surface ocean by migrating fish that form the deep scattering layer is poorly known, but potentially large. Biomass measurements and CTD profiles from the CCE-P0704 cruise were combined with physiological and mortality rates from the literature using a computer model. The model results indicate an overall fish-mediated transport of 0.7-3.2 mg C m⁻² d⁻¹ in the California Current. The fish carbon flux is similar to estimates of the migratory zooplankton flux from other ecosystems and is 6-7% of the passive carbon flux measured concurrently with sediment traps. The measured fish biomass is biased low due to net avoidance. Correction of the bias based upon published capture efficiencies indicates that fish-mediated carbon flux is 45-50% of the passive flux measured with sediment traps at 100 m. We plan to measure capture efficiency bias on future CCE-LTER cruises by combining quantitative sonar data with mesopelagic trawl sampling.

Spatial Variation in Stable Carbon and Nitrogen Isotope Ratios in Primary Producers and Selected Consumers from Shallow Coastal Waters

Ratios of stable carbon and nitrogen isotopes represent a hallmark of contemporary in situ measurements. The distribution of carbon and nitrogen isotopes in seawater reflects the trophic status of the ecosystem and can reflect the impact of human activities. Rates of carbon and nitrogen cycling in coastal ecosystems are significantly higher than in the open ocean. The mixing of nitrate and ammonia from riverine inputs with the overlying oxygenated surface waters produces a unique isotopic signature that is used to track the carbon and nitrogen cycles in these systems. The study of carbon and nitrogen isotopes is essential for understanding the role of coastal ecosystems in the global carbon and nitrogen cycles.

Applications of Plankton Tracking and Identification for Underwater Device Ensembles

In order to develop in-situ methods for quantifying plankton movements, particle trajectories were extracted from video captured aboard the R/V Thomas G. Thompson, along a 1300-mile transect in the coastal northeastern Pacific in May 2007. Videos captured at sea were noisy from detritus and ship motion. Four algorithms to identify active swimming were compared, two algorithms estimate mean and std. flow vectors, one estimates average particle speed, and one estimates the mean directional distribution of all particles. Individual deviations from average water motion were used to identify active swimming. To develop a suite of algorithms effective across varied conditions, a diverse set of video footage was analyzed; footage had varying particle densities, water motion, and variations therein. Estimation of mean flow vectors identified active plankton with high precision for video footage with lower particle density and more water motion. For footage with higher particle densities and low water motion, performance decreased as density increased. Automatic methods of plankton trajectory identification could be used for developing a near real time system of monitoring biological activity and distinguishing from abiotic particle density.
predators into a realm normally devoid of these. Cross Seamount, located roughly 185 miles south of the Bering Sea, has sea ice that is 33 meters thick and has a diameter of approximately 8km. Using a dual warp modified Cobbd trawl with an open square mouth of approximately 140m², trawls were conducted both directly over and away from the summit of Cross Seamount to target the deep scattering layer during the day and the shallow scattering layer at night. All organisms collected were identified down to the lowest taxonomic level possible. Results from this study indicate that there is a significant decrease in abundance of organisms and absence of certain deeper migrating taxa directly over the summit as opposed to away. Reasons for the significant decrease in abundance could be due to increased predation directly over the summit or from active variation avoidance.

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STABLE ISOTOPIC COMPOSITION OF DISSOLVED SILICON IN THE EASTERN ATLANTIC OCEAN

Diatoms are important primary producers in nutrient-replete environments such as upwelling zones and the Southern Ocean, where they may account for up to 75% of annual primary production and represent a significant carbon export from the surface ocean. As diatoms fractionate Si isotopes during formation of their siliceous frustules, the Si isotopic composition of diatomaceous opal and surface seawater reflects the degree of silicic acid utilisation. However, the use of Si isotopes as a paleoceanographic proxy is hampered by incomplete understanding of the dynamics of Si in the ocean, and a more thorough investigation of the modern ocean, especially nutrient-depleted waters, is thus vital. We present the stable isotope composition of Si dissolved in surface and deep waters of the eastern Atlantic Ocean. These samples, including highly depleted surface zones in which Si concentrations lie below 2µM, were collected on cruise ANT XXIII/1 and measured using high-resolution MC-ICPMS (Nu Plasma 1700).

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FRESHWATER FLUXES IN FRAM STRAIT FROM A 9-YEAR LONG MOORING RECORD

Excessive amounts of freshwater added to the northern North Atlantic from the Arctic through Fram Strait can moderate the dense water formation and associated ocean density contrasts driving the northern part of the Meridional Overturning Circulation (MOC). Here, we present results from a 9-year long mooring record in western Fram Strait at 79°50' North which provides a platform to monitor the liquid freshwater flux from the Arctic into the Nordic seas continuously. The observed annual and interannual variability as well as long term changes of the water mass properties and volume transport in East Greenland Current are presented. The annual mean freshwater flux relative to a salinity of 34.9 is observed to be relatively constant despite a slight increase in the total annual mean southward volume transport in the Fram Strait over recent years. Relative to the 9-year mean the summer months of 2005 and 2006 indicate increased freshening of the outflowing upwell over deep water mass at the mooring sites in the East Greenland Current and on the East Greenland Shelf.

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MODELING THE ICE-OCEAN ECOSYSTEM IN LANDFAST ICE ON THE CHUKCHI SHELF AND WITHIN THE FLUCTUATING ICE MARGIN OF THE BERING SEA

In recent years, modeling of both pelagic and sea ice regimes has revealed new insights into life at the dynamic interface between sea ice and water. Central to these modeling studies are field investigations, which are for the most part scarce in the Arctic. However, two sites on the Alaskan shelves have yielded and continue to produce biophysical multi-year time series observations that are crucial to the modeling work. This presentation will provide an overview of numerical modeling studies conducted through collaborations in recent years for the landfast ice ecosystem in the Chukchi Sea and the ice-ocean ecosystem in the fluctuating ice margin of the Bering Sea. Using the one-dimensional model, physical controls on biota are assessed, and hypotheses, such as seeding of the phytoplankton bloom by ice algae, investigated. Work in progress, including the addition of a sea ice microalgal loop, will also be presented. This new component of the model will help to investigate the partitioning of sea ice primary production between the pelagic, benthic and sea ice microbial realms under climate change.

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LONG LIVE LIMPETS: SUSTAINING A COLLABORATIVE SCIENCE EDUCATION PROGRAM

The LiMPETS program is a collaborative effort among California’s National Marine Sanctuaries, the Farallones Marine Sanctuary Association (FMSA), the Marine Science Institution at the University of California at Santa Barbara, and the University of California at Santa Cruz. The LiMPETS network was created in 2002 when the National Marine Sanctuaries streamlined and united two independently conceived student monitoring programs, the Seymour Center’s Student Intertidal Monitoring Program (SIMP) and FMSA’s Sand Crab Monitoring Program. Protocols for monitoring rocky intertidal and sandy beach ecosystems were developed with the expertise of Dr. John Pearse, Dr. Jennifer Saltzman, and others. Since 2002, partnerships, funding, and leadership within the program have both helped and hindered the growth and success of LiMPETS. Lack of funds and support for the program has stymied its growth. However, our diverse partnerships and the integrity of the program itself, are the program’s greatest strengths. We will share past and present challenges and successes of this unique science education program and will unveil our new website and strategic plan for growth and sustainability of the LiMPETS program.

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SEANET: COLLABORATIONS IN OCEAN SCIENCE EDUCATION IN ALASKA

A unique collaboration among ocean research organizations in Alaska has created an informal network of communicators, educators and scientists soon to be formalized as SEANET - Scientists and Educators of Alaska Network, part of a proposed Center for Ocean Sciences Education Excellence (COSEE): Alaska—People, Oceans and Climate Change. By sharing a senior outreach manager, the Alaska SeaLife Center (research and informal education), North Pacific Research Board (research) and Alaska Ocean Observing System (coastal and ocean monitoring) collaborate in communicating about their marine research programs to audiences in Alaska, the nation and the world. Together, the organizations sponsored the first Communicating Ocean Science (COS) Workshop during the annual Alaska Marine Science Symposium, which drew more than 400 ocean scientists to present the results of their research in Alaska’s seas. At the COS workshop, scientists, educators and communicators shared best practices in local, regional and national programs for communicating ocean science, and in 2008, will focus on networking scientists and educators.

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CREATING INTERACTIVE DATA TOOLS & CASE STUDIES TO SUPPORT FUTURE USE OF SATELLITE-DERIVED SALINITY DATA

Despite the long history of ocean exploration, salinity has never been measured in 25% of Earth’s oceans. After its May 2010 launch, the NASA Aquarius instrument will measure global sea surface salinity (SSS) and produce monthly maps with 0.2 psu accuracy. How do we engage today’s learners to utilize these future data sets? By providing resources that demonstrate how improved understanding of salinity patterns - with ties to climate and the water cycle - can benefit society as a whole. Our “hands on” activities include lessons about the water cycle - can benefit society as a whole. Our “hands on” activities include lessons about
velocity field is examined in comparison with the frontal hydrography. Hydrography of the front is examined between cruises from the Scripps data. A strong near-bottom high salinity tongue is frequently present in the first and last cruises coming from the outer shelf waters. The front is most easily seen in the second cruise when temperatures dropped and a storm was present. The water column was vertically mixed, as opposed to the first and last cruises in which vertical stratification was present.

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AN EVENT BASED APPROACH FOR OCEAN OBSERVING DATA: A CASE STUDY ON STRATIFICATION PROCESSES IN THE GULF OF MAINE

Rapidly expanding oceanographic data collection is creating a need for approaches to highlight and visualize important events within observational data streams. We have developed an objective method to find and extract oceanographic events from the Gulf of Maine Observing System (GoMOOS) time series data and have built an events database. The events are explicit change units detected across multiple variables, depths, geographic locations, and temporal granularities. An event viewer allows visualization and investigation of event-event relationships in different spatio-temporal settings. This presentation will illustrate the event approach using stratification events within the Gulf of Maine detected at intra-seasonal (~2-30 day) to interannual scales. We compare seasonal events (e.g. the transition from mixed to stratified conditions) and intra-seasonal events (e.g. multi-day periods of continuously increasing stratification) for each of the six years in the data record across buoy locations, depths, and years. The results enrich our understanding of oceanographic and temporal variation in timing and drivers of stratification. This approach holds promise beyond oceanographic data analysis for a broad range of sensor network data streams.

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SPECTRAL COMPARISONS BETWEEN A HIGH RESOLUTION MODEL AND IN SITU DATA IN FREQUENCY AND WAVE NUMBER

We will use spectral analyses of a high resolution (3km) regional Navy Coastal Ocean Model (NCOM) and a large number of temperature-salinity profiles collected in the western Pacific, to make comparisons between the model and the data. The dominant frequencies and wave numbers in both the model and the in situ data will be determined and compared. Particular emphasis will be placed on the internal tide band and its importance in the upwelling region, which will be used to validate which frequencies and wave numbers the model is reproducing well, and which it is not. It has been determined that the internal tides have a large day to day impact on the model's forecast capability. The period under study gives us a unique opportunity to evaluate internal tides as there were no major weather events or changes in the large scale ocean features to confuse the analysis.

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BIO-OPTICAL VARIABILITY OF SOUTH AND EAST AUSTRALIAN COASTAL WATERS AND IMPLICATIONS FOR THE PARAMETERISATION OF COMPLEX WATERS ALGORITHMS

There is a significant demand for MERIS- and MODIS-derived, valid and accurate, estimates of chlorophyll, TSS and CDOM (as well as Kd or primary productivity) for the optically complex waters of the Australian East Coast, including the Great Barrier Reef. State-of-the-art remote sensing of coastal water bodies involves forward modeling that accurately reproduces the water leaving radiance or reflectance. An inversion process (such as a look up table approach or an optimisation inversion) is then applied to create remote sensing based maps of a water column variable from the remote sensing spectral information. Often it is assumed that one average set of Specific Inherent Optical Properties is adequate for the inversion. In many coastal environments, the interaction of river outflow plumes and tidal inflow of often clear ocean water cannot be described accurately by a fixed bio-optical region. Thus adequate knowledge of the variability of optical properties that exist within one remote sensing image over optically shallow to optically deep waters is crucial for creating remote sensing based maps of these aquatic ecosystems. The spatial and temporal variability of Apparent Optical Properties, Inherent Optical Properties and Specific Inherent Optical Properties from the Australian East Coast, including the Great Barrier Reef will be presented and strategies to deal with this variability in a remote sensing image will be discussed.

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SIGNAL STRUCTURE IN BIVALVE EXCURRENT FLOW

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OPTICAL PROPERTIES OF TERRESTRIAL CDOM: RELATION TO LIGNIN

In a previous study, we proposed that the optical properties of humic substances (HS) and terrestrial chromophoric dissolved organic matter (CDOM) originate from the molecular charge transfer interactions between hydroxy-aromatic donors and quinoids acceptors formed by the partial oxidation of lignin precursors. Previous work by Hernes and Benner (2003) showed that lignin phenol content co-varies with CDOM absorption on the Mississippi River with this idea. To further test whether degraded lignin is the predominant source of terrestrial CDOM, we investigated the spatial and seasonal variation across the Middle Atlantic Bight of (a) terrestrial CDOM optical properties (absorbance and fluorescence); (b) lignin phenol content; (c) ultra-high resolution mass spectrometry of C18 extracted organic matter. Preliminary data show that (i) C18 phenol content correlates with the terrestrial CDOM emission maxima for an extracted lignin matches that of CDOM; HS, and C18 extracted organic matter (C18-OM); (ii) ultra-high resolution mass spectra of HS and C18-OM are consistent with that of degraded lignin.

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Benthic predators, such as blue crabs (Callinectes sapidus), use dispersed chemicals to locate prey, such as bile salts, Mercenaria mercenaria. Most previous studies of this predator-prey interaction have concentrated on the predator behavior rather than the source characteristics controlled by the bivalve prey. Nevertheless, recent studies have shown that the source characteristics and ambient flow conditions greatly influence the structure of the chemical plume and therefore the information available. Source characteristics that may be altered by bivalve behavioral response to ambient flow conditions influence the bivalve prey movement and therefore the information available. Source characteristics that may be altered by bivalve behavioral response to ambient flow conditions include the excurrent flux, flow unsteadiness, and siphon behavior. We hypothesize that
certain combinations of source characteristics and ambient conditions may create a pre- 
refrigeration, and importing digital signal information downstream. In the minimal signal 
anomalous jet. This study, a Particle Image Velocimetry (PIV) system was used to quanti- 
the current velocity of the benthic bivalve clam Mercenaria mercenaria under varying ambi-

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monitoring sea surface salinity in the global ocean from ships of opportunity

Sea surface salinity (SSS) observations are needed to improve our understanding of the 
earth’s water cycle and climate variability. SSS has proven to be valuable for improving 
estimates of evaporation minus precipitation budget, describing and understanding cli-
timate variability at seasonal to decadal time scales, testing physical processes, and 
numerical model performances, improving mixed layer representation by assimilation 
techniques used in operational oceanography, quantifying the role of salinity on sea level 
change, and improving El Nino prediction lead time. The importance of SSS in the cli-
mate system has motivated the development by European and US/Argentina space agencies 
of dedicated satellite missions (SMOS and Aquarius) to enhance global observations. 
This presentation focuses on the French SSS Observation Service (http://www.legos.obs-
mip.fr/observations/sss/), its strength and potential developments. This service aims at 
collecting, validating, archiving and distributing in situ SSS measurements derived from 
Voluntary Observing Ship programs, both for climate research and operational oceanogra-
phy. Details will be given about instruments and software, management of real time 
data transmission, validation processes for real time and delayed mode data, with a special 
focus on derived products, climatic indices and recent scientific results.

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impact of hurricanes on the inner shelf of the texas coast.

ties from the galveston shoreface

side scan sonar and chirp subbottom profiler surveys of the landfall sites shortly af-

ter the category 1 hurricane claudette (matagorda peninsula, 2003) and category 4 
hurricane rita (sabine bank, 2005) provided unique opportunities to document seabed 
changes created by the storms. the matagorda peninsula survey revealed a 2 km wide 
and 1 to 2 m deep. follow up surveys reveal that within six months, the seabed 
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at 1/12-degree and 1/25-degree grid resolutions and are also used to provide open bound-
ary forcing for the Monterey and coastal model which is implemented on a curvilinear grid with horizontal resolution reaching 1 Km. The numerical studies of these nested simulations are focused on the Monterey Bay area, where many observations were collected from an extensive field program (Adaptive Sampling And Prediction) conducted in the summer of 2006. A number of statistical comparisons are used to provide error met-
rics and a quantitative assessment of the predictive skill of each model.

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MECHANISMS OF VARIABILITY IN A CONVECTIVE BASIN

The oceanic poleward heat transport and the meridional overturning circulation are strongly affected by what happens in convective basins, where dense water is formed. Interannual variability in the formation and export of dense water is mostly due to changes in the two main drivers: local buoyancy fluxes and the remotely-forced circulation. Their relative contribution is investigated by using an idealized model for a convective basin. This model consists of two isopycnic layers. Dense water formation is induced by buoyancy loss in the interior, which is at rest. Newly formed dense water is transmitted to the surrounding boundary current through parameterized eddy fluxes. The inflow conditions in the bound-
ary current, i.e. the thickness of dense water and the barotropic velocity, represent the influence of the remotely-forced circulation. When applied to the Labrador Sea, the model suggests that variability in the formation of Labrador Sea Water simply integrates the atmo-
spheric buoyancy forcing on decadal timescales, whereas variability in the export of dense water as Labrador Sea Water is directly related to the subpolar gyre variability.

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FACTORS INFLUENCING NITROGEN-CHLOROPHYLL RELATIONSHIPS FOR TEN ESTUARIES ON THE U.S. ATLANTIC AND GULF OF MEXICO COASTS

Regression relationships between summer concentrations of total (inorganic + organic) nitrogen and phytoplankton chlorophyll a in surface water have been developed for nine estuaries on the U.S. Atlantic coast and one adjacent to the Gulf of Mexico. These systems are estuarine embayments and six are river-dominated estuaries. All systems show substantial year-to-year variability in relationships between total nitrogen (TN) and chlorophyll a. Freshwater inflow and temperature appear to influence year-to-year vari-
ability in response. Comparisons among estuaries are made using data averaged over sev-
eral summers. Such relationships between TN and chlorophyll a concentrations for river-dominated estuaries are weaker and more system-specific than for estuarine embayments. However, when data for river-dominated systems are analyzed within zones having narrow ranges of water clarity, relationships for most systems strengthen and become more similar. Important factors influencing time-
averaged response of chlorophyll a to TN in these ten systems are estuary type (embay-
ment vs. river-dominated), and the magnitude and spatial distribution of water clarity.

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THE POWER SPECTRUM AND VERTICAL STRUCTURE OF THERMOCLINE OXYGEN VARIABILITY

The observed variability of dissolved O2, now documented in every ocean basin, appears to be especially strong at decadal time scales and at the base of the ventilated thermocline. We propose novel hypotheses for these two recurrent features, illustrating them with an idealized model of the oxygen cycle forced by random physical and biological fluctua-
tions. The response of O2 to those fluctuations is strongly damped at time scales shorter than that of thermocline ventilation, producing a red spectrum even without any distinct decadal climate forcing. The O2 spectrum may be further modulated by the coupling between physical and biological sources of O2 variability. The vertical structure of O2 vari-
ance is influenced by the basin-scale isopycnal O2 gradient in the mean state, because it de-
termines the magnitude of O2 anomalies produced by circulation variability. Both hypo-
theses find support in observations and in GCM experiments. Our results suggest that along with long-term climate change, stochastic processes may be an important influence on the variability of biogeochemical tracers in the ocean interior.

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WIND FORCING AND PHYSICAL, NITRATE AND FLUORESCENCE VARIABILITY IN THE SURFACE BOUNDARY LAYER OVER THE NORTHERN CALIFORNIA SHELF

The northern California shelf exhibits an archetypal spring and summer upwelling/re-
xtration cycle whose physical, nutrient, and fluorescence variability is well described. Variability in other seasons is not described as well. We review and contrast the spring and summer variability to that in fall and winter using data from the NSF Coastal Ocean Processes (CoOP) Wind Evaporation and Shell Transport (WEST) program. Data include meteorological and physical oceanographic parameters from a dense buoy array over the shelf and nitrate and chlorophyll fluorescence over the mid-shelf near Bodega Bay, CA. During spring and summer upwelling, the surface boundary layer can extend to 30 m or more. The cold, nitrate rich upwelled water is clear with low fluorescence. Relaxation events are accompanied by surface warming, a shallower surface boundary, and increased surface fluorescence peaks. Surface nitrate levels rapidly decrease to zero. In late summer, relax-
ation events lengthen and fluorescence often increases. Some of the highest fluorescence levels occur during fall. In winter and early spring, relatively low fluorescence and surface nitrate co-exist, however the nitrate is seldom drawn down to zero.

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STABLE CARBON ISOTOPES OF LIPIDS IN CORAL AND ZOOXANTHELLAE TISSUES AND THEIR SUGGESTED CONTRIBUTION TO THE VARIATION OF RESPIRATORY CARBON DIOXIDE

The concentration of lipids and their stable carbon isotopic composition has been mea-
sured in the organic tissues of corals and their associated zooxanthellae from Montastrea faveolata. These samples were collected monthly from the Florida reef tract between 1995 and 1996 at a number of different reefs. The δ 13C values of lipids were found to be significantly lower than bulk tissue values for both coral and zooxanthellae. The δ 13C values of the lipids from coral tissue range from -20.32 to -14.06%, and the lipids of the zoa-
xanthellae range from -22.9 to -11.98%. The lipids were most depleted in δ 13C values in the fall, and most enriched in the spring. Results of this study suggest that the seasonal trends seen in respiratory CO2 of scleractinian corals previously noted may be linked to variation in the amount of lipids composing the coral’s respiratory material. The origin of the seasonal variations in the isotopic composition of the lipids may be related to carbon limitation or variation in the seasonal cycle of δ 18O in the coral reef environment.

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SENSITIVITY OF OCEAN CIRCULATION AND TRACER DISTRIBUTIONS TO SMALL CHANGES IN SURFACE HEAT AND FRESHWATER FLUXES

Sediment cores retrieved from the ocean floor reveal significant changes in the distribu-
tion of many chemical tracers in the ocean on timescales of hundreds to thousands of years. Changes in the distribution of tracers over time have been used to infer changes in the characteristics of the large-scale ocean circulation. In this study, we vary the surface heat and freshwater fluxes in a three-dimensional coarse-resolution ocean general circula-
tion model (OGCM) to show that the distribution of chemical tracers in the ocean can undergo significant changes with very little change in the values of some key ocean circu-
lation components. For example, we show that variations in radiocarbon age in the North Atlantic on the order of that observed on glacial-interglacial timescales can be achieved with little change in either the strength of the meridional overturning circulation or in the northward heat and freshwater transports by the ocean. Our results indicate that large changes in tracer distributions may not necessarily imply large changes in the large-scale ocean circulation or heat transport.

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THOUGHTS ON THE MESOSCALE, MIXING AND TOPOGRAPHY

Dissipation of energy from mesoscale, or `balanced’, flow is an important unresolved prob-
lem in oceanography. Recent observations of elevated mixing over complex topography suggests interactions between the mesoscale and topography results in transfers from
balanced flows to unbalanced flows. Analytical and numerical examinations of the mechanics of such interactions are described.

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VENUS: TWO YEARS OF EXPERIENCE AND RESULTS FROM A CABLED OBSERVATORY

The Victoria Experimental Network Under the Sea (VENUS) is a cabled ocean observatory, with arrays near southern Vancouver Island, in both Saanich Inlet and the Strait of Georgia. The first array was deployed in February 2006 with an observatory node at 100m depth in Saanich Inlet. The second array, with nodes at 300 and 1750m was deployed in the Strait of Georgia in the fall of 2007. The fibre optic cabled observatory allows for unprecedented power and bandwidth to and from instruments connected to the observatory nodes. Data is retrieved and available over the web in near real-time. Preliminary instruments include standard oceanographic devices such as CTDs and ADCPs, as well as inverted echo-sounders, broadband hydrophones, dissolved gas sensors, settling traps, and a user controllable pan and tilt digital camera. Advanced systems under development include a dedicated sediment and delta dynamics laboratory. The data archive and instrument access are provided through the VENUS web site (http://www.venus.uvic.ca/), where galleries can be searched and data products requested. An overview of the observatory infrastructure, some preliminary scientific results, and how new users can access the facility will be presented.

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NORTH PACIFIC CYCLES EXPLAIN OCEAN CLIMATE AND ECOSYSTEM CHANGE IN THE CALIFORNIA CURRENT

Decadal fluctuations of salinity and key biological variables in the Northeast Pacific over the past 50 years have been well documented and are thought to be related to climate change. Dramatic fluctuations in salinity, nutrients, chlorophyll, zooplankton biomass, fish stocks and seabirds, however, are often poorly correlated with the most widely used index of large scale climate variability in the region, the Pacific Decadal Oscillation (PDO). Here we define a new index of climate change, the North Pacific Gyres Oscillation (NPGO) and show that it is significantly correlated with previously unexplained fluctuations of salinity, nutrients and chlorophyll. Fluctuations in the NPGO are driven by regional and basin-scale variations in wind-driven upwelling and horizontal advection - the fundamental processes controlling salinity and nutrient concentrations. Nutrient fluctuations drive concurrent changes in zooplankton population concentrations, and may force similar variability in higher trophic levels. The NPGO thus provides a strong indicator of fluctuations in the mechanisms driving planktonic ecosystem dynamics. Observations and global warming simulations show the NPGO amplitude to be increasing over the last 50 years; we expect the dynamics underlying the NPGO to play increasingly dominant roles in forcing decadal changes in marine ecosystems.

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BENTHIC TURBULENCE INDUCED BY NONLINEAR INTERNAL WAVES OF DEPRESSION

Results are presented from parallel spectral multidomain 3-D Direct Numerical Simulations (DNS) of the time-dependent boundary layer generated in the footprint of a fully Nonlinear Internal Wave (NILW) of depression. A frame of reference propagating at the wave phase speed is employed with wave Reynolds numbers reaching as high as $10^5$. The global instability of the separated wave-induced boundary layer produces benthic erotions characterized by the ejection of vortices high into the water column. The effect of developing transverse instabilities on the spanwise coherence of shed vortices is investigated. The energetics of the benthic boundary layer are quantified in terms of near-bed kinetic energy and dissipation rates and the structure of the bottom shear stress field. Depth-time plots of vorticity produced by virtual sensors spanning the lower 10% of the water column are compared with corresponding diagrams obtained from the CMO96 field experiment. A strong qualitative similarity is observed, suggesting that the mechanisms observed in the DNS are operative in the field. Finally, possible improvements are discussed for existing ADV-based parameterizations of along propagation-path NILW energy losses through bottom interactions.

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MULTIDECADAL VARIATIONS IN BIODIVERSITY OF FISHES IN AN IMPACTED Ecosystem of Santos, Brazil, is one of the most affected by anthropogenic actions of South America, but it has an important role as rearing and residence grounds for the fish community. This study has evaluated multidecadal variations in its fish community structure. The ichthyofauna yielded 95 species and 29 families (only one elasmobranch). The fish community structure presents high abundance, biodiversity and richness, and is similar to that from 20 years ago. Some differences rose, suggesting that Santos Bay is an impacted area yet: only Sciaenidae amounted 73% of catch in numbers, and three species to more than 80%; there was a decrease of abundance and size of large predators, and of the relative importance of some species; the most abundant species is still the same but its importance is higher than before. After 20 years of improvement of environmental quality, questions as how to deal with this findings in an underdevelopment country with little past information; or the supposed benefits of the environmental protection actions; or the degree of resilience of the community and the way how to measure it, come up.

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THE LINK BETWEEN BLUEFIN TUNA AND OCEAN ENVIRONMENTAL CONDITIONS

The bluefin tuna is considered one of the most economically valuable species of tuna in the North Atlantic. The high demand for bluefin tuna in the international markets has put this stock under heavy fishing pressure in recent years. Given the economical importance of the bluefin tuna fishery and the concerns regarding the depleted status of this stock, it is of utmost importance that we understand how environmental conditions affect the behavior and mortality of this species. This knowledge will aid fishery managers balance pressure on this stock from the fishing industry and the environment. In order to support this effort, we are linking information on oceanographic environmental conditions derived from satellite observations, such as sea surface and subsurface temperatures, surface wind, and water color to bluefin tuna catch and effort data. The combination of these data sets will make it possible to associate patterns in the distribution of bluefin tuna and fishing effort to oceanographic conditions and features. Quantifying these relationships and understanding the mechanisms that drive them has enhanced our ability to sustainably manage this species.

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A NOVEL MECHANISM FOR MARINE PHOSPHORUS SEQUESTRATION VIA BURIAL AND TRANSFORMATION OF DIATOM-DERIVED PHOSPHOPHATE IN SEDIMENTS

Excess nutrient phosphorus is removed from wastewater by inducing sludge bacteria to synthesize polyphosphate. Here, we describe a similar, natural mechanism by which dissolved phosphate in marine surface waters is sequestered by polyphosphate-forming diatoms and transported to sediments as these polyphosphate-laden organisms senesce and sink. Cultured marine algae grown under phosphate replete conditions have previously been shown to store significant phosphorus as inorganic polyphosphate. But our findings represent the first instance in which natural communities of common marine diatoms have been shown to synthesize polyphosphate under sub-micromolar dissolved phosphate concentrations. Further, our results suggest that polyphosphate may nucleate the authigenic formation of calcium phosphate minerals in marine sediments. Thus, the transport of polyphosphate from its planktonic origin in surface waters to the underlying sediment, followed by subsequent mineral transformation provides a critical "biological pump" mechanism for the long-term sequestration of water column derived phosphorus in marine sediments. Importantly, this phosphorus removal mechanism may explain the puzzlingly dispersed distribution of fine-grained apatites observed in marine sediments worldwide.

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HYPOXIA, A PARADOX OF EUTROPHICATION

The vast majority of our current marine hypoxic zones (about 200 documented cases) have developed over the last 50 years in response to anthropogenic forcing, through increased nutrient loadings and subsequent eutrophication. Until the 1950s, reports of mass mortality caused by lack of oxygen were limited to small systems with histories of oxygen stress. In the 1960s, the number of systems with reports of hypoxia-related problems started to increase, and in the 1970s and 1980s there was an explosive growth in systems with reports of hypoxia. By the 1990s most estuarine and marine systems in close proximity to population centers had reports of hypoxia or anoxia. There is encouraging news, since the 2000s, with some large systems such as the Black Sea and Boston Harbor responding positively to decreased anthropogenic stressors. While development of dissolved oxygen is the most widespread deleterious consequence of eutrophication, hypoxic area can be reduced or eliminated through management of nutrient or organic inputs. The rate and trajectory of recovery from hypoxia are functions of a system's resilience, and will be the focus of this presentation.

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A HISTORICAL RECORD OF PARTICULATE ORGANIC CARBON EXPORTED FROM THE OB RIVER, SIBERIA

Permafrost soils and peat bogs in northern watersheds store vast amounts of organic carbon (OC) for many millennia, and these reservoirs are believed to be susceptible to destabilization by climate change. We characterized the properties of particulate OC exported from the Ob River, Siberia, and deposited in a deltaic lake to assess whether this large Arctic river exports significant amounts of permafrost-derived particulate OC and to determine how these properties have changed over time. Bulk elemental (C and N) stable carbon, carbono, lignin phenol and nuclear magnetic resonance (NMR) analyses reveal dramatic differences in the quality of the OC deposited in this lake over the last century, with OC ages ranging between 300 and 40 years. These results likely result from mixing of old, plant-derived OC that has been stored in the watershed for millennia with younger, algal-derived OC. Compound-specific radiocarbon analyses of higher plant wax biomarkers extracted from these sediments confirm that plant-derived OC within this sediment is significantly pre-aged.

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REAL-TIME TURBULENT ODOR PLUME QUANTIFICATION: 1. SIGNAL STRUCTURE PERCEIVED BY BLUE CRABS

Many aquatic arthropods locate prey and engage in social interactions strictly by tracking dispersed chemicals in benthic boundary layers. In a turbulent flow, the received chemical concentration signal is chaotic and unpredictable. We have developed a three-dimensiona

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LIVING IN A BACTERIAL WORLD: NEW PERSPECTIVES FOR TEACHING OLD CONCEPTS

Bacteria are in us, on us and all around us, but humans are not the only organisms to maintain constant associations with microbes. There is much to be discovered about the interactions between coral animals and the microbial community, and researchers at the Smithsonian Marine Station at Fort Pierce (SMSFP) are looking for answers by investigating the early life stages of two Caribbean corals, Porites astreoides and Acropora palmata. Coral microbiology offers an exceptional framework for teaching fundamental scientific concepts, but because this research is still in its infancy, it is rarely accessible for discussion in the classroom. SMSFP researchers and educators collaborated to develop an interactive teacher workshop based on that framework. The workshop “Coral Reefs: Bacterial Worlds” presents new perspectives on teaching the concept of symbiosis, draws on examples of marine animal-bacterial symbioses to discuss the evolution of complex life, and introduces microscopy, DNA extraction, and PCR and DNA sequencing, which are used at SMSFP to investigate microbiology and symbiosis in the marine environment. Here I present current coral-bacterial research and highlight key messages of the teacher workshop.

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USING TRACERS FOR QUANTIFYING TRANSPORT PROCESSES IN LARGE-SCALE CONSTRUCTED WETLANDS

Chemical tracers (rhodamine-WT and LiCl) were injected into large-scale (147-928 ha) surface flow wetlands designed to remove phosphorus (P) from agricultural drainage waters in south Florida, USA. Analysis of the tracer response curves provided quantified parameters (effective hydraulic residence time, dispersion coefficient, residence time distribution, and tanks-in-series number) that provided a means of comparing hydraulic performance among wetlands. Internal monitoring of tracer and P concentrations yielded two-dimensional time series plots that identified which areas within a wetland were receiving most of the flow, and whether P removal was impaired because of hydraulic constraints. Because of the uneven wetland bottom topography and distribution of aquatic vegetation, preferential flow paths developed within most of the wetlands. This resulted in short circuiting in some parts of the wetland, while other areas were rendered as

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REGIONAL COUPLED BIOGEOCHEMICAL-CIRCULATION MODELS TO EXPLORE TO WHAT EXTENT THE TROPICAL OCEAN MINIMUM ZONES ARE CONTROLLED BY THE PROCESSES SETTING THE SURFACE NUTRIENT LEVELS. OUR MODEL RESULTS SUGGEST ONLY A WEAK RELATION BETWEEN STOCKS OF SURFACE NUTRIENTS AND RATES OF OXYGEN CONSUMPTION. THIS HINTS AT A LIMITED ROLE OF IRON IN CONTROLLING OXYGEN MINIMUM ZONES.

The official data center for the International CLIVAR/CO2 Repeat Hydrography Program is the CLIVAR and Carbon Hydrographic Data Office (CCHDO) at the UCSD Scripps Institution of Oceanography. At the CCHDO, the CTDO, hydrographic, ocean carbon, and tracer data are collected, verified, corrected for content and format errors, assembled with relevant documentation, and carefully prepared for public dissemination and long-term archive. Shipboard data from US cruises for this program are available five weeks after return from sea. Availability of data from other nations depends upon individual data release and data sharing policies. Ocean carbon data are quality controlled by the Carbon Boundary Data Information Analysis Center (CBIAC) at Oak Ridge National Laboratory, and merged into the bottle data files at the CCHDO. Data are available from the CCHDO at http://cchdo.ucsd.edu and from CBIAC at http://cbicornl.oceans/oceans/RepeatSections/Repeat_map.html.

The CCHDO brings data sets together to a common content and readability standard and collects and preserves data documentation. All data sets are available in multiple formats, in addition to custom formats by arrangement. The CCHDO/WHPO also provides its public holdings, including documentation, to NODC/WDC-A for archiving and further distribution.

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A HIGH RESOLUTION COUPLED SEA-ICE/OCEAN MODEL FOR THE ANTARCTIC PENINSULA REGION

A high-resolution (4 km) regional ocean circulation model that includes a dynamic sea-ice model and thermodynamically active ice shelves has been developed for the Antarctic Peninsula area. The dynamic sea-ice model (Budgell, 2005) is based on ice thermodynamics that include two ice layers, a snow layer, and a molecular sub layer at the ice/ocean interface. The ice-shelf thermodynamics are based on a three equation viscous sublayer model. Atmospheric forcing comes from several sources including the operationally used Antarctic Mesoscale Prediction System. We are in the process of running simulations covering the period of the SO GLOBEC field season (2001-2003) in order to examine the model fidelity with respect to hydrography (traditional and seal based), drifter, mooring and satellite measurements. The focus of the comparisons is to assess the model's suitability as a platform for studying the environmental effects on the region's biology, including ocean exchange and shelf retention.

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DECREASES IN SUMMER PACK ICE EXTENT RESULT IN ANNUAL AND SEASONAL PREY SHIFTS AND LOWER BREEDING SUCCESS IN AN ARCTIC SEABIRD

We examined temporal variation in the availability and composition of fish in an area of the eastern Bering Sea experiencing major changes by cryogenic change by measuring annual and seasonal variation in the prey and nestling growth of the Black Guillemot (Cepphus grylle), an arctic seabird. In 2006 pack ice remained within 40 km of the breeding colony during the nestling period (late July to early September) and guillemots provisioned their young almost exclusively on Arctic Cod (Boreogadus saida), an ice-associated fish that is the guillemot's preferred prey. In 2007 prey choice and nestling growth were similar to 2006 until mid-August when ice rapidly retreated to >200 km from the colony. Chick growth was limited mainly on Arctic Cod (Boreogadus saida), an ice-associated fish that is the guillemot's preferred prey. In 2007 prey choice and nestling growth were similar to 2006 until mid-August when ice rapidly retreated to >200 km from the colony. Chick growth was limited mainly on Arctic Cod (Boreogadus saida), an ice-associated fish that is the guillemot's preferred prey. In 2007 prey choice and nestling growth were similar to 2006 until mid-August when ice rapidly retreated to >200 km from the colony. Chick growth was limited mainly on Arctic Cod (Boreogadus saida), an ice-associated fish that is the guillemot's preferred prey. In 2007 prey choice and nestling growth were similar to 2006 until mid-August when ice rapidly retreated to >200 km from the colony. Chick growth was limited mainly on Arctic Cod (Boreogadus saida), an ice-associated fish that is the guillemot's preferred prey.

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Using a high-resolution ocean circulation model forced by NCEP reanalysis fluxes, interannual variability of the Guinean Dome (GD) is studied from a western boundary of the Atlantic Meridional Mode (AMM). This is possible because the present model simulates SST anomalies associated with the AMM and GD well. The GD develops off Dakar seasonally from late spring to late fall owing to wind-induced upwelling; its seasonal evolution is associated with the ITCZ movement as discussed by Yamagata and Iizuka (1995). We find that interannual temperature variations of GD in boreal fall are significantly correlated with the AMM. When GD is unusually strong (weak) in fall, ITCZ is located anomalously northward/southward from late spring to early summer. This northward (southward) migration is due to a WES feedback mechanism in spring over positive (negative) SST anomalies. Whether this SST preconditioning in the GD region is associated with a previous opposite event or not needs more investigation. We conclude, however, that both positive and negative phases of AMM that develop in spring are linked closely to interannual variations of GD through the ITCZ migration.

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ASSESSMENT OF SHORT-TERM TEMPORAL VARIABILITY IN THE COMMUNITY STRUCTURE OF TINTINNIDS, PLANKTONIC CILIATES OF THE MICROZOOPLANKTON

There are few data on the temporal variability of biodiversity metrics with regard to marine plankton. We sampled an open water site in the N.W. Mediterranean Sea subject to little advection. On 20 dates over a 4-week period in autumn 2004, large volume samples (10 l) were obtained from 6 depths between the surface and 90 m at the Dyfamed Station midway between the French coast and Corsica. Quantitative estimates of the tintinnid community varied considerably compared to qualitative descriptors. Average water column concentrations of tintinnids ranged from 10 - 501 l-1 and varied with chlorophyll concentrations. Numbers of tintinnid species varied between 24 and 33, from day to day and values of the Shannon H' index ranged from 2 to 2.7. However, identity of the dominant species (the most abundant species, collectively representing ≥ 50% of total individual abundance) was constant. Species rank-abundance curves for all dates were nearly identical and mostly closely resembled log-series distributions rather than log-normal or geometric distributions. This work was supported by the French program LIFE-CYBER and the European Network of Excellence MARBEF.

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SEDIMENT PROFILES OF LESS COMMONLY DETERMINED ELEMENTS OBTAINED RAPIDLY BY LASER ABLATION-ICP-MS

Numerous studies have documented profound anthropogenic influences on trace element profiles in nearshore marine sediments from estuaries. However, the vast majority of these studies focus on a small number of relatively high-abundance of trace elements, (e.g. Ni, Cu, Zn, Cd and Pb). A high-throughput analytical method that greatly extends this list would be Laser Ablation - Inductively Coupled Plasma - Mass Spectrometry is a promising technique with unique advantages: time and labor expended on sample preparation are eliminated and results are obtained quickly. Laser Ablation-ICP-MS provides a high throughput analytical tool with significant potential for the study of marine sediments. We report the analysis of 10 l of sediments using LA-ICP-MS. We have demonstrated that select elements exhibit featureless profiles: S, Ca, Ti, V, Mn, Ge, Nb. In some cases, we have been able to identify specific origins of these profiles that may be due to anthropogenic influences, i.e. enrichment after 1920 followed by decline after ca.1980, possibly reflecting increased regulatory efforts: Co, Cu, Zn, Cd, Sn, Se, Tl, Pb and Bi. As expected the redox-sensitive elements: Mn, Re and U have similar profiles to one another and W's profile indicates that it is also a potential redox-indicator. The remaining elements exhibit featureless profiles: S, Ta, Ti, V, Mn, Ge, Nb.

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ALTERNATE MECHANISMS CONTROLLING THE FORMATION, MAINTENANCE AND DISSIPATION OF THIN LAYERS IN WESTERN MUNTEY BAY IN 2005 AND 2006

Thin layer models have suggested that interactions between biological, chemical, physical and optical structures and processes can control the formation, maintenance of thin phytoplankton and zooplankton layers. As part of an ONR LOCM experiment, we deployed an array of autonomous profilers to quantify temporal and spatial changes in fine-scale physical, bio-optical and chemical structure and then used near-real-time data from the array to guide ship-based collection of plankton samples from inside and outside thin layers. In 2005, the dinoflagellate Akashiwo sanguinea formed thin layers each night at the depth of the nutricline then migrated up into the upper water column during the daytime where it could get sufficient light for photosynthesis. In 2006 several other dinoflagellates and a photosynthetic ciliate formed intense thin optical layers and oxygen maxima during day in near surface waters, but did not form thin optical layers at depth during the...
night even after surface nutrients were briefly depleted. These results emphasize the need to combine adaptive sampling with 3-D time series data when trying to understand the alternative mechanisms controlling thin layer dynamics.

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It has been shown that the vorticity in the deep-water island wake is primarily generated by the stress in the boundary layer (Dong, et al., 2007). In the shallow-water island wake, the mechanism for vorticity generation differs from the deep-water wake significantly. The Regional Oceanic Model System (ROMS) is applied to study. The PV budget is calculated to analyze the generation and evolution of the PV anomalies in the wake. The PV analysis shows the frontal and diabatic processes are dominant in the PV generation and the redistribution of the PV anomalies are due to the advection process.

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Accurate global SST is required for climate monitoring and by ocean and atmospheric forecasting systems on a daily basis to constrain systems at boundaries. The Global Ocean Data Assimilation Experiment (GODAE) High Resolution SST Pilot Project (GHRST-PP) has initiated a new activity, called the GHRST-PP Multi-Product Ensemble (GMPE) that uses ensemble techniques to investigate SST analysis differences using both analyses and observational products. As a UK contribution to the GMPE, the Met Office has implemented an SST ensemble system in collaboration with other operational agencies that allows centres to assess the relative performance of their SST product against a ‘consensus’ standard product. Each day a GMPE median average SST map from a number of input analysis products after their differing analysis grids have been homogenised by area averaging onto a standard 0.5° lat/lon grid. Operational SST maps from a number of input analysis products after their differing analysis grids have been homogenised by area averaging onto a standard 0.5° lat/lon grid. Operational SST and Sea ice analysis inputs include: OSMIA Met Office (UK), Reynolds’ (NCDCS, USA), NAVOCEANO K10 10km, NRI GHRST-PP 10km analysis, JMA 25km MGDSST, Japan, MERSEA 10km, France, BRMC Global, Australia, and 10km products from RSS USA. The GMPE ensemble is updated each day and output data sets are available together with a variety of diagnostic and anomaly plots on a daily basis (T0-24) at http://www.ghrst-pp.org/Todays-global-SST.html. This presentation reviews the GHRST-PP GMPE and provides a summary overview of differences between the input SST analysis data sets.

Donnelly, M. I., University of Central Florida, Orlando, USA, mwtd@bellsouth.net; Brockmeyer, R., St. Johns River Water Management District, Palatka, USA, rbrockmeyer@sjrwm.com; Stewart, J., Voxelia County Mosquito Control, Daytona Beach, USA, jswetar@ voxelia.us; Greening, W., Voxelia County Mosquito Control, Dayton Beach, USA, wgreening@ voxelia.us; Walters, L. J., University of Central Florida, Orlando, USA, lwalter@pegasus.cc.ucf.edu; RECOVERY OF SALTMARSH FLORA AND FAUNA AT RESTORED MOSQUITO IMPOUNDMENTS IN MOSQUITO LAGOON (VOLUSIA COUNTY, FL)

In the 1960s, portions of saltmarsh habitat in Mosquito Lagoon, FL were impounded for mosquito management. The dike and adjacent ditch decreased the area of saltmarsh and changed the marsh’s hydrological characteristics. These changes facilitated invasion by exotic and native non-halophytic vegetation and decreased freshwater-estuary connectivity. Opening culverts and breaching dikes in the 1990s restored connectivity, followed by complete removal of dikes in the late-1990s. Vegetation monitoring began in 2005 and was expanded in 2007 to include the diversity and abundance of fiddler crabs, shorebirds, and vegetation at five restored impoundments in different stages of recovery and two reference sites. Soil characteristics, organic matter content, and elevation were measured to explain differences between restored sites and neighboring reference marshes. GIS-based estimates of area returned to marsh elevation were also made. Natural recruitment of native flora and fauna was observed at all restored sites. In addition, the abundance of exotic flora was reduced following impoundment restoration. These results are providing insight on the effectiveness of this restoration method, recovery rate estimates, and future saltmarsh restoration project planning.

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A detailed composite sea-level record for the late Quaternary of the northern Gulf of Mexico (NGOM) reveals the major sea-level events for the period since the Last Glacial Maximum (LGM), including a complete Holocene history. Following the LGM, sea level rose in pulses, apparently in response to global climate events. Millennium-scale cycles have persisted throughout the post-LGM, with amplitude diminishing with time. The northern Gulf of Mexico sea-level record correlates well with similar histories reported from the north and tropical Atlantic. During the mid- to late Holocene, the NGOM sea-level history depicts a rapid rise to near-current levels by about 6000 years ago. Since then, sea level has undergone swings of +/- 2 meters. This fine-scale sea-level behavior during the latter half of the Holocene has had a significant effect on the initiation and evolution of coastal landforms on Gulf of Mexico shorelines.

Donovan, C. D., Turner Designs, Inc., Sunnyvale, USA, cd Donovan@turnerd esigns.com; Younan, L., Turner Designs, Inc., Sunnyvale, USA, lyounan@turnerd esigns.com; TWO NEW SENSORS AVAILABLE FOR AQUATIC OPTICAL CHARACTERIZATION AND VARIABLE FLUORESCENCE

Turner Designs has developed two new optical sensors the C6 Multi-Sensor Platform and the PhytoFlash Submersible Active Fluorometer. The C6 Multi-Sensor Platform was designed for extended or short-term deployments with a mechanical wiper that eliminates bio-fouling. The instrument can be configured with up to six optical sensors ranging from ultra-violet to the infrared spectrum. Depth and temperature sensors are also included. A variety of optical sensors can be configured differentiating chlorophyll a pigments in algae, fresh water and marine cyanobacteria pigments, turbidity, CDOM, as well as custom optics for specific pigments. Performance data including the optical characterization of a freshwater lake will be presented. The PhytoFlash Submersible Active Fluorometer is an in situ variable fluorescence system that has been developed to allow for real-time measurement of the primary variable fluorescence variables: Fv, Fo and Fm. Practical applications include the detection of the onset of algal blooms, indication of nutrient status of planktonic algae as well as the measurement of algal community change. Performance data will be presented.

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The relation between the Pacific Decadal Oscillation (PDO) and the Atlantic Multidecadal Oscillation (AMO) is investigated based on analyses of Sea Surface Temperature (SST) observations over the past century. It is shown that the AMO either leads the PDO by 13 years or lags the PDO by 17 years. The AMO and PDO might therefore be viewed as part of the same oscillation cycle with a period of approximately 60 years. It is further argued on the basis of the same observations that the PDO may be viewed as involving an ocean basin scale mode of adjustment with decadal time scale that is superimposed on a multidecadal modulation. The validity of this interpretation of the PDO based on the analysis of observations is further investigated through the investigation of coupled global climate model simulations performed using the NCAR CCSM 3.0 model. In simulations that reach steady state the PDO is observed to have a multidecadal modulation related to the North Atlantic variability. The simulation performed using the NCAR CCSM 3.0 model. In simulations that reach steady state the PDO is observed to have a multidecadal modulation related to the North Atlantic variability.
The Southern Ocean's Subantarctic and Antarctic Intermediate water masses dominate the oceanic uptake of anthropogenic CO₂. The model means show a decrease in the annual mean subduction and entrainment rates resulting from warming and freshening at the ocean's surface in the South-East Indian and Pacific Oceans. A corresponding cooling and freshening is found on density surfaces within the ocean interior in these two water masses (upper 1500 m) and compare well with observations. There is a decrease in the loss of the net surface buoyancy flux at model and intermediate water densities (25.8 to 27.4 kg m⁻³) which is dominated by surface water heat and the flux driven by Ekman transport, and through increases in the vertical stratification below the mixed layer. Our multi-model analysis shows a decrease in the renewal rates of Southern Ocean water masses and hence affecting the uptake of anthropogenic CO₂.


LONGITUDINAL PROFILES OF CDOM, TEMPERATURE, AND CONDUCTIVITY AS A MEANS TO LOCALIZE GROUNDWATER INPUTS IN THE SAN JOAQUIN RIVER, CA.

Dissolved organic matter (DOM) and nitrate (NO₃) in the San Joaquin River (SJR) are water quality constituents of concern because they may stimulate algal growth, and because of impacts on drinking water treatment. Past research utilizing isotopes of nitrogen and oxygen (15N and 18O) suggest that nitrate in local groundwater sources to the River may be derived from numerous confined animal feeding operations proximal to the River. But the areas where significant transfer occurs remain obscure. To localize potential groundwater inputs and investigate riverine DOM dynamics, a lagrangian boat survey was completed during low flow conditions along a 100 km reach of the SJR. A boat instrumented with GPS and a sensor probe was used to obtain continuous longitudinal profiles of depth, temperature, specific conductivity, pH, dissolved oxygen and optical properties of DOM throughout the entire river reach. The resulting longitudinal profiles displayed spatial and temporal variations in temperature, specific conductivity, dissolved oxygen and DOM dynamics which can be related to potential groundwater discharge areas as well as various surface water inflows.

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PRISM GLOBAL SEA SURFACE TEMPERATURE RECONSTRUCTION: A GLOBAL WARMING DATA SET

The Pliocene Research, Interpretation and Synoptic Mapping (PRISM) Project provides a conceptual model and synoptic view of the earth during an interval considerably warmer than modern (~3.3 to ~3.0 Ma) through reconstruction of sea-surface temperature (SST) and other paleoenvironmental parameters. The new PRISM reconstruction has revised SST fields based upon integration of previous and new faunal and floral analyses with new geochemical proxies and biomarkers, a revised vegetation/land cover data set using a biome classification, 3-dimensional land ice distribution based upon ice-model experiments, new sea-level estimates based upon stable isotopes and bottom water temperatures, and revised sea-ice distribution.

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IMPLICATIONS OF SEASONAL FLOOD DEPOSITS FOR CORAL-REEF ECOSYSTEMS; EXAMPLE FROM HANALEI BAY, KAUAI, HI, USA

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CHANGES IN THE SUBDUCTION OF SOUTHERN OCEAN WATER MASSES IN TEN IPCC MODELS

The Southern Ocean's Subantarctic Mode and Antarctic Intermediate water masses dominate the oceanic uptake of anthropogenic CO₂ and store heat, freshwater and dissolved gases. We analyse the ocean's response to changes in surface forcing using two different methods and across ten models from the IPCC Fourth Assessment Report. We compare the 1950s 20th century mean climate and the 2090s A2 scenario, where CO₂ concentration reaches 860 ppm by the year 2100. Subduction rates are diagnosed and analysed on density surfaces (which evolve with time) and on surfaces that are fixed in time, defined by the position of density surfaces in the 1950s. The model means show a decrease in the annual mean subduction and entrainment rates resulting from warming and freshening at the ocean's surface in the South-East Indian and Pacific Oceans. A corresponding cooling and freshening is found on density surfaces within the ocean interior in these two water masses (upper 1500 m) and compare well with observations. There is a decrease in the loss of the net surface buoyancy flux at model and intermediate water densities (25.8 to 27.4 kg m⁻³) which is dominated by surface water heat and the flux driven by Ekman transport, and through increases in the vertical stratification below the mixed layer. Our multi-model analysis shows a decrease in the renewal rates of Southern Ocean water masses and hence affecting the uptake of anthropogenic CO₂.

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MEETING ABSTRACTS

ASLO/AGU/TOS/ERF
and spatial variability of the warming and examine the relative importance of the air sea heat flux versus heat advection by the Atlantic Water inflows in forcing these observed changes. The biological responses to the warming are also highlighted. Changes include: earlier phytoplankton blooms; elevated zooplankton biomass levels; shifts in fish distributions and spawning sites; higher recruitment levels; and differing benthos communities. Of particular note is the northward extension of several species of fish resulting in a potential of Miami, Miami, Florida, usa, sevins@rsmas.miami.edu; Sanchez, M., Florida International University, Miami, USA, maestro42@fiu.edu; Bellmund, S., National Park Service, Homestead, USA, Sarah.Bellmund@nps.gov

NITROGEN CYCLING IN BISCAYNE BAY, FL

Biscayne Bay, Florida is a tropical coastal lagoon situated adjacent to a large urban population with many natural and anthropogenic nitrogen sources, including atmospheric input, N fixation, nutrient regeneration/recycling, landfill soil leaching, runoffs, septic tank leakage, and treatment wastewater effluent. To understand the relative importance of input sources of N, the stable isotope systematics (δ13C, δ15N, and δ18O) were measured in macroalgae, seagrasses, and seawater samples from Biscayne Bay and the Miami Central wastewatertail bove two years. Mean 615N and 613C for algal tissue in Biscayne Bay were +5.2 (+0.0%e) and +14.5 (+0.42%) and +6.9 (+0.1%) and +19.5 (+0.2%) for the wastewatertail algae. Within the Bay, nearshore algal samples were enriched by up to ~7% compared to offshore algae. High 813C values within the Bay imply regenerated seagrasses are the dominant DIC (dissolved inorganic carbon) source. Bay seawater and Miami Central wastewatertail had DIN (dissolved inorganic nitrogen) δ15N values of ~+4.5 (+0.0%) and ~7.5 (+0.7%), respectively. Combining 615N and 618O values from nitrate, an isotopically traceable precipitation component is distinguishable in the Bay; lower wastewatertail values imply a rathification nutrient origin. This study will con-tinue to examine temporal and spatial C, N O isotope variations at greater resolution.

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THE IMPORTANCE OF CARRION TO ABYSSAL FISHES: STOMACH CONTENT AND STABLE ISOTOPE EVIDENCE

Photographic investigations document deep-sea fishes scavenging on the carcasses of surface living animals but the fishes also prey on deep-sea fauna. Few studies have attempted to deter-mine the relative importance of each trophic pathway. Recent documentation of inter-decadal changes in macrourid densities in the abyssal Pacific, possibly related to changing food supplies, has generated interest for investigating this trophic pathway. We conducted stomach content and stable isotopic analyses of two abyssal macrourids, potential carrion sources, and potential benthic prey, collected concur-rently at 4100m off California (station M). Stomach content analysis revealed squid, fishes, and carrion (hake, jack mackerel) as the most important prey for Coryphaenoides armatus. C. yaque-niae's diet included more small crustaceans and polychaetes. The nitrogen and carbon isotopic values of potential carrion were comparable to the most isotopically depleted benthic animals examined, deposit feeding echinoderms. The highest isotopic enrichments were observed in benthic shrimps and large predaeous polychaetes. Macrourids had intermediate values sug-gestin that while they forage on benthic prey, carrion is a major component of their diet. The implications of these findings to the abyssal food web will be discussed.

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OFF-SHELF EXPORT FROM THE GULF OF LIONS CONTINENTAL SHELF: ROLES OF LACAZE-DUTHERS AND CAP DE CREUS CANYONS IN THE GULF OF LIONS SEDIMENT DISPERAL SYSTEM

The relationship between sediment supply, margin geometry, proximity to the source and wave/current processes controls the fate of sediment and the effectiveness of subma-rine canyons as active conduits for sediment from the continental shelf to the deep-sea. Sediment is transported to the southwest Gulf of Lions shelf in a step-wise process pri-marily from the Rhine River, along a mid-shelf mud deposit. Coarsened shelf deposits on the southwest terminus reflect increased energy caused by narrowing shelf topography. Here a central mud deposit is absent and the outer-shelf is bypassed. Export off-shelf in winter 2004-2005, was mainly by cold-water density currents but evidence exists for inter-nal wave resuspension, hemipelagic settling and sediment gravity flows. Seabed stratigra-phy in the canyons reflects localized zones of both ephemeral deposition and long-term accumulation. The canyon heads show evidence of sediment bypassing. In lower-canyon depths (>400 m water depth), sedimentation in distinct locations reflects both hemipelagic settling and sediment gravity flows. Local geology and flow interactions play a critical role in redistribution and off-shelf export of sediment in the Gulf of Lions.

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THE RESPONSE OF THE BARENTS AND NORWEGIAN SEAS TO RECENT CLIMATE CHANGES

Since the 1990s, there has been rapid warming of the waters in the Norwegian and Barents Seas with temperatures near at or about all time record highs. We document the extent

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ECOLOGICAL EFFECTS OF MERCURY DEPOSITION IN THE ADIRONDACK REGION OF NEW YORK; CRITICAL ISSUES FOR RECOVERY

We synthesize multidisciplinary research on atmosphere-forest Hg dynamics and effects on ecosystems in the Adirondack region of New York, including issues regulating recov-ery following emission controls. The Adirondacks have exhibited marked changes in net atmospheric deposition since about 1900 including decreases since the 1970s. Litterfall is the dominant input pathway of Hg (~17 µg/m2·yr) to the Adirondacks, throughfall is nearly balanced by soil erosion and the major loss is soil accumulation (~15 µg/m2·yr). Limited drainage losses ofionic Hg are converted to methyl Hg largely in wetlands, particularly during the summer growing season, supplying downstream surface waters. A recent survey of 25 Adirondack lakes shows the water columns have largely exhibited decreases in total and methyl Hg concentrations changes while the Hg content of yellow perch have been mixed. These changes appear linked to changes in the DOC concentra-tions. Critical issues for the recovery of Adirondack ecosystems are the effects of changes in atmospheric Hg, SO42- and NO3- deposition, changes in DOC and its influence of Hg bioavailability, and the legacy of Hg accumulated in soils.

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SWITCH IN CARBONATE-SILICICLASTIC SEDIMENT DISPERAL AND ACCUMULATION DURING THE LAST GLACIAL SEA LEVEL CYCLE, GULF OF PAPUA SHELF EDGE AND ADJACENT BASINS

During the last 130ky, sediment composition/fux, shed to the Gulf of Papua (Gol) shelf edges and adjacent troughs, have changed dramatically through time. Highstand intervals, such as MIS 5e/Holocene MIS 1, are characterized by high bank-derived argonite fuxes; offshore slopes and basin floors become carbonate-rich. During the early regression when sea level had fallen down to ~40-70 m, netic carbonate production on atolls and barrier reefs shut down, whereas siliciclastic fuxes dramatically increased across all of Ashmore Trough. The distal and central parts of Ashmore slope became sediment starved, whereas its more proximal northern slope continued to receive high siliciclastic fuxes throughout the late regression and lowstand, when the GoP coastline had migrated to the modern shelf edge. A large volume of sandy/muddy siliciclastic sediment, bypassing this part of Ashmore, accumulated as numerous turbidites in the adjacent Pandora Trough. The initial sea level rise during early deglaciation created favorable conditions for the establish-ment/growth of coral reefs alongside the modern shelf edge on top of the former lowstand siliciclastic coastal deposits. The timing of a calci-turbidite accumulation and the first appearance of bank-derived argonite in the fine carbonate fraction in the basins coincide to a time interval when sea level had risen to ~50-40 m, marking the re-flooding of the modern atoll tops which remained exposed for most of the glacial cycle.

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ENSOS IN THE TROPICAL PACIFIC CORALS FROM STABLE ISOTOPE AND RADIOCARBON MEASUREMENTS

We present isotope measurements of monthly and annual coral bands from sites in the tropical and subtropical Pacific Ocean, including the Galapagos Islands. The purpose of this study is to understand the changes in circulation and climate that have occurred in the past few hundred years within the context of ENSO and the Interdecadal Pacific Oscillation. Measurements of δ14C and δ18O in monthly and annual coral samples re-volve periods of high ENSO variance, particularly during the Little Ice Age (late 1600s), and periods of low ENSO variance including the early 1800s. Possible mechanisms that could account for the observed variability of the isotope records, including teleconnections to mid and high latitudes, will be discussed.
KELVIN WAVE ENERGY IN THE INDONESIAN ARCHIPELAGO

Kelvin waves generated by winds over the equatorial Indian Ocean propagate eastward along the equator, bifurcating to the north and south upon reaching Indonesia. Sumatra, Java and the Nusa Tenggara island arc act as a branchy waveguide, directing the waves eastward along the coast and allowing some energy to pass into the Indonesian seas. The continued energy penetration, however, means that the energy is partitioned between the passages of the Indonesian archipelago are poorly understood due to a historical lack of data that adequately distinguish the space and time scales of the different forcing mechanisms. Here, we present a filtering program to de-trend the Kelvin waves generated by winds over the equatorial Indian Ocean. For the purposes of this study, the energy associated with the Kelvin waves is isolated using a wavelet analysis and a wavelet thresholding technique. The energy within the Kelvin waves is transferred to the SEDEX model and the physical and biological responses of the ecosystem are simulated. The SEDEX model is used to simulate the physical and biological responses of the ecosystem. The model results are compared favorably with field observations from the SEDEX model. The model results are compared favorably with field observations from the SEDEX model. The model results are compared favorably with field observations from the SEDEX model.
generating baroclinic topographic waves by a tropical cyclone impacting a low-latitude continental shelf

Numerical model experiments have been performed to analyze the low-latitude baroclinic continental shelf response to a tropical cyclone. The theory of coastally trapped waves suggests that, provided appropriate slope, latitude, stratification and wind stress, bottom-intensified topographic Rossby waves can be generated by the storm. Based on a scale analysis the Nicaragua shelf is chosen to study propagating topographic waves excited by a storm, and a model domain is configured with simplified but similar geometry. The model is forced with wind stress representative of a hurricane translating slowly over the region at 6 km h⁻¹. Scale analysis leads to the assumption that baroclinic Kelvin wave modes have minimal effect on the low-frequency wave motions along the slope, and coastal-trapped waves are the primary topographic Rossby waves. Analysis of the simulated motions suggests that the shallow part of the continental slope is under the influence of barotropic topographic wave motions and at the deeper part of the slope baroclinic topographic Rossby waves dominate the low-frequency motions. Numerical solutions are in a good agreement with theoretical scale analysis. Another model experiment forced with a faster translating hurricane demonstrates that fast moving tropical cyclones do not excite energetic baroclinic topographic Rossby waves. Instead, robust inertial oscillations are identified over the slope.

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MULTIDIMENSIONAL PATHWAYS OF GROUNDWATER ADVECTION AND ASSOCIATED NUTRIENT FLUXES IN SALT MARSH ESTUARIES

We explore two different pathways of nutrient delivery via groundwater discharge in two contrasting New England salt marsh estuaries: in the first, freshwater is delivered primarily by overland flow; in the second freshwater input is dominated by groundwater discharge. We used geochemical tracers, radon- and radium isotopes, to determine large-scale fresh groundwater recharge. We also quantified tidally induced pore water circulation through the marsh bank sediments. A multi-tracer mass balance model was used to evaluate pore water residence time, which in turn was used to estimate carbon remineralization rates derived from pore water nitrogen increases over time. We also examined the role of the spring-neap tidal cycle in pore water exchange dynamics.

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SURFACE WATER PH MEASUREMENTS AND CARBONATE CHEMISTRY IN THE NORTH ATLANTIC OCEAN (ICELAND BASIN)

A semi-autonomous potentiometric pH system has been deployed between the UK (Glasgow) and Iceland (Reykjavik) during July and August 2007 aboard the RRS Discovery. During this cruise, biophysical interactions in the Iceland Basin were investigated during a post-bloom period on an eddy scale surface. High resolution pH measurements were undertaken in seawater sampled continuously from the ship's underway supply (~5m depth). This potentiometric method consists in a flow-cell approach using a highly reproducible free-diffusion liquid junction. Accuracy and precision of 0.01 pH unit can be achieved and high resolution data obtained if care is taken with electrode handling and Tris buffer preparation. The pH measurements showed small scale spatial and temporal variations, and correlation of pH and fluorescence data was observed, which indicated biological control on the carbonate system. Results of pH measurements were compared with discrete measurements of Dissolved Inorganic Carbon and Total Alkalinity in order to get a good understanding of the carbonate system in this area.

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INTRASEASONAL VARIABILITY OF INDIAN OCEAN SEA SURFACE TEMPERATURE DURING BOREAL SUMMER. MADDEN-JULIAN OSCILLATION VERSUS SUB-MONTHLY FORCING AND PROCESSES

Air-sea interactions in the Indian Ocean during boreal summer are investigated with a series of experiments using the HYbrid Coordinate Ocean Model (HYCOM). QuickSCAT...
winds and satellite observed OLR are used to identify the wind and convection patterns associated with 10-30 day atmospheric intraseasonal oscillations (ISOs). We assess the validity of the model SST output via comparisons with TRMM SST, and find that HYCOM does a good job of correctly simulating the ocean's response to both submonthly and MJO events. Representational regions in the Arabian Sea, the Bay of Bengal, and the warm pool that are simulated particularly well are chosen for further study. We find that wind plays a much larger role in altering SSTs than either shortwave fluxes or precipitation. Wind speed is slightly more dominant than wind stress in many cases, which is different than wintertime events, during which the two are comparable. We then evaluate how wind speed (via entrainment and turbulent heat fluxes) and wind stress (via upwelling and horizontal advection) modify SSTs.

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COUPLING BETWEEN THE C, N, P, FE, SI, CA AND LITHOGENIC CYCLES IN A GLOBAL OCEAN BIOGEOCHEMICAL AND ECOLOGICAL MODEL

We present comparisons of a broad suite of observational constraints from satellites to sediments with a multiple element (C, N, P, Si, Ca) biogeochemical model of small, large and diazotrophic phytoplankton and cycling of organic matter. The model includes such processes as gas exchange, atmospheric deposition, river inputs, ligand-based iron scavenging, N2 fixation, water column denitrification and sediment processes of lithogenic and iron retention. The CACO2 model calculates denitrification. Phytoplankton physiology is based on colimitation by light, nitrogen, phosphorus and iron with flexible N, P, Fe, chlorophyll, Ca and Si stoichiometry. Loss of phytoplankton to the microbial loop and to mesozooplankton is parameterized through a size-based relationship. This model is embedded in a 1-degree; global ice-ocean general circulation model (MOM4) forced by atmospheric reanalysis for quantifying the relationship between food web structure, biogeochemical cycles and atmospheric CO2 signature. Our analysis focuses on controls on the decoupling between the various elemental cycles represented in the model and on the dynamical roles played by variability linked to the annual cycle, El Nino, and other modes.

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THE ECOLOGY OF ARCTIC LAGOONS IN A CHANGING CLIMATE: ARE TERRESTRIAL INPUTS OF ORGANIC MATTER IMPORTANT?

The nearshore shelf of the Beaufort Sea receives massive freshwater discharge from the Mackenzie River and along with numerous smaller rivers and streams elsewhere along the coast, produce an environment that is decidedly euxinic in character, especially in late spring and summer. Because of its low in situ productivity, allochthonous inputs of organic carbon are important to the functioning of this arctic euxinic system. Coastal erosion and river discharge add significant amounts of suspended sediment from upland regions into coastal lagoons. The depletion in the 13C content of invertebrate and vertebrate consumers, which drops about 4-5 ppt eastward along the eastern Alaskan Beaufort Sea coast, may reflect the assimilation of this terrestrial organic matter into local food webs. On the eastern Alaska-Beaufort Sea coast, we describe the ecological structure of these coastal lagoons for the first time. The possible role of terrestrially derived carbon to arctic euxinic food webs is especially important in view of the current warming trend in the arctic environment and the role of advective processes that transport carbon along the nearshore shelf.

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ECOLOGICAL IMPACTS OF THE 2005 RED TIDE ON ARTIFICIAL REEF STRUCTURES

A harmful algal bloom (red tide) and associated anoxic/anoxic event in 2005 resulted in localised to chitin deposited around cell wall girdle bands during the interval when one tial phase and silicate starvation. These cells were also stained with a fluorescently labeled lectin under nitrate limitation; one was upregulated under both silicate and iron limitation. Expression of chitin synthase genes were also monitored in batch cultures during exponen
tial phase and silicate starvation. These cells were also stained with a fluorescently labeled chitin-binding lectin and the resulting fluorescence signal was measured quantitatively with flow-cytometry. Staining of stained, silicate-limited cells indicated that the lectin localized to chitin deposited around cell wall girdle bands during the interval when one chitin synthase gene was upregulated. Elongated, silicate limited cells formed aggregates during the period that nitrogen-rich chitin was enriched at their girdle bands, which may have implications for the nutrient composition of sinking biomass at the end of a bloom.

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MEASUREMENT OF COPEPOD PREDATION ON NAUPLII USING QPCR OF THE CYTOCHROME OXIDASE I GENE

Copepod adults may be important predators on copepod nauplii in the ocean. Field (verti
cal distribution) and lab (swimming behavior, escape responses) observations suggest that there are species-specific differences in predation susceptibility. We present a method here to directly measure in situ predation rates by older stage copepods upon copepod nauplii using species-specific primers for the mtCOI gene and real-time quantitative PCR. The general approach is to determine the mtCOI gene copy number of an individual prey organism and the copy number of the same gene in the stomachs of predatory copepods collected in the field. From knowledge of DNA disappearance rates in the stomachs, inges
tion rates can be calculated. mtCOI copy number have been determined for stages N1 to N2 of Acartia tonsa. Using species-specific primers, mtCOI genes of A. tonsa N2 fed to adult Centropages typicus was detectable for up to 3 hr. Exponential rates of decline of prey mtCOI genes were similar to those measured for gut pigments. This method could be modified to examine feeding ecology in a range of predator-prey systems.

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ACOUSTIC THROMBOMETER IN THE NORTH PACIFIC: (B) UNDERSTANDING BASIN-WIDE AVERAGES OF TEMPERATURE BY COMPARISONS TO THE POPULAR NUMERICAL OCEAN MODELS

With a decade of long-range (several Mm) acoustic propagation data obtained during the Acoustic Thermometry of Ocean Climate (ATOC) and North Pacific Acoustic Laboratory (NPAL) projects, the interannual, seasonal, and higher frequency variability of transbasin-
averaged ocean temperature in the North Pacific can be examined. Acoustic transmissions were made from sources located off the northern Californian coast and north of Kauai, Hawaii to several receivers of opportunity located in the North Pacific Basin. The acoustic

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PROFILING ALTIMETRY COMPARED WITH SWATH ALTIMETRY IN THE CONTEXT OF TERRESTRIAL HYDROLOGY DATA ASSIMILATION

Accurate characterization of the hydrologic cycle at local, regional, and global scales is an essential aspect of many crucial science and societal questions. Current methods for characterizing surface water and river discharge are inadequate in many parts of the world because of poor spatial and temporal distributions. A spaceborne synthetic aperture radar swath altimeter, WATER HM's KaAtR instrument, has been proposed for measuring such river discharge variables. Is it possible to use a Kalman filter to determine discharge by solely a profiling altimeter (PA) without the aid of in-situ observations? The swath altimeter (SA) provides a measurement of surface elevation across a swath tangential to the flow path, while the PA provides only a single elevation measurement along the flow path. In this paper, the PA and SA measurements are inter-compared in the context of a data assimilation system for river discharge estimation. The DA scheme utilizes the LISFLOOD- FP model to obtain a priori estimate of discharge and floodplain inundation and ingests altimeter measurements generated by the Jet Propulsion Laboratory Instrument Simulator. Observing System Simulation Experiments are performed to examine the relative performance of the PA and SA measurements in the context of the DA scheme for discharge estimation.

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MEASUREMENT OF COPEPOD PREDATION ON NAUPLII USING QPCR OF THE CYTOCHROME OXIDASE I GENE

Copepod adults may be important predators on copepod nauplii in the ocean. Field (verti
cal distribution) and lab (swimming behavior, escape responses) observations suggest that there are species-specific differences in predation susceptibility. We present a method here to directly measure in situ predation rates by older stage copepods upon copepod nauplii using species-specific primers for the mtCOI gene and real-time quantitative PCR. The general approach is to determine the mtCOI gene copy number of an individual prey organism and the copy number of the same gene in the stomachs of predatory copepods collected in the field. From knowledge of DNA disappearance rates in the stomachs, inges
tion rates can be calculated. mtCOI copy number have been determined for stages N1 to N2 of Acartia tonsa. Using species-specific primers, mtCOI genes of A. tonsa N2 fed to adult Centropages typicus was detectable for up to 3 hr. Exponential rates of decline of prey mtCOI genes were similar to those measured for gut pigments. This method could be modified to examine feeding ecology in a range of predator-prey systems.

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CHITIN AS A COMPONENT OF THE DIATOM CELL WALL

Chitin is the most abundant polymer in the ocean and is synthesized by the enzyme chitin synthase. Analysis of diatom chitin synthase genes suggests that more genera of diatoms may synthesize chitin than previously thought. To discover potential roles of chitin, chitin synthase gene expression was measured in Thalasiosira pseudonana cultures grown under silicate, iron, or nitrate limitation. All chitin synthase genes were down regulated under nitrate limitation; one was upregulated under both silicate and iron limitation. Expression of chitin synthase genes was also monitored in batch cultures during exponen
tial phase and silicate starvation. These cells were also stained with a fluorescently labeled chitin-binding lectin and the resulting fluorescence signal was measured quantitatively with flow-cytometry. Staining of stained, silicate-limited cells indicated that the lectin localized to chitin deposited around cell wall girdle bands during the interval when one chitin synthase gene was upregulated. Elongated, silicate limited cells formed aggregates during the period that nitrogen-rich chitin was enriched at their girdle bands, which may have implications for the nutrient composition of sinking biomass at the end of a bloom.
data are a high signal-to-noise measure of large-scale temperature with excellent temporal resolution. Although only a few realizations of the seasonal cycle are available, inter- and intra-annual variabilities have signal amplitudes comparable to the seasonal cycle. The sea-
sonal cycle of temperature is mostly accounted for by local air-sea heat exchange. The time
scales for some of the changes in temperature are short, sometimes of order weeks. Not all
available acoustic paths are suitable for assessing the seasonal cycle, however. Near Hawaii, the
acoustic sampling does not extend to the near-surface waters, so seasonal variations there are not
measured. To better understand the nature of the signals, the temperature changes observed
by the acoustics will be compared to temperature changes modeled by a co-temporal, high-resolution ocean model (POP: Parallel Ocean Program).

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USING RESOURCE COMPETITION THEORY TO UNDERSTAND THE DISTRIBUTION OF MARINE PHYTOPLANKTON

Resource competition theory has been used by ecologists to predict outcomes of competi-
tion between phytoplankton, and their distribution in the environment (Tilman, 1977).
Here we use this theoretical framework to gain insights into the solutions of a global three
dimensional physical-biogeochemical-ecosystem numerical model. This model is initialized with many phytoplankton types, whose growth traits are drawn randomly from observed ranges. The resulting spatially varying ecosystem structure is therefore self organizing rather than imposed. In particular, the model successfully characterizes the observed dis-
tribution of the picocyanobacteria Prochlorococcus, which dominate the phytoplankton community in regions of much smaller density. We use the theoretical framework, modified to include the effects of light, temperature and grazing on phytoplankton abundances, to investigate the physical and ecological factors that underpin the modeled biogeography. We find that Prochlorococcus dominates regions where the physical environ-
ment is fairly stable, and at least one of their required nutrients are drawn down to low levels that are consistent with the theoretical predictions. In these stable regions the chemical re-
composition is regulated by the characteristics of the ecosystem structure.

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THERMOCLINE AND SUBTHERMOCLINE CURRENTS FROM THE CENTRAL TO WESTERN EQUATORIAL PACIFIC: A SNAPSHOT VIEW FROM THE EUC-FE CAMPAIGN

Shipboard ADCP observations were obtained in August/September 2006 across the equa-
toral Pacific from 140ºW to 145ºE, providing a quasi-synoptic view of the circulation. Centered in the thermocline, the Equatorial Undercurrent (EUC) straddles the equator above the westward Equatorial Intermediate Currents. Filtering out large vertical scales using a baroclinic mode decomposition reveals the signature of the Equatorial Deep Jets (EDJ): zonal currents within 1.5° of the equator from 400 m depth to the bottom of the measurements, reversing with 300-400-m vertical wavelength. The EDJ's are zonally
consistent over the central 40º of the survey, but not over the entire zonal extent. At the
western boundary, two currents contribute high-salinity south Pacific waters to the EUC:
the northwestward New Ireland Coastal Undercurrent is split by topography, with its
western boundary, two currents contribute high-salinity south Pacific waters to the EUC.

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ASSESSING THE ROLE OF ENVIRONMENTAL STRESSORS AND GENETIC COMPOSITION ON TOXIN PRODUCTION IN LAKE ERIE CYANOBACTERIAL HAB POPULATIONS

Blooms of the cyanobacterial HAB Microcystis have recently resurged in some regions of the
Great Lakes and, due to the use of these water bodies for water drinking and recreation, there is a significant need to understand the factors contributing to bloom toxicity. Microcystis bloom toxicity is regulated by both environmental factors and genetic com-
position. The response of the natural Microcystis community to some key environmental stressors (nutrients, light, grazers) was assessed by measuring changes in growth rates and concentration of the microcystin in laboratory experiments. Additionally, a quantitative PCR assay was used to quantify changes in the number of toxic colonies using the mcyB gene, which is involved in the synthesis of the toxin microcystin. The genetic composition of the Microcystis community in western Lake Erie was also assessed over the course of a bloom season using both the highly variable phyocyanin intergenic spacer

region (PC-IGS) and mcyB. Sequence analysis showed that there is shift in community composition over time and that strain composition plays a role in Microcystis bloom toxicity in this region.

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A REGIONAL WAVE MODELING SYSTEM IN THE ADRIATIC SEA

A wave prediction system using the SWAN (Simulating Waves Nearshore) model was run
covering the Adriatic Sea and the Gulf of Manfredonia supporting the field experiment, “Dynamics of the Adriatic in Real-Time 2006” (DART06) which provided a unique oppor-
tunity for examining the characteristics of ocean surface waves and model performance in such a regional environment. The regional SWAN model was run in real-time from October 2005 to November 2006 using winds from forecasts provided by the ALADIN meteorological model run by the Croatian Meteorological and Hydrological Service. Comparisons of the daily forecasts of significant wave height to in situ and altimeter measurements showed that SWAN performed fairly well with a generally small negative bias. Afterwards, SWAN was run in hindcast mode to include wave-current interaction by using surface currents as input from NCOM (NAV Coastal Ocean Model) run at the Navy Research Laboratory. The results of including wave-current interaction showed significantly improved wave model performance. Several cases will be illustrated to show wave model performance issues in this particular environment.

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SUB-INERTIAL MID-SHELF ACROSS-SHELF OFFSHORE FLOWS IN THE SURFACE LAYER OF THE CENTRAL MID-ATLANTIC RIGHT

An examination of sub-inertial across-shelf, offshore flows over the mid-shelf of the cen-
tral Mid-Atlantic (MAB) was conducted using surface velocity measurements from a long
range HF radar system. Observations from Aug 2002 to Jan 2004 were used to subjectively identify several episodic flow patterns over an area approximately 240km by 115km off the New Jersey coast. The predominant structure was a shelf-wide flow that primarily occurred during months in which the water column is usually well-mixed (Oct-April). The other episodic flow patterns typically had a smaller single scale region of intensified across-shelf flow. An EOF analysis of the across-shelf flow was performed in an attempt to determine the robustness of the observed spatial features and to study the physi-
cally forcing to these modes. EOF mode 1 dominated the variance and appeared similar in structure to the mature state of the shelf-wide episodic events. In terms of forcing, cur-
rent vector/wind stress correlations over the study region revealed significant seasonally
dependent spatial variability with across-shelf flow during the mixed period appearing to be more closely associated with across-shelf wind stress. (25-60 at zero lag). On a larger scale, this research is important because the MAB circulation interacts with the Gulf Stream, a current critical in transporting heat to higher latitudes and in global circulation.

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MERCURY RISK TO BIRDS IN THE SAN FRANCISCO BAY ESTUARY

The San Francisco Estuary is a site of hemiherpic importance for waterbirds, and also has a legacy of mercury contamination. We examined space use in four common waterbird species and assessed mercury concentrations in adults, chicks, eggs, and their prey, and quantified the effects of mercury on reproduction. We found that mercury was highest in Forster’s terns and assessed mercury concentrations in adults, chicks, eggs, and their prey, and quantified the effects of mercury on reproduction. We found that mercury was highest
in Forster’s terns, followed by stints, Caspian terns, and avocets. Overall, we estimated
that risk to reproductive impairment was 22%, 22%, 10%, and 1% in Forster's terns, stints,
Caspian terns, and avocets. Moreover, 58% and 46% of breeding Forster's terns and their
eggs respectively, were at high risk to mercury impairment. Failed to hatch and abandoned
eggs had more mercury than randomly collected eggs for Forster's terns but not stints or
avocets. Further, we found that hatching success declined with increasing egg mercury in Forster's terns but not stints or avocets. We also found that dead stilt (but not avocet)
chicks had higher down mercury concentrations than randomly sampled living chicks.
Our results indicate that waterbird exposure to mercury is high enough to be a cause of
concern, and that reproduction may be impaired.

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The 2005 Caribbean coral bleaching event was the most extensive and devastating on record for this basin. NOAA Coral Reef Watch satellite data provided warnings that allowed researchers to document the extent and intensity of the event. The greatest bleaching and mortality were seen along the Antillean Arc where the thermal stress exceeded any seen in the Caribbean during the past 21 years of satellite data. Gridded in situ records showed that average temperatures were the warmest in over 100 years. Coral bleaching exceeded 90% at many sites, and extended across most of the wider-Caribbean region; mortality exceeded 40% at many sites. Collaboration among researchers from 22 countries provided the best documentation of a basin-scale bleaching event to date. This event showed one of the key problems that climate change poses to coral reefs: warming oceans can kill corals in even the best-managed or most remote coral reefs. Steps need to be taken to increase the resilience of coral reefs to survive bleaching, ocean acidification, and other climate change threats.

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THE EFFECTS OF LANDUSE AND SOIL CHARACTERISTICS ON NUTRIENT LOADING USING THE SOIL & WATER ASSESSMENT TOOL (SWAT): A COMPARATIVE STUDY

Managing an ecosystem is a complex task due to the diversity of information required for holistic planning and policy implementation to ensure the health of an ecosystem. Watershed and environmental managers are tasked with decision-making and policy implementation with limited resources. A model integration tool, including Geographic Information Systems (GIS) that facilitates spatially explicit representation of the intricacies of the interactions between groundwater, surface water, soil, land cover and the climate to the streamflow and nutrient loading can be an invaluable tool for environmental managers. The Soil and Water Assessment Tool (SWAT) is a GIS-integrated model that can determine hydrologic budget of a watershed as well as nutrient loading into an ecosystem. This study uses SWAT to model physical processes for two nearby drainage basins in west central Florida and compares the resulting hydrology and water quality data to landuse and soil characteristics to determine if these components are major factors in the variability between the watersheds/nutrient loading.

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IN SITU STUDY OF NUTRIENTS AND PH USING THE SPECTROPHOTOMETRIC ELEMENTAL ANALYSIS SYSTEM II (SEAS II): CASE STUDIES FROM RIVERINE AND OPEN OCEAN DEPLOYMENTS

Development of chemical sensors capable of high-resolution and high-frequency data sampling enables researchers to examine detailed vertical and diurnal variations of chemical species. The Spectrophotometric Elemental Analysis System II (SEAS II) offers a versatile robust instrument for measurement of chemical species under a variety of aquatic conditions. Nutrient and pH measurements from the Hillsborough River, Tampa Bay, Gulf of Mexico, and Atlantic Ocean demonstrate the ability of SEAS II to analyze in a broad range of aquatic environments. In addition, optical cells are easily reconfigurable allowing the user to determine analytes from low nanomolar to mid-micromolar concentrations. The instrument records and internally stores real-time measurement data and can transmit these data via cabled connections to a variety of receivers including a shipboard hydrowire system and wireless Ethernet adapter. We present data from Hillsborough River and Atlantic Ocean deployments to illustrate how the versatility of SEAS II make it a potential candidate for use in ocean observing systems.

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USE OF MITOCHELONIAL CYTOCHROME B AS A TOOL FOR RE-EVALUATION OF THE NORTHERN GULF OF MEXICO SPECIES OF THE ZAUSODIES COMPLEX

Identification of species solely by their morphological characters can give misleading results because some species may not have differentiated morphologically. DNA sequence analyses can differentiate individuals that are genetically similar from those that are not. It thus provides another means of erecting species’ boundaries. When DNA-sequence-analysis results and morphological results agree, workers can view the morphologically based taxonomy with much more confidence and accept the utility of the morphological characters that were used to discern species boundaries. Our objective is to re-evaluate the morphologically defined species boundaries of the northern Gulf of Mexico species of the Zausodies complex (Copopea: Harpacticoidea: Harpacticoidae) with DNA-sequence data from the mitochondrial cytochrome b gene. Harpacticoids were identified morphologically. DNA was extracted from the posterior portion of individuals; the anterior portion was kept as a voucher. A portion of the target gene was PCR amplified and sequenced, and haplotype trees were generated by neighbor-joining analysis of the aligned sequence data. Preliminary results indicate that the morphological and DNA-sequence data are in agreement.

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SEASONAL AND SUBINERTIAL VARIATIONS IN THE SOYA WARM CURRENT REVEALED BY HF RADARS, COASTAL TIDE GAUGES, AND A BOTTOM-MOUNTED ADCP

The Soya Warm Current (SWC) is a coastal boundary current, which flows along the coast of Hokkaido in the Sea of Okhotsk. Seasonal and subinertial variations in the SWC are investigated using data obtained by high-frequency ocean radars, coastal tide gauges, and a bottom-mounted acoustic Doppler current profiler. The velocity of the SWC reaches its maximum, approximately 1 m/s, in the summer, and becomes weaker in the winter. The almost same seasonal cycle was repeated in the period from August 2003 to March 2007. The SWC also exhibits subinertial variations with a period from 10-15 days. The surface transport by the SWC shows a significant correlation with the sea level difference between the Japan Sea and Okhotsk Sea for both of the seasonal and subinertial variations, indicating that the SWC is driven by the sea level difference between the two seas. The subinertial variations in the SWC are significantly correlated with the meridional wind component over the region. Continental shelf waves triggered by the wind are considered to be a possible generation mechanism for the subinertial variations.

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LETHALITY OF PAH’S TO MARINE PHYTOPLANKTON

Polycyclic Aromatic Hydrocarbons (PAHs) are ubiquitous environmental contaminants derived from biogenic or anthropogenic sources from incomplete combustion of fossil fuel. PAHs reach and impact aquatic environments after ongoing atmospheric transport and subsequent deposition, or through direct spillage of petroleum and its refined products. Even if PAHs are considered toxic but not biocumulative for high organisms, for phytoplankton they are, and may reach higher levels in the cells, being a key vector to transfer to other organisms. Lethality of PAHs has been quantified for a variety of aquatic organisms as copepods, sandworms or macroalgae, but not for phytoplankton. The goal of this study was to quantify the lethality of two different PAHs (Pyrene and Phenanthrene) to marine phytoplankton by analyzing the effect of different concentrations of PAHs, ranging from 1 to 1000 µg/L, on the growth and cell death a variety of phytoplankton species growing in cultures and compared with the lethality observed in natural communities. The resulting cell death-PAHs relationships observed will be used to define the thresholds and points of non return of PAHs to marine phytoplankton.

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MODEL AND IN SITU STUDIES OF LARVAL DISPERSAL AND CONNECTIVITY IN GLACIER BAY, ALASKA

Larval dispersal may be driven by multiple physical oceanographic processes; however, in Glacier Bay, a high latitude (fjord in Alaska, temporal variation in late-stage larval abundance of Dungeness crabs, Cancer magister) suggests that transport of larvae into the fjord is tidally-driven. In this interdisciplinary study we compared spatial distributions of larvae with results from a 2-D tidal circulation model (ADCIRC) for Glacier Bay. The model is forced with tides, meteorological conditions and freshwater inputs. We observed that late-stage larval abundance is highest near the mouth and declines with distance up the bay. The model suggests that these larvae could enter Glacier Bay from the west and be transported to their observed locations on the flood tide. The model also suggests that larvae in Glacier Bay are not connected to larvae found to the east of the bay as a result of a circulation barrier. We hypothesize that these larvae are immigrating into Glacier Bay after developing outside, akin to the observation in CA, OR, and WA that larvae migrate offshore to the continental shelf and return to nearshore areas as megalopae.

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INFLUENCE OF ENVIRONMENTAL VARIABLES ON THE MICROBIAL COMMUNITY OF ARCTIC LAND FAST SEA ICE

Changes in sea ice community structure affect carbon and nutrient cycling in polar seas, but the response in microbial species composition to key environmental variables still remains largely descriptive. Using ice cores recovered from 3 locations near Point Barrow, AK in May 2006, we documented the diversity and composition of eukaryotic sea ice microorganisms in relation to vertical depth within the cores, light availability (mainly as variable snow cover) and nutrient concentrations. We used DGGE (denaturing gradient gel electrophoresis) of a PCR (polymerase chain reaction) amplified section of the 16S rDNA gene in combination with epifluorescence microscopy to compare the community struc-
ture of the major eukaryotic microbial phylotypes in the ice. We find that there are clear differences in the community structure from the top of the ice to the bottom of the ice at all sites, as expected, but more importantly, between sites with (30 cm) and without (0 cm) snow. This underscores the importance of snowfall and snow distribution for sea ice microbial community structure on scales of only meters, and the potential impact of climate change on sea ice ecosystems.

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APPLICATION OF MICROARRAY TECHNOLOGY TO INVESTIGATE CORAL RESPONSE TO STRESS AT DIFFERENT SCALES ON SOUTH FLORIDA REEFS

Coral communities are increasingly impacted by a variety of natural and anthropogenic stressors acting on local or global scales. Based on the type of stressor and scale of impact, corals exhibit different responses. A better understanding is needed regarding how corals respond to the cumulative effects of stressors acting on different scales. Through the application of microarray technology, gene expression profiles can be used to diagnose which stressors are impacting coral populations in the field. Changes in gene expression are key elements of the stress response, occur before physiological damage is evident, and can be directly related to the causative agent of stress. In this study, a focused coral gene microarray was used to detect gene expression patterns of coral in South Florida associated with changing environmental conditions. This is the first study to use a focused Cnidarian microarray to detect stress in field coral populations related to seasonal events, such as precipitation as well as point source stress, such as xenobiotics. In addition, a clear correlation between the expression of symbiont genes with the expression of host stress response genes was evident. Through the application of microarray technology and gene expression profiling, varying degrees of stress impacting different sites across times were compared in natural coral populations.

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AN AUTOMATED VISUAL EVENT DETECTION SYSTEM FOR OBSERVATORY VIDEO

The permanent presence of underwater cameras on oceanic observatories, such as the Victoria Experimental Undersea Network Under the Sea (VENUS) and Eye-In-The-Sea (EITS) on Monterey Accelerated Research System (MARS), will generate valuable data that can move forward the boundaries of understanding the underwater world. However, sightings of underwater animal activities are rare, resulting in the recording of many hours of video with relatively few events of interest. The burden of video management and analysis often requires reducing the amount of video recorded and later analyzed. Sometimes enough human resources do not exist to analyze the video; the strains on human attention needed to analyze video demand an automated way to assist in video analysis. Towards this end, an Automated Visual Event Detection System (AVED) is in development at the Monterey Bay Aquarium Research Institute (MBARI) to address the problem of analyzing terabytes of video. Here we describe the overall design of the system to process video data and enable science users to analyze the results. We present our results analyzing video from the VENUS observatory and test data from EITS deployments.

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OBSERVATIONS AND MODELS OF MOMENTUM, HEAT AND MASS EXCHANGE FROM CLIMODE

The NSF sponsored CLIMode MDMo Water Dynamic Experiment (CLIMODE) is designed to investigate the formation, evolution, storage, and dispersal of Eighteen Degree Water (EDW), the subtropical mode water of the North Atlantic. One of the overall objectives of CLIMODE is to improve our estimates EDW formation through air-sea exchange. To conduct these investigations, the air-sea interaction team relied on research vessels, a highly instrumented surface drifter and a drifting Air Sea Interaction Spar (ASIS) during the CLIMODE field programs. All of these platforms measured the momentum, buoyancy, sensible heat, and mass fluxes using the direct covariance method after motion correction. Of particular interest were the extreme conditions encountered during cold air outbreaks. The combination of high winds and large air-sea temperature and humidity difference drove combined latent and sensible heat fluxes that exceeded 1200 W/m² during these events. Additional extreme wind events drove surface stresses that routinely exceeded 10.0 N/m². These enormous fluxes and air-sea gradients are used to reduce the uncertainty in the drag coefficient, Stanton number and Dalton number at wind speeds greater than 15 m/s.

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NEAR-RESONANT FORCING OF THE COASTAL OCEAN BY SEA BREEZE/LAND BREEZE NEAR THE CRITICAL LATITUDE IN THE GEORGIA BIGHT

Recent analysis indicates that non-tidal diurnal currents approach 30cm/s on the shelf of the Georgia Bight, with appreciable diurnal variance persisting from April through October. These diurnal motions appear to be inertial oscillations (IOs) and near-inertial internal waves, forced by diurnal winds associated with sea breeze/land breeze (SBLB), resonant with the inertial frequency at 30°N. Near the critical latitude, diurnal/inertial currents can exceed 25cm/s more than 120km offshore and are surface-intensified, with IOs in the lower layer 180° out of phase with those in the upper layer. Observational wind and current data from 1999-2006 are analyzed from a moored array in the Georgia Bight, between 29-32°N, where linear theory predicts significant changes in SBLB structure, and SBLB may be modified by the presence of the Gulf Stream. The spatial structure, variability, and phase of diurnal/inertial currents are described and compared to that of diurnal wind forcing as both the atmospheric forcing and ocean response pass through the critical latitude for diurnal/inertial resonance. The vertical structure and phase-locking of the currents to the diel cycle may have significant implications for cross-shelf larval transport.

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AIRCRAFT TEMPERATURE MEASUREMENTS IN THE SNOHOMISH ESTUARY DURING COHSTREX

During the COHSTREX experiment in July 2006, the Snohomish estuary in Washington State was surveyed with an airborne infrared imager in order to map the river’s surface temperature, Tskin. The along-river maps of Tskin contain the signature of several estuarine processes. Tidal movements of the estuary front was captured by repeated surveys over the tidal cycle. A near-surface warm layer developed diurnally, with enhanced warming in cloud-free, light-wind conditions. In addition to these river-scale changes in Tskin, the maps also capture the small-scale variability of coherent structures shed from bottom bedforms, wakes from in-river obstacles like pilings, and wakes from small motorboats. These turbulent overturns bring deeper water to the surface, and thus their infrared signature has the potential to give information on the water’s vertical stratification. The relation between Tskin disturbances and vertical stratification will be evaluated here based on comparison to the in-situ moored data of COHSTREX.

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MODELING WAVE- AND TIDE- DRIVEN CURRENTS WITH DELFT3D FOR AUVFEST 2007

In June 2007, the Delft3D modeling suite was used to determine wave and circulation conditions during AUVFest at Panama City Beach, Florida. The model for AUVFest was designed to encompass two areas in which a variety of technologies, including autonomous underwater vehicles (AUVs), operated. Bathymetry for the Delft3D model was created by combining low resolution bathymetry with bathymetry collected by AUVs in the areas of interest. The modeling exercise coupled the flow and wave components of the Delft3D suite, and acquired boundary conditions for the components from PCTides and SWAN model runs for the entire AUVFest area of Panama City Beach. An acoustic doppler current profiler (ADCP) was deployed in an area of interest but relatively deep water; preliminary comparisons showed that the model underpredicted velocities at the ADCP location because Delft3D computed only wave-driven currents. We will alter the modeling approach in the flow component by specifying dominant tidal harmonics along the boundaries, thus including tidal currents in the computation. We will compare the results to the ADCP data and examine the differences of the two modeling approaches.

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PROSPECTS FOR TIDAL STUDIES WITH HIGH-RESOLUTION ALTIMETRY

Atmospheric data from the TOPEX/Poseidon and Jason-1 missions have allowed tidal elevations in the open ocean to be mapped to high accuracy—even minor constituents such as M4 (mixed tides of ocean amplitude measured in cm) can now be reliably determined with the long timeseries available. However, many tidal phenomena remain poorly constrained by the coarse sampling of a traditional nadir altimeter. For example, internal tides are clearly seen in the altimeter data radiating away from generation sites over rough topography in the deep ocean. However, wavelengths are ~100 km or less, and thus poorly sampled by a nadir altimeter. Model simulations show that maps of internal tide energy flux constructed from T/P data significantly underestimate actual fluxes. Increasing the sampling density (e.g., by using tandem mission data) increases the mapped fluxes. However, accurate mapping, which may shed light on tidal mixing and energy dissipation in the deep ocean, would require almost complete spatial coverage. Challenges
also arise with the surface tides in shallow coastal seas, where spatial wavelengths are much shorter than typical meter track spacings, and frequency spectra are often more complex due to the presence of non-linear constituents. Future technologies that provide nearly continuous coverage and extend close to the actual coast would greatly improve our ability to map tidal elevations and currents, in these areas of great societal importance.

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**DAILY VARIABILITY IN ENVIRONMENTAL CONDITIONS AND PHYTOPLANKTON COMPOSITION DURING TWO BLOOM EVENTS IN THE LAFAYETTE RIVER, VIRGINIA.**

The Lafayette River is a eutrophic urban tidal tributary prone to seasonal harmful algal blooms, with cell densities recorded during this study on average twice that of other Virginia tributaries. Over a 34-day sampling period, two distinct bloom events occurred involving Cryptomonas spp. and the mixotrophic dinoflagellate Gymnodinium instriatum. Chlorophyll a, nutrient levels, physical and chemical parameters were measured daily in addition to phytoplankton enumeration. Sixty-five species of phytoplankton from 8 major taxonomic groups were identified during the two bloom events. Mean total phytoplankton cell densities ranged from 5.8x10^3 to 7.8x10^4 cells l^-1. Picoplankton densities varied from 3.7x10^6 to 1.3x10^7 cells l^-1. During the bloom periods, Cryptomonas spp. and Gymnodinium instriatum constituted as much as 96.1% and 89.8% of the cells respectively, contributing to a negative correlation between diversity and productivity (r=-0.71, p=0.0005). Precipitation, elevated nitrogen concentrations, and decreased salinity were associated with both blooms. Picoplankton abundance was also elevated during the bloom periods. The short length of both blooms (~5 days) emphasizes the usefulness of daily monitoring studies in understanding the effects of environmental conditions and ecological interactions on phytoplankton populations.

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**ORGANIC CARBON CYCLING OVER THE NORTHWEST ATLANTIC MARGIN: IMPORTANCE OF LATERAL TRANSPORT.**

The fate of the diverse sources of organic carbon (OC) supplied to and produced over continental margins remains a subject of debate, but there is growing evidence that a significant fraction may be transported to the interoceanic basins. Establishing the fluxes and mechanisms involved in margin-to-deep-ocean carbon transport therefore represents an important challenge. The Northwest Atlantic margin is characterized by the existence of strong and persistent detached and bottom nepheloid layers that may serve as conduits for export of OC to the interior ocean. As part of a project to understand dynamics of particulate OC (POC) in this region, suspended and sinking POC was collected using submersible pumps and bottom-tethered time-series sediment traps deployed over the continental slope adjacent to a physical oceanographic mooring array. Geochronical data (including isotopic and lipid biomarker compositions) as well as flux measurements provide strong evidence for significant lateral transport of POC. When evaluated in the context of hydrographic observations, this information provides constraints on the provenance and transport pathways of POC over the continental margin.

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**VARIATIONS IN SPRING SST AND FORAGE FISH DISTRIBUTIONS IN THE SOUTHEASTERN BERING SEA; BASIS SURVEY RESULTS FOR 2002-2007.**

The eastern Bering Sea (EBS) shelf is a highly productive high latitude system that provides critical habitat for important pelagic fish stocks. Shelf-wide surveys were conducted during late summer / early fall 2002-2007 in the eastern Bering Sea, as part of a multiyear international research program, Bering-Aleutian Salmon International Survey (BASIS), to study the effects of ocean conditions and lower trophic level variations on forage fish abundance and distribution. The EBS underwent large-scale warming during 2002-2003, followed by cooler spring shelf surface temperatures and a more southerly ice extent in 2006 and 2007. This shift substantially altered juvenile salmon and other forage fish (e.g. age-0 pollock, herring, and age-0 pacific cod) abundance and distribution in the southeastern Bering Sea and may affect the overall ecology of this region.

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**THE NORDIC SEAS AS A PACEMAKER IN THE OCEAN CONVEYOR**

The dense overflows from the Nordic Seas are the main source of North Atlantic deep water and thus complete the overturning of the Atlantic Meridional Overturning Circulation (AMOC). We assess the influence of key regions and processes within the Nordic Seas on the state of the overflows using three independent sources of data: a unique set of hydrographic observations from 1950 to 2005, a dedicated tracer release experiment, and output from a regional ocean model. The commonly presumed causality between convective mixing in the Greenland Sea and changes in the overflows is neither evident in the observations nor in the model. There is on the other hand significant co-variability between the properties of the cyclonic loop of Atlantic-derived waters through the Nordic Seas and the overflows feeding the Atlantic conveyor. The found co-variabilities - or lack thereof - is a benchmark for the variability that should be reproduced in models that address AMOC and decadal predictability.

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**SEDIMENT TRANSPORT PROCESSES AT THE MOUTH OF COLUMBIA RIVER.**

Tides, density differences due to river inflow, and an extremely severe wave climate are the driving forces for flow at the mouth of the Columbia River (MCR), USA. Interaction between irregular bathymetry and jetties aborting both sides of the inlet result in a complex sediment transport field near the entrance. A process-based numerical model (Delt3D Online Morphology) was applied to obtain insight into the relative importance of different forcing mechanisms for sediment transport. Validation of model results with field measurements over the period August-September 2005 shows that the model reproduces the dominant flow features, and salinity and wave fields near the entrance reasonably well. Comparison of results for different forcing scenarios indicates that residual sediment transport is the result of a near balance between tidal and non-tidal flows. Density stratification affects the system from a depth where it interacts with an incoming tide at the mouth during low wave conditions. Finally, sediment transport and morphologic change of the ebb tidal delta is largely driven by storm waves.

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**GLOBAL OBSERVATIONS OF INERTIAL WAVES FROM LAGRANGIAN DRIFTERS.**

Since January 2004 surface drifters from the Surface Velocity Program are tracked by multiple satellites and this allows for the resolution of ocean surface currents variability at higher frequencies than previously available, especially towards higher latitudes. From this dataset, this study describes the characteristics of Lagrangian frequency velocity spectra as a function of latitude, on basin scales. As an example, inertial and semidiurnal tidal peaks are clearly resolved. A robust global feature is the general confinement of anticyclonic spectral energy at a given frequency between the equator and the latitude at which this frequency equals the local inertial frequency. It is hypothesized that this manifestation of inertial waves which have been forced by the wind stress at the surface and have propagated freely according to beta-dispersion.

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**HIGH LATITUDE SULFUR CYCLING IN LOS ALAMOS ICE-OCEAN MODELS.**

As a central component of several marine systems models, the biogeochemical Parallel Ocean Program (POP) has recently been augmented with a dynamic global sulfur cycle. Although most results are encouraging, high latitude processes remain deficient; polar improvements necessarily constitute a next generation emphasis. Based on a blend of available regional simulators, eponitic algae and their high DMS production have been implemented within the Los Alamos sea ice model (CICE), which runs interactively with POP and produces Pan-Arctic results in agreement with sparse data. Pelagic ecosystems within POP have been adjusted to reflect dominant high latitude phytoplankton classes including Phaeocystis. The new species are treated as segregated explicit variables competing with diatoms and microbes. Progress will be reported for (1) Arctic simulations conducted in a decoupled cryobiological CICE, (2) the northern polar domain of the POP ocean model, and (3) basin scale, interactive ice-ocean computations. Sensitivity tests include incorporation of biotic absorption of solar radiation within the skeletal layer using multiple scattering radiative transfer. In addition to the Arctic work, preliminary results will be presented for the Southern Ocean.

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**ASLO/AGU/TOS/ERF**
Ni and Co, dissolved concentrations increased southward in concert with NO₃ and PO₄, sandwiched between the Subtropical (~43S) and Subantarctic Fronts (~51S). For Cd, Cu, Zealand, in the Austral winter 2006. This transect straddles the Subantarctic zone which is 0-1000m, SAFe standardised) from 40S to 52S in the south T asman Sea, west of New

butions of dissolved Fe, Co, Ni, Cu, Zn, Cd and Pb in the upper water column (10 stations, FROM 40-52S; 155-160E

TRACE METAL CYCLING DURING WINTER IN THE SUBANTARCTIC ZONE

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THE IMPORTANCE OF PH, PARTICULATE CARBON, AND PHOTOSYNTHESIS IN CONTROLLING WATER-COLUMN RESPIRATION RATES IN THE AMAZON BASIN

although water-column respiration has been hypothesized to be the main source of outgassing CO₂ from Amazonian rivers, we lack an understanding of the variability in the observed rates. This study examined the variability of respiration rates in rivers and streams throughout the Amazon Basin and the organic source material of respired CO₂. Respiration rates ranged from 0.03 to 1.77 µmol L⁻¹·h⁻¹ of O₂ consumed and were most positively correlated with fine particulate organic carbon (r²=0.708). Respiration was also positively correlated with pH (r²=0.58). Sites with a pH < 7 (low pH) had a higher ratio of respiration to photosynthesis (2.3 ± 0.3) than sites with a pH > 7 (high pH) (1.1 ± 0.2). The isotopic signature of respired CO₂ suggests that autochthonous carbon is fueling respiration at high pH sites, whereas C₃ and C₄ vegetation are respired at low pH sites, with C₄ vegetation playing a larger role during the high-water period. Depth-integrating respiration rates reveal that respiration accounts for 21-37% of the evading CO₂ in large rivers, indicating that other processes are also important producers of CO₂.

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ORGANIC MATTER IN CARBONATE BIOMINERALS: A BULK AND MOLECULAR ISOTOPE APPROACH TO ECOLOGICAL MONITORING AND RECONSTRUCTION

Filter-feeding bivalves are increasingly used as integrators for monitoring water-quality trends in estuaries. Stable isotopic analysis is a powerful technique that may be employed for this purpose. As bivalves feed near the base of the trophic pyramid, the carbon and nitrogen isotopic compositions of the tissues of these organisms are reflective of estuarine primary production, and thus provide data relevant to water-quality monitoring. Organic matter incorporated into the shells of these organisms during calcification draws on the same biochemistry as the body tissues and therefore preserves similar signals. Consequently, organic matter in bivalve shells represents an archive of data for historical reconstructions of water quality prior to the onset of monitoring efforts. Here, data will be presented showing the incorporation of dietary signals into the tissue and shell organic matter of the American Oyster (Crassostrea virginica) along a salinity transect in Rookery Bay, FL. Isotopic characterization of organic matter will be shown for both bulk samples and specific amino acids. The advantages of compound-specific amino acid analysis in this context will be discussed.

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HIGH SPATIAL RESOLUTION MAPPING OF WATER QUALITY AND BATHYMETRY WITH A PERSON-DEPLOYABLE, LOW COST AUTONOMOUS UNDERWATER VEHICLE

YSI and OceanServer Technology partnered to develop the first autonomous underwater vehicle specifically designed for water quality mapping. Several of the features that make this person-deployable vehicle unique include the intuitive mission planning software, 12 hour run times with remote IF communication, and the complete on-board water qual-

ity sensor suite that samples at a frequency of 1Hz. The result is detailed maps of water

column. Therefore, Russell Reservoir may be a sink for iron, manganese, and phosphorus in the Savannah River System. Sediment samples were taken from the fore-
bays of Hartwell, Russell, and Thurmond Reservoirs and at an upstream location within Russell Reservoir. Russell had significantly more iron at the oxygenation system than at upstream locations within Russell or in Hartwell. Hartwell had significantly more iron than Thurmond. Phosphorous showed a similar distribution. Manganese was greater in the Russell forebay than at an upstream location or Hartwell. However, Thurmond had significantly more manganese than Hartwell or Russell.

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IRON SEQUESTRATION IN LAKE SEDIMENTS FROM ARTIFICIAL HYPONIMETRIC OXYGENATION: RICHARD B. RUSSELL RESERVOIR

Upstream to downstream, Hartwell, Richard B. Russell, and J. Strom Thurmond are warm, monomictic reservoirs of the Savannah River. In summer, they undergo thermal and chemical stratification with hypoxic/anoxic hypolimnia. To improve the water quality of releases from Russell Dam during stratification, the U.S. Army Corps of Engineers is implementing a hypolimnetic oxygenation system in the forebay of Russell Reservoir. This system may facilitate oxidation and flocculation of iron and possibly manganese. Phosphorus can adsorb to the flocculates, and their sedimentation effectively removes them from the water column. Therefore, Russell Reservoir may be a sink for iron, manganese, and phosphorus in the Savannah River System. Sediment samples were taken from the fore-
bays of Hartwell, Russell, and Thurmond Reservoirs and at an upstream location within Russell Reservoir. Russell had significantly more iron at the oxygenation system than at upstream locations within Russell or in Hartwell. Hartwell had significantly more iron than Thurmond. Phosphorous showed a similar distribution. Manganese was greater in the Russell forebay than at an upstream location or Hartwell. However, Thurmond had significantly more manganese than Hartwell or Russell.

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THE ANNUAL CYCLE OF IRON IN THE UPWELLING DRIVEN CENTRAL CALIFORNIA REGION

A seven years time series reveals an annual cycle of surface water iron in Monterey Bay, California that is dominated by the injection of high concentrations at the onset of upwelling each spring. A companion study at the upwelling center clearly indicates a sedi-

mentary source for the iron. River discharge during winter storms results in the deposition of a sediment "fluff" layer along the shelf at the upwelling center. Initial rapid shoaling of isotherms at the onset of upwelling brings water from the "fluff" layer to the surface. Iron concentrations then rapidly decrease although upwelling intensifies and iron nitrogenate concentrations occur ~ 2 months later. Decoupling of the iron and nitrate supply suggests the potential for iron limitation. However, iron limitation was apparent only one of the seven years, following two consecutive years of low river flow. Generally, complete drawdown of nitrate occurs by late summer, which cannot be supported by dissolved iron concentrations alone. Summer chlorophyll concentrations are highly correlated to dissol-

vable (unfiltered) iron concentrations emphasizing the importance of particulate iron in meeting this ecosystem's iron requirements.

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OXYGEN CONCENTRATION VARIABILITY: A TRACER OF DIURNAL TO DEcadal-SCALE MARINE BIOLOGICAL AND PHYSICAL PROCESSES

The distribution of oxygen concentration in the ocean is determined by a combination of biological processes and ocean ventilation. The utility of oxygen as a tracer of biological processes and ocean environmental change has come to light in recent years because of repeated ship-board measurements on hydrographic sections and at ocean time-series stations. Seasonal changes in the eustrophic zone suggest that net community produc-

tion in the open ocean is less variable than suggested by satellite or model predictions. Decadal-scale changes in the thermocline indicate trends in ocean ventilation and circula-

tion. Because the reliability of oxygen sensors is improving and there has been an explo-

sion of platforms for making measurements remotely, it is now possible to realize a global coverage of oxygen change on seasonal and decadal scales. The temporal and spatial detail of oxygen change observed using sensors on Moorings, Argo floats, Sea Gliders and vol-

unteer observation ships demonstrate the utility of this approach. I address some issues of sensor accuracy and drift that must improve to resolve processes that create oxygen concentration changes smaller than a few percent.

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DISTRIBUTION AND ANNUAL VARIABILITY OF HALOBATES ACROSS THE EASTERN AND CENTRAL TROPICAL PACIFIC

Five species of the aquatic insect Halobates live in the Pacific Ocean, thriving in specific biogeographic boundaries. Research suggests these insects collect surface dwelling insects, affecting their distribution patterns. Further studies are needed to understand these patterns.

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SCIENCE (M)COMMUNICATION IN A POLICY WORLD – WHY BETTER?

Science has a clear role to play in informing natural resource policy by providing understanding and knowledge of natural (and other) processes to policy makers. However, scientists and policy makers alike are often frustrated by the apparent lack of consideration – or misuse – of science in the policy making process. Is it worth a scientist’s time to try to communicate their science directly to policy makers? Why not leave this task to the “experts”? Cultural differences between policy makers and scientists make this prospect daunting, but also suggest that participation by scientists is powerful.

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MONITORING RIVERS AND LAKES WITH A KA-BAND INTERFEROMETRIC RADAR ALTIMETER

Profiling nadir-pointing radar altimeters are not capable of providing adequate space-time sampling of global surface water, independently of their intrinsic accuracy. To overcome this limitation, we present an instrument concept, the Ka-band Radar Interferometer (KaRIN), which is able to provide the appropriate space-time sampling with a height and slope accuracy suitable to resolve topographic signatures of land hydrology applications. The KaRIN instrument builds on the interferometric SAR concept demonstrated by the NASA Shuttle Radar Topography Mission (SRTM) and the Wide-Swath Ocean Altimeter concept. Two major modifications are made to these systems to achieve the desired performance. The spatial sampling requirement implies full synthetic aperture processing. Besides, achieving the desired height and slope accuracy with a realizable spaceborne instrument requires using a Ka-band radar at near nadir incidence. The sampling of river discharge requires an approximately weekly revisit time, an ability to image water bodies with a spatial resolution of 100m, a height accuracy better than 10cm and a slope accuracy of 10 microrad. To validate the science performance of the system we have implemented a Virtual Mission simulation and evaluated the measurement performances over a variety of water scenes. Simulations and related results will be presented. They demonstrate the ability of such a system to meet continental waters observation requirements.

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THE INFLUENCE OF VARIABILITY IN PREY COMPOSITION AND DISTRIBUTION ON ADELIE PENGUINS (PYGOSCIS CLADAE) FORAGING ENERGETICS AND CHICK GROWTH: A MODELING STUDY

Individual-based models (IBMs) are developed to explore the implications of variability in prey available to Adélie penguins (Pygoscelis adeliae) on adult foraging energetics, chick growth and recruitment. The model is parameterized to reflect conditions of the western Antarctic Peninsula and the study is designed to consider environmental variability relevant to that region. The modeling environment consists of a central-place foraging model that interacts with an idealized prey-field comprised of prey-patches and is linked through the approach on two domains (a 1/30 degree model of the northwest European shelf, and a 1/12 degree model of the Atlantic Ocean) using 531 orbit cycles of T/P-Jason and 114 cycles of Topex tandem mission data. Solutions are validated using harmonic constants from a set of 77 shallow water tide gauges, demonstrating dramatic improvement in solution accuracy for NLC M4, M54, and M4N.

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“PHOTOREMINERALIZATION” OF PARTICULATE ORGANIC CARBON

“Photoremineralization” of carbon accompanies previously reported “photodissolution” of particulate organic carbon (POC) from resuspended estuarine and deltatic bottom sediments. Irradiations of suspensions of bottom sediments from Atchafalaya Bay, LA were conducted in a solar simulator. Dissolved oxygen, POC, dissolved organic carbon (DOC), and dissolved inorganic carbon (DIC) were measured before and after every irradiation. Dissolved oxygen levels remained constant in dark controls but decreased in irradiated suspensions in proportion to POC loss, with one mole O consumed for every 2-3 moles POC “photodissolved”. Photodissolution of POC was recovered as a combination of DOC and
WHERE DOES HIGH SI ORIGINATE IN CASCADIA BASIN?
Hammond, D.

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A TIDAL CREEK CONDITION INDEX BASED ON ECOLOGICAL VARIABLES
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This article summarizes the findings of several field investigations into a coastal mixing zone
MEXICO: IMPLICATIONS FOR SUBMARINE GROUNDWATER DISCHARGE AND
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This article summarizes the findings of several field investigations into a coastal mixing zone
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data-logging multi-parameter probes completed a series of salinity profiles along transects
that began offshore and ranged to 14km inland. These profiles were designed to provide a high
resolution 3-D map of the mixing zone morphology. The salinity profiles revealed mix
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of physical mixing is the flux of significant volumes of seawater across the principal interface
and into the mixed zone. The water balance of the mixing zone is poorly quantified except at
a limited number of locations. However, preliminary results suggest that the mixing process
produces an inward flow of water from the Caribbean Sea inland to the mixing zone. In contrast to
submarine groundwaters discharge, this effect moves seawater from offshore to the terres
trial aquifer. This effect is referred to as seaweed induction.

A TIDAL CREED CONDITION INDEX BASED ON ECOLOGICAL VARIABLES
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Supported by Sarasota County and Southwest Florida Water Management District.

Estever, E.

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SALINITY PROFILES IN A SUBTERRANEAN ESTUARY IN QUINTANA ROO, MEXICO: IMPLICATIONS FOR SUBMARINE GROUNDWATER DISCHARGE AND SEAWEED INDUCTION

This article summarizes the findings of several field investigations into a coastal mixing zone
aquifer in the northeastern Yucatan Peninsula by cave-diving scientists. Divers equipped with
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Carbon and nitrogen flows within the food web of a subtidal sandy sediment were studied using a dual stable isotope approach. First, 13C and 15N natural abundance of consumers and potential benthic and pelagic resources suggested a tripartite trophic network: the 13C isotopic signatures of some benthic fauna were similar to those of benthic diatoms (~16‰), other fauna or taxa were ~14‰- depleted, similar to benthic cyanobacteria (~20‰) and suspended particulate matter (~21‰); and, another group showed intermediate δ15C values, suggesting a mixed diet. Second, the microphytobenthos of sediment cores was labeled through a pulse-chase experiment with 14C bicarbonate and 15N nitrate. The fate of the labeled microphytobenthos was followed in the different heterotrophic consumers. Transfer of 13C and 15N to consumers was fast. Heterotrophic bacteria contributed most to the total heterotrophic incorporation of 14C, followed by meiofauna and macrofauna, consistent with the heterotrophic biomass distribution. Significant labeling of meiofauna allowed us distinguishing between utilization of MPB and phytoplankton-derived carbon. This dual approach provided complementary information on the role of MPB in structuring benthic communities in sandy sediments.

The model was used to study the impact of WAD, stratification, winds and river inflows, and the role of MPB in structuring benthic communities in sandy sediments.

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collected surface water temperature, salinity, PCO₂, pCO₂, and air PCO₂ data every 3 hours almost continuously since December 2005 in Känoe Bay, Hawaii. All measured values showed significant variability over a range of time scales. Surface water pCO₂ ranged from 230 to 590 Pamt but was generally higher than atmospheric due to net calcification. A linear TA/salinity relationship was derived from discrete surface water samples collected near the mooring. Using this relationship and the mooring data, we evaluate the full carbon system with particular attention to factors influencing calcification rates. Surface water saturation state with respect to aragonite, for example, varied from 1.2 to 3.5 with low values occurring during storm fresh water input. We will discuss the variability in the carbon system and its potential influence on the local corals.

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13C AND 15N IN POM IN RELATION TO MUCILAGE FORMATION IN THE NORTHERN ADRIATIC SEA

C and N stable isotope ratios and composition of particulate organic matter (POM) were studied weekly in spring and summer 2003 and 2004, and the latter affected by mucilage appearance, in the Gulf of Trieste (northern Adriatic Sea) to track the temporal variations and differences between the two years. The 13C and 15N composition of POM was not directly linked to phytoplankton biomass dynamics. The delta13C-POC values varied with temperature. In 2004, delta13C-POC variations followed the delta15N-POC values as well as the delta13C-DIC values which were probably dependent on photosynthetic use of 12C. Variations of delta15N-POC values were the consequence of phytoplankton N sources. Lower delta15N-POC (<3 ‰) and higher delta13C-POC (~20 ‰) values observed in July 2003 were probably due to contribution of N2 fixation. The significant correlation between delta15N-POC values and nitrate concentrations in 2004 implied intense nitrate assimilation in the ‘New primary production’ successively producing high molecular weight polysaccharide macrogel with a mean delta13C and delta15N values of -19 ‰ and 5 ‰, respectively. A low fractionation factor, -1 ‰, was found probably as a consequence of microbial biodenitrification and specific growth conditions. The 13C composition of POM revealed higher contribution of allochthonous organic matter in 2004 due to higher riverine inflow.

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FRESH WATER IN THE NORTHERN EAST GREENLAND CURRENT FROM 1982 THROUGH 2005

We describe the distribution and variability of the Pacific fresh water and total fresh water in the East Greenland shelf and slope in the region west of the Polar Front from Fram Strait to 72øN. These waters make up a considerable part of the Polar Water leaving the North Pacific to the east. We determine the total fresh water and Pacific fresh water fractions using the phosphi- rate and nitrate concentrations together with salinity. During 1993 and 2002, alkalinity values were also determined allowing estimates of river water and sea ice melt water fractions as well. Pacific fresh water and river water accounted for almost all of the fresh water in this region in 2002, when data where taken early in spring, while a considerable amount of sea ice melt water was present in 1993, when measurements were done later in the season. In 2004 and 2005 there were almost no traces of Pacific fresh water in the East Greenland Current.

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VERTICAL DISTRIBUTION AND POPULATION STRUCTURE OF COPEPODS ALONG THE NORTHERN MID-ATLANTIC RIDGE

The Mid-Atlantic Ridge (MAR) is the largest topographic feature in the North Atlantic Ocean. Despite generally limited surface production, there is evidence that the mid-ocean ridges are ecologically important for higher trophic levels relative to the surrounding open ocean. The complicated topography of the MAR influences local and regional circulation patterns which in turn are likely to affect the distribution of the zooplankton fauna. In this paper we explore the vertical distribution and population structure of selected copepod species on the northern MAR, with the goal of better understanding the nature of the interactions between zooplankton and a mid-ocean ridge system. Zooplankton were sampled on the ridge between Iceland and the Azores (~60-41 N) on the MAR-ECO-expedition in June 2004. Depth stratified sampling revealed information on vertical distributions from surface down to 2500 m. The Subpolar Front (SPF) is the major biogeographic boundary in the studied area. Several species were observed to change their vertical distributions along the transect, becoming deeper on the southern stations. Factors influencing vertical distributions are evaluated and relationships between zooplankton, water masses, and ridge topography are discussed.

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THE EFFECT OF BENTHIC MACROALGAE ON JUVENILE CRAB PREDATION AND SURVIVAL IN THE YORK RIVER ESTUARY

Nutrient loading is causing an ecological shift in the Chesapeake region, leading to the loss of traditional habitats, like seagrass, in favor of a new less studied habitat, macroalgae. This change can have important consequences for the blue crab Callinectes sapidus, a major resource in this region. Mesocosm studies show that the benthic macroalgae Gracilaria can reduce predation mortality on juvenile blue crabs. This follow up field study tested the ability of macroalgae to effect survival rates of juvenile crab between 11-33mm carapace width in the York River a subestuary of the Chesapeake Bay. This experiment is ongoing, but preliminary results show algal presence and amount having an impact on crab sur- vival which varies with the size of the juvenile crab.

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EFFECTS OF WIND-WAVE-CURRENT INTERACTION ON OCEAN AND SURFACE GRAVITY WAVE RESPONSE TO HURRICANES

In existing ocean models, momentum fluxes through the air-sea interface are parameterized by the bulk formulae, neglecting their dependence on the sea state. While surface gravity wave models usually ignore the affect of ocean currents. In this study, the wind/ wave/current interaction mechanisms and their effect on ocean and surface wave field response are investigated through a set of numerical experiments using a fully coupled wind-wave-current model. The Princeton Ocean Model (POM) was used to simulate the ocean response and the wave fields are simulated using the WAVESWATCH III model for all experiments. The results show that the spatial variation of the hurricane-induced surface waves plays an important role in reducing momentum fluxes into currents in the rear-right quadrant of the hurricane. During wave/current interaction, the momentum flux is mainly affected by the reduction of wind speed relative to currents while the wave field is mostly affected by refraction due to the current shear. Results of three case studies in Ivan (2004) suggest that an improved drag parameterization and the wave current interaction improve the wave forecasts.

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A DUAL-WEIGHTED POD APPROACH FOR 4D-VAR ADAPTIVE MESH OCEAN MODELLING

Proper Orthogonal Decomposition (POD) is an efficient way to reduce the dimension size of both the dynamic model and control space in 4D-Var data assimilation by identifying the few most energetic modes in a sequence of snapshots from a time-dependent system. Our motivation is to develop a novel POD reduced 4D-Var data assimilation technique for a 3D mesh adaptive finite element model (Imperial College Ocean Model). An effective dual-weighted (goal-based) approach is employed to estimate error and optimise the reduced bases, thus improving the quality of reduced order models, whilst the same goal- based function can be used to guide mesh adaptivity and inversion. The reduced order adjoint model developed here is used to optimise the initial conditions in a gyre case. The new POD model has been validated by comparing 4D-Var simulation results from adaptive and static meshes. Furthermore, error estimation (including the error in POD reduced modelling and the interpolation error in adapting the mesh) is carried out allowing us to assess the quality of reduced order adaptive mesh models.

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BEDLOAD SEDIMENT TRANSPORT IN THE SWASH ZONE OF LABORATORY BEACHES

High flow velocities and substantial sediment transport can occur in the swash zone resulting in large morphological changes. However, swash flows are complex owing to
asymmetry, turbulence and infiltration processes making it difficult to understand and quantify sediment mobility and transport patterns. Nearly all studies of instantaneous swash-zone sediment transport have focused on the suspended load component even though time-averaged measurements have shown the bedload component can be a dominant mechanism. Our work involves testing newly fabricated resistivity concentration probes to resolve the time-dependent sediment concentration profile in the bedload layer of the swash zone. We present new instrumentation and assessment of test designs that have been made to determine the optimal design which ensures consistent plausible results. Preliminary bedload data from the swash zone of a laboratory beach will be discussed.

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APPLICATION AND EVALUATION OF A DATA-ASSIMILATIVE COASTAL OCEAN FORECASTING SYSTEM

The application and evaluation of a data-assimilative coastal ocean forecast system based on the Regional Ocean Modeling System (ROMS) will be presented. The focus will be on applications of the system to the Monterey Bay region and the Southern California Bight. Both ROMS configurations use atmospheric forcing produced by regional atmospheric models and are integrated using a 3-dimensional variational data assimilation algorithm (3DVAR). For the Monterey Bay region, emphasis of development is found between independent measurements of temperature and salinity and the co-located ROMS-analyzed values. An assessment of the forecast skill and predictability will also be presented. Concerning this, preliminary results obtained for the Monterey Bay during August 2006 show a significant increase in forecast skill when surface current data gathered by coastal High-Frequency radars are assimilated. This increase makes the forecasts more skillful than persistence forecasts. Analysis of the forecasts for the Southern California Bight will be presented at the meeting.

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INSPIRED BY CURIOSITY, INSPIRED BY USE: A PARADIGM FOR OCEAN SCIENCE AND ENGINEERING RESEARCH

Funding sources for ocean science and engineering research in the United States have been shifted periodically since the 1930s. The post-Cold War funding situation has caused the academic sector to examine options for new sources of funding and the quid pro quo of accepting such funding. The balance between major program activities (e.g. ORION) and individual grants within NSF is vigorously debated within the ocean science community. New partnerships between government agencies (e.g. NOAA) and the academic community are being forged. Private philanthropy is considered as an increasingly important source of funding for ocean science research and education by various private and public academic organizations. I submit that the "Pasture's Quadrant" paradigm of the late Professor Donald Stokes is one useful framework for organizing the interactions within ocean science and engineering research and applications of the research and for organizing productive discussions with present and potential sources of funding, including private philanthropy.

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A STATISTICAL INVERSE MODEL IN THE SOUTHEASTERN PACIFIC OCEAN

It has been suggested in older and recent literature (e.g. Shaffer et al., 2004) that a broad deep eastern boundary flow is linking the equatorial Pacific Ocean to the Southern Ocean. The depth range of this flow corresponds to the Pacific Deep Water (2500m) where it is suggested by the distribution of perminal 3He originating from the East Pacific Rise. In this study, we propose to use a large set of data along with inverse techniques to estimate the stationary advection and diffusion of water properties and tracer concentrations (potential vorticity, potential temperature, salinity, dissolved oxygen and silica concentra-

to the area of interest. The various data are combined into an inverse model first developed by McKeague et al. (2005), Herbig et al. (2006). The model uses a advection-diffusion-model and Markov Chain Monte-Carlo techniques to estimate velocities along and across surfaces of neutral density as well as isopycnal diffusivities. It is composed of 9 layers between the 27.4 and 28 neutral densities. The circulation in the upper layers of the model compare well with direct independent estimates of velocities from oceanic float trajectory and profiler data. The model is being tested with extreme data in the deeper layers in regards to the 3He distribution along the Eastern boundary and its mixing with the Antarctic Circumpolar Current.

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OBSERVATIONS OF THE TURBULENT DISSIPATION RATE IN THE SURFZONE

Surfzone turbulence, generated at the surface by breaking surface gravity waves and near the bottom from the vertical shear of ocean currents, vertical mixing, sediment, tracers, and biota. However, the vertical structure of surfzone turbulence and the relative contributions of these two sources is not well understood. Turbulence is often quantified using the turbulent dissipation rate (dissipation). During the HR06 experiment at Huntington Beach CA, a cross-shore transect of seven ADVs were deployed that were sampled rapidly (8 Hz) in order estimate the dissipation rate. The changing tide levels provide a range of depths at each instrument and the waves and currents varied over the month-long experiment. Dissipation is much larger within the surfzone than seaward of it, and increases with increased incident wave height indicating that breaking-waves are a strong the turbulent source. However, at times strong alongshore currents also contribute significantly to the observed dissipation. Various dissipation scales will be examined to determine the relative importance of each source under various wave, tide, and current conditions. Supported by ONR, NSF, CA Coastal Conservancy, and NOAA.

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ROGUE WAVES IN OCEANIC TURBULENCE

A stochastic model of wave groups is presented to explain the occurrence of exceptionally large ocean waves, usually referred to as rogue waves. The model leads to the description of the non-Gaussian statistics of oceanic turbulence (Zakharov 1990) and to a new asymptotic distribution of crest heights over large waves in a form that generalizes the Tayfun model (Tayfun 1986). The new model explains the unusually large crests observed in experiments of random wave trains. However, comparisons with realistic oceanic measurements gathered in the North Sea during an intense storm indicate that the general-ized Tayfun model do not appear to improve upon the Tayfun distribution.

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PERMANENT EL NINO IN THE EARLY PILOCENE: EVIDENCE, MECHANISMS, AND THE POLEWARD HEAT TRANSPORT PARADOX

Proxy temperature records show that in the early Pliocene, approximately 3 to 5 million years ago, the tropics were characterized by permanent El Nino-like conditions. The equa-torial Pacific was as warm as in the west as it is in the west today. Concurrently, major coast-al upwelling regions were up to 10°C warmer. This climate state persisted even though the external factors that control climate were essentially the same as at present and the Earth was experiencing greenhouse conditions similar to today’s, with the concentration of CO2 in the atmosphere comparable to present day values. State-of-the-art climate models fail to reproduce this permanent El Nino even when forced by large oceanic atmospheric CO2. Is there a problem with the data, or with the models? Here, we discuss mechanisms for permanent El Nino conditions, likely causes of why the models fail to replicate them, and potential implications for modeling climate change in the tropics. In particular, we conclude that the current generation of climate GCMs may lack an additional mechanism of poleward heat transport essential for maintaining a permanent El Nino.

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EVIDENCE FOR UPEWELLING OF CORROSIVE ‘OCEAN ACIDIFIED’ WATER ONTO THE CONTINENTAL SHELF

During a cruise in May-June 2007 onboard the RV Wecoma, we observed ‘ocean acidified’ water that is corrosive to calcifying organisms upwelling onto the continental shelf of western North America from Queen Charlotte Sound, Canada to San Gregorio Baja California Sur, Mexico. The ocean uptake of anthropogenic CO2 has shoaled the aragonite saturation horizon so that seasonal upwelling exposes significant portions of the shelf to waters that are undersaturated with respect to aragonite. The corrosive waters reached mid-shelf depths of ~40-120 m along most transect lines, and reached all the way to the surface on two transects off northern California. In the region of the strongest upwelling, the isoleines of Ω = 1.0, DIC = 2190 and pH = 7.75 closely followed the 2.6°C potential density surface. This density surface shoaled from a depth of ~175 m in the offshore wa-ters and breached the surface over the shelf near the 100 m bottom contour, ~40 km from the coast. These results indicate that the upwelling process caused the entire water column
Hydrographic, water quality, and nutrient data from the Louisiana shelf are analyzed to produce quantitative criteria for defining process-oriented zones within the hypoxic sediments is mainly from the Yangtze River watershed including upstream input. Lead to 39.213 for Pb208/Pb204. The study shows that Pb in the Yangtze River intertidal zone of U238, U235 and Th232 and the isotope ratios are different from source to source.

Therefore, the ratios of these Pb isotopes can be used to find the origin of Pb. In this study, a total of 59 surface sediment samples (<5 cm) were obtained from the Yangtze River estuary intertidal zone. We will address the interannual variability of the hypoxic area and the effects of reduced and increased nutrient loadings and organic carbon inputs from the rivers and estuaries on the hypoxic area. We focus in particular on the recurring summer hypoxia of the eastern shell. Model results reproduce the basic features of the hypoxic zone. These include seasonality, size, location, duration, and vertical structure of the regions depleted of dissolved oxygen. The model also indicates that nutrient loading is an important factor in controlling the creation of reducible material, however, physical forcing processes, such as wind forcing, freshwater stratification, and current shear, control the spatial and temporal scales of variability of near-bottom dissolved oxygen concentrations.

Mixing of the West Spitsbergen Current: Summertime Observations The West Spitsbergen Current (WSC) is the major source of heat and salt for the Arctic Basin. It carries warm and salty Atlantic Water northwards through the Fram Strait. Along the path, WSC cools and freshens rapidly. To study the processes involved in the mixing of WSC, profiles of high-resolution CTD and dissipation rate of TKE were collected in the upper 500 m, in August 2005 and 2007. Sections across WSC cover 750 km along-path distance from Bear Island to the north of Svalbard, crossing the Yermak Plateau. Consistent throughout all sections is enhanced dissipation over the sloping bottom boundary (Moum et al., 2004) is proposed to account for the enhanced mixing. The downwelling favorable northward flowing WSC results in cross-slope transport of relatively cold and fresh coastal water at the bottom which is statically unstable and convects vertically leading to vigorous mixing. Significantly enhanced turbulent fluxes are inferred at the slope suggesting that the boundary layer mixing can be an important mechanism in summertime cooling and freshening of WSC.

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Tidal currents in lower Cook Inlet, Alaska, are investigated using direct velocity measurements from a boat-mounted Acoustic Doppler Current Profiler (ADCP). A series of channel transects were performed in the summer of 2005 at Anchor Point as part of NOAA’s
Kachemak Bay Research Reserve activities. Observations of the tranverse vertical velocity structure in this area are limited and have been mostly obtained from scattered ADCP deployments. In this study, the transect data are used to map the spatial structure and to estimate the volume transport of the tidal currents. Results from previous 40-day ADCP deployments on the same line as the boat track are used to identify major harmonic constituents. These results, obtained using NOAA's standard harmonic analysis routines, indicate a strong dominance of semidiurnal tides with maximum tidal current velocities of about 100 cm/s.

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VERTICAL PROJECTION OF VELOCITY, DENSITY AND TEMPERATURE USING VELOCITY-BASED FEATURE MODEL AND A LINEARIZED EQUATION OF STATE

One of the challenges in observational oceanography has been to infer the subsurface velocity field from surface observations. We use velocity-based feature modeling technique (VBFM) to describe and characterize a vertical section of observed horizontal velocities, and then create a realistic 2-D velocity field for a region. By separating the observed velocity section into two non-dimensional functions, one for the shear profile, and other for the horizontal structure, it is possible to represent the original velocity section using only the surface velocity for value. Assuming geostrophy and using the thermal wind relation, one can then estimate the density field. The associated temperature field is determined by using a linearized equation of state with a constant salinity value. As a first example of this methodology, we present some results for the Brazil Current - Intermediate Western Boundary Current (BC-IWBC) system at 23°S. Realistic velocity sections were simulated by sectorial POM (Princeston Ocean Model) with the VBFM-derived temperature fields used to initialize the model along with the climatological salinity fields.

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THE EFFECTS OF OCEAN ACIDIFICATION ON LYRE CRAB HYAS LYRATUS METABOLIC PROCESSES

Recent studies show that increasing amounts of atmospheric CO2 dissolving into the ocean cause acidification of the marine environment. Some predictive oceanographic models indicate that pH will drop up to 0.5 pH units over the next 100 years. It is well documented that ocean acidification (OA) inhibits the ability of organisms to form and maintain calcium carbonate structures. Examples of such organisms are diatoms, mollusks, and crustaceans. The physiological cost to crustaceans that must regulate internal pH and form a calcareous exoskeleton during larval and juvenile and adult moults is unclear. We measured standard metabolic rates of female lyre crabs, Hyas lyratus that were acclimated for one week at pH 4.8, 7.5, 7.0, and 6.5. Metabolic rates were significantly different between crabs held at pH 8 and pH 6 (0.55 vs. 0.43 ml O2/kg/min). Enzymatic rates of lactate dehydrogenase (LDH), pyruvate kinase, and citrate synthase decreased significantly with decreased pH. This decreased LDH activity could be detrimental to physiological processes requiring anaerobic metabolism. In fact, increased mortality was observed in crabs that were acclimated to pH 7.5, 7.0 and pH 6.5 and exposed to hypoxia for 24 hours when compared with control crabs held at pH 8.0. It is likely that there is an energetic cost to crabs associated with OA. This could have a negative impact on energetically costly physiological processes such as growth and reproduction.

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RESTRATIFICATION OF THE OCEAN SURFACE MIXED LAYER BY FRONTAL INSTABILITIES

The ocean surface mixed layer is regularly remixed by small-scale, turbulent convective and dynamical processes that slump horizontal density gradients. Subsequent mixing events depend critically on the amount of restratification that has occurred. Processes as deep convection, mesoscale water formation, phytoplankton biology, and air-sea chemical and heat exchange are thus sensitive to restratification. The paradigm of dynamical restratification is the slumping of lateral buoyancy gradients through surface frontogenesis in regions of confluent flow. In this presentation we show that in the real ocean the bulk of restratification is associated with three dimensional instabilities that develop along fronts and not with the two-dimensional slumping associated with frontogenesis. We present scaling laws and a parameterization scheme for the rate of restratification by frontal instabilities. The scalings laws are applied to the real ocean to show that frontal instabilities are a leading order effect in the mixed layer heat budget and in the exchange of nutrients between the surface ocean and the thermocline.

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LONG-TERM TEMPERATURE OBSERVATIONS PROVIDE USEFUL INSIGHTS INTO THE ACTIVITY OF MUD VOLCANOES

Submarine mud volcanoes have been discovered all over the world and are known to emit large amounts of methane into the water column. However, estimates of emissions have been based on individual observations during research cruises and neglect any temporal variability. The time scale associated with conduction and convection, long-term temperature observations yield important information about the dynamics of mud volcano activity on time scales in the order of months or years. A successful deployment of a temperature logger on Hakon Mosby mud volcano on the SW Barents Sea slope for a period of nine months documented an eruptive event associated with rapid temperature changes in the sediments that point to highly dynamic seepage and complex flow patterns. Preliminary results from an on-going temperature observation on Dvurechenski mud volcano in the Black Sea seem to be strongly influenced by gas hydrate formation in the near-surface sediments. Based on these experiences, further long-term observations of in-situ sediment temperature, pore pressure, and geochemical porewater composition at mud volcanoes are planned.

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AN OBSERVED SUMMER TIME HEAT BUDGET ON THE INNER CONTINENTAL SHELF OFF THE NORTHEASTERN UNITED STATES

The transport of heat over the inner continental shelf (12-m water depth) is investigated using observations of water velocity and temperature, surface gravity waves, and heat flux between the ocean and atmosphere to calculate terms in a depth-integrated heat budget off Massachusetts during summer 2003. Heat transport due to surface gravity waves (Stokes’ drift) is included and is substantial. On time scales of weeks to months, the inner shelf is persistently cooled by a mean upwelling circulation combined with very weak surface heat stratification. The cross-shelf heat flux nearly balances the strong surface heating throughout mid-summer, so the water temperature is almost constant. The along-shelf heat flux divergence is apparently small. The cross-shelf heat flux agrees with a simple model in which the cross-shelf velocity profile, including the Stokes’ drift, is a steady, upwelling circulation. On time scales longer than the flushing time for the volume (a few days) the temperature profile is forced by the surface heat flux to adjust so that the slowly-varying surface heating and cross-shelf advection balance, and the inner shelf heat content is in a quasi-steady state.

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CDOM DYNAMICS IN THE GLOBAL OCEAN: WHAT WE LEARN FROM DEcadAL TIME-SERIES OF SATELLITE-DERIVED CDOM ABSORPTION COEFFICIENTS

A thorough knowledge of surface CDOM dynamics in the ocean is fundamental to our understanding of organic carbon cycling and the biogeochemical effects of UV radiation in the ocean. Here, we implement an updated version of the SeaUV algorithm (Ficht et al., Remote Sensing of Environment, 2007) to ten years of monthly-binned SeaWiFS ocean color data (1997-2007) in order to examine the time-series of CDOM absorption coefficient at 320nm, a (320), and investigate the global scale dynamics of CDOM in the surface ocean. Time-series analyses and signal decompositions performed on a per pixel basis revealed that the world’s ocean exhibits distinct patterns of CDOM variability and year-to-year predictability. The analysis also revealed downward trends in a (320) of up to 30% in two areas of the Pacific ocean. We further examine these observed CDOM regimes with regards to their regulating processes using climatological data for the mixed layer depth (NMLD), UV incident irradiance and remotely-sensed SST, UV penetration, as well as other oceanographic data.

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MODELING ECOLOGICAL COMPLEXITY IN THE COASTAL GULF OF ALASKA: FROM NPZD TO NEMURO

Ecosystem complexity in the northwestern coastal Gulf of Alaska (CGOA) is investigated by coupling two lower trophic level ecosystem models, with explicit iron limitation on nutrient uptake, to a three-dimensional coastal ocean circulation model. The first
ecosystem model is a simple 4-component NPZD model, while the second is the more complex 31-component NEMURO model, with multiple limiting nutrients. 3D nutrient transport, phytoplankton/bacterial, and zooplankton sizes and interactions are included. Iron limitation is included in both the ecosystem models by adding governing equations for micro-nutrient compartments representing dissolved iron and phytoplankton-associated iron. Simulated nitrate and chlorophyll concentrations with the NPZD model exhibit striking similarities with available remotely-sensed and in situ observations. In addition to reproducing the seasonal variability in a “climatological” sense over a 10-year period, the coupled model provides important information on the different modes of variability affecting the physical and biological variables as a function of cross-shelf position. The added ecosystem complexity present in NEMURO significantly improves the prediction of the vertical chlorophyll profiles on the shelf, and yields useful insight on the seasonal variability in phytoplankton and zooplankton community structure in the CGOA.

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**CHRONIC TURBIDITY ON THE MOLOKAI FRINGING CORAL REEF: GOATS, SUGAR, AND WATERSHED CHANGE**

Major changes to south Molokai (Hawaii) watersheds, principally from agriculture and forest logging, have dramatically altered the physical character and overall hydrology of the adjacent coral reef. The increased sediment discharge poses a significant impediment to reef health by blocking light and inhibiting photosynthesis, directly smothering and abrading coral, and triggering increases in the growth of macro algae. Our studies on a 10-km segment of the fringing reef show that high levels of suspended sediment are chronic. Measurements of turbidity, suspended sediment concentration (SSC) and sediment composition were made in 2005 and 2007 during spring tides on the 800-m wide reef flat. SSC values during typical high-tide and trade-wind conditions were 10 to 60 mg/L (roughly 8 to 50 NTU's) within 250 m of the shoreline and 5 to 10 mg/L farther seaward; the mud is 65 to 95 % terrigenous in origin. Removal of particles by weak off-reef flow is a long-term process, resulting in particle residence times of years. As a result of watershed modification and sediment retention on the reef flat, coral cover is low to absent.

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**NATURAL GEOLOGICAL RESPONSES TO ANTHROPOGENIC ALTERATIONS OF THE NAPLES BAY ESTUARINE SYSTEM**

The Naples Bay Estuary System (NRES), situated in southwest Florida, has undergone extensive modifications caused directly and indirectly by anthropogenic influences. These alterations include the substitution of mangrove-forested shorelines with concrete bulkheads, channelization of the shoreline and within the watershed, and channelization of the bay for recreational boating. The NRES consists of northern Naples Bay, southern Naples Bay, and Dollar Bay, whose shorelines are fully bulkheaded, partially bulkheaded, and natural, respectively. This project investigates the natural geological response of the bay for recreational boating. The NBES consists of northern Naples Bay, southern Naples Bay, and Dollar Bay, whose shorelines are fully bulkheaded, partially bulkheaded, and natural, respectively. This project investigates the natural geological response of the bay for recreational boating. This project investigates the natural geological response of the bay for recreational boating. This project investigates the natural geological response of the bay for recreational boating. This project investigates the natural geological response of the bay for recreational boating.

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**DIURNAL VARIABILITY IN SEA SURFACE TEMPERATURE DERIVED FROM GEOSTATIONARY SATELLITE OBSERVATIONS: SEASONAL PATTERNS AND DEPENDENCE ON WIND SPEED AND INSOLATION**

During the day, the upper few meters of the ocean are heated by short-wave solar radiation, partially offset by net outgoing long-wave radiation and sensitive and latent heat fluxes. During the night, the surface layer cools due to these outgoing fluxes. This daily heating and cooling gives a diurnal cycle in the sea-surface temperature (SST). The typical amplitude of the diurnal variability of SST ranges from 0.1 to 4 K, depending on wind strength and resolution. We use the SSTs derived from the Spinning Enhanced Visible and Infrared Imager (SEVIRI) radiance observations to characterize diurnal variability on the scale of ocean basins. We derive seasonal average maps characterizing diurnal warming in the Atlantic Ocean and Mediterranean Sea. Using the solar surface irradiance observations from SEVIRI and wind observations from a combination of microwave sensors (SSMI, TMI, QUIKSCAT, AMSR-E) we calculate the dependence of SST on these parameters and time of day, to give an empirical, statistical model of diurnal warming.

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**CONTRASTING N** fixation in the Chesapeake Bay outflow plume with surrounding coastal and shelf waters

Few measurements of N2 fixation have been made in coastal regions in comparison to the measurements made in oligotrophic regions where it is an important source of new nitrogen (N). Although the coastal region can be replete with N, N2 fixation can be an important component of the N cycle. Coupling N2 fixation rates with nifH gene probing allows us to link diazotrophic assemblages with in situ N2 fixation rates. Results from nine cruises along the Virginia coast affected by the Chesapeake Bay outflow plume showed N2 fixation rates between 0 and 35 nmol N L-1 d-1. For comparison, transects were conducted off-shore and within the mid-Atlantic Bight. Although rates were high along the shelf in the fall 2006 (17.6 nmol N L-1 d-1), during summer 2006 N2 fixation rates were lower (1.1-3.7 nmol N L-1 d-1), neither rivaling those observed in the plume. Genetic diversity was measured, and although N2 fixation was highest in the plume as opposed to contrasting shelf waters, nifH sequencing only detected α- and γ- proteobacteria while cyanobacterial unicells dominated the coastal and Gulf Stream influenced stations.
ASLO/AGU/TOS/ERF

Meeting Abstracts

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A SEASONAL STUDY OF ð¹³C(DIC) AND ð¹⁸O(H) IN THE BALTIC AND SKAGERRAK WATER COLUMN

The Skagerrak is influenced by water from the Baltic Sea, the North Sea, and the North Atlantic Ocean. To help understand the oxygen and carbon stable isotopic compositions of benthic foraminifera in the Skagerrak, we have collected monthly samples of ð¹³C(DIC), ð¹⁸O, temperature, salinity and nutrients from the water column at 10 stations in the Baltic and Skagerrak over a year. By sampling at different water masses, and by documenting the influences of water exchanges, stagnation periods, and productivity on ð¹³C(DIC) and ð¹⁸O(H) we hope to quantify the full range of oxygen and carbon isotopic relationships in this region, and to provide a foundation for paleoceanographic reconstructions using foraminiferal oxygen and carbon isotopic composition. The Baltic is dominated by large freshwater inputs and strong stratification at conditions prevail over large areas. The ð¹³C(DIC) values in the Baltic range between -7 and -4‰, the ð¹⁸O(H) between -5 and 1‰. In the Skagerrak oxygen isotopes vary between -0.4 and 0.4‰ and carbon isotopes between 0.6 and 1.8‰ depending on water mass and time of the year.

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BEYOND THE DWBC, NADW PATHWAYS

High chlorofluorocarbon (CFC) concentrations have been repeatedly observed in the interior of the deep western North Atlantic Basin. They imply substantial input has been diverted over time from the Deep Western Boundary Current (DWBC) into the interior. The low values of the Atlantic MOC is usually viewed as a consistently western intensified current, which transfers water and properties smoothly through the subtropics into the Southern Hemisphere. However, the CFCs and other studies suggest that this pathway is not smooth, and it is not the only pathway. As compared with what would be based only on DWBC advection we present other likely interior pathways, which slow transport of NADW through the subtropics while ventilating the interior. Interior pathways result on DWBC advection we present other likely interior pathways, which slow transport of NADW through the subtropics while ventilating the interior. Interior pathways result.

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MEGA COASTAL MORPHODYNAMIC FEATURES ON THE FLORIDA ATLANTIC CONTINENTAL SHELF: SHOREFACE TO UPPER FLORIDA- HATTERAS SLOPE FROM MIAMI TO JACKSONVILLE

Until recently, the range of morphodynamic features lying above the Florida-Hatteras Slope on the continental shelf along the east coast of Florida was relatively unknown. Mapping of mega- and mesoscale seafloor features from Miami to Jacksonville, a shelf area of about 20,500 km-2 extending up to 27 km offshore, was based on interpretation of airborne Laser Bathymetry (ALB), reclassified NOAA bathymetry, sidescan sonar, and seismic reflection profiling. Megascalar features include coralline-algal reef systems, drowned karst, hardgrounds, submerged paleo shorelines (drowned beach ridge plains), and buried paleo channels. Megascale features include inter-reefal sand troughs in the ETF, ebb-tidal deltas, transverse bars, shoals, sand waves, ridges, and banks. Morphodynamic units on the southern shelf are separated from morphosedimentary units on the northern shelf by the Bahamas Fracture Zone (BFF). Sedimentary deposits occur in two submarine physiographic provinces that are separated by the BFF. Use of ALB and reformatted NOAA bathymetry in the form of 3D terrain models permits classification of submarine landform topologies that was not previously possible using isobaths

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PUMPING RATES OF THE GIANT BARREL SPONGE XESTOSPONGIA MUTA ON CARIBBEAN REEFS: SCALE SIZING, ENVIRONMENTAL CONTROLS, AND BLEACHING EFFECTS

The ability of sponges to remove DOM and POM from the water column contributes to the cycling of carbon and nutrients between the water column and the benthos. Given the filtering potential of a diverse and dominant sponge fauna, analysis of DOC cycling on coral reefs requires mechanistic understanding of sponge filtration rates. The giant barrel sponge, Xestospongia muta, comprises up to 60% of sponge biomass on Caribbean reefs with a size filtering potential of a diverse and dominant sponge fauna, analysis of OM cycling on coral reefs is needed. During volumetric pumping rates scaled linearly with tissue volume and ranged 40 ml-H-O h-1 ml-tissue. Pumping rates were constant over periods up to 24 h, although some specimens decreased pumping during rapid fluctuations in water temperature. Cyclic (non-fatal) bleaching did not affect filtration rates.

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IDENTIFYING AND CHARACTERIZING POLLUTED SURFACE WATERS IN THE SOUTHERN CALIFORNIA BIGHT BASED ON METAL LEVELS IN KELP (M. PROPELLOSA) SEEVE TUBE SAP

Metal concentrations in kelp tube sap (STS) may be useful in determining the dispersal of coastal effluent plumes. Common trace metals average a 100-fold increase in concentration in STS as compared to their total concentration in seawater. In this study, concentrations of 19 different metals were measured in STS using ICP-MS. STS was collected from Macrocyathus pyrifera fronds obtained from several coastal southern California locations, including a presumed “non-polluted” reference site on the seaward side of Catalina Island. Results indicate the presence of 8 new elements not formerly identified within Macrocystis STS including, Rh, Pd, Ag, Sn, and Cs. Several metals (e.g. Cu, Zn, Pb) were found at significantly higher levels within STS collected from populations inside the Port of Los Angeles/ Long Beach in comparison to Catalina Island. Also, significant differences in levels of other metals (e.g. Fe, As, Ag, Cd) were found between populations within and outside the harbor breakwall. These results indicate the potential usefulness of this method in spatially describing metal pollution arising from coastal sources.

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PACIFIC SUBTHERMAL EQUILATORIAL CURRENTS: A DEEPER CLIMATOLOGY FROM NEW SHIPBOARD ADCP

Because of its temporal variability and complex structure in all three spatial dimensions, the Pacific equatorial subthermocline circulation remains to be described fully. During the last four years, more than 50 velocity sections have been collected within 8 degrees
of the equation using new shipboard acoustic Doppler current profilers that reach 750-m depth or more, the range commonly available with the prior generation of instruments. Averaged by longitude, the new measurements show the Equatorial Intermediate Current (EIC) and the Lower EIC weakening from west to east. The average of western Pacific sections shows the Secondary Southern Subsurface Countercurrent from 5-6 degrees S with speeds exceeding 0.1 m/s extending from 280-670 m depth. It is similar in location but weaker in the central Pacific. Although eastward jets tend to have higher speeds, consistent and vertically extensive regions of westward flow such as the South EIC are also prominent in the mean sections as well as in synoptic sections.

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FROM DEEP OCEAN SEDIMENTS TO GLACIAL LAKES: BACKTRACKING EVIDENCE FOR LATE PLEISTOCENE/EARLY HOLOCENE JÅ–KULHAUS USING CORES FROM ODP LEGS 169 AND 169S

ODP Legs 169 and 169S recovered remarkable turbidite deposits. Their sources were traced by shipboard researchers using a multiproxy approach of sedimentary petrology, radiometric age dating, paleoecology, and paleomagnetism to catastrophic late Pleistocene/early Holocene deglacial flooding events (jâkulaus) in the Pacific northwest. Teachers participating in the 2007 SOI School of Rock (SOR) professional development program described and interpreted the Leg 169 and 169S cores, without prior knowledge of the deglacial flood interpretation, following the SOR pedagogical approach of data and discovery, first, and discussion and interpretation second. Themes such as size sorting, mineral provenance, and benthic foramin fossil ecowraps were drawn out in group discussions, and were supported by data available in Ocean Drilling Program-related publications and database. The teachers also linked the science to popular culture by connecting what they observed in the cores with the movie Ice Age 2 which depicts a jâkulaus event in a cartoon format. This exercise demonstrated to teachers the importance of marine deposits in studies of environmental change on land and that rates of environmental change are sometimes very rapid.

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REMOTE SENSING DETECTION OF RED TIDES IN A COASTAL UPWELLING SYSTEM 

The spectral reflectance of dense “red tide” blooms shows a peak in the NIR portion of the electromagnetic spectrum, at wavelengths 20 nm longer than that of the chlorophyll fluorescence peak. This signal has been used as a basis for mapping extreme surface blooms with remote sensing image data. Linear baseline algorithms measure the height of a spectral peak above a baseline determined from reflectance intensity at two wavelengths on either side of the peak. Variation in the wavelength center of the reflectance peak presents a challenge for consistent measurement of bloom intensity across different multispectral sensors, which have different band centers and widths across the NIR portions of the spectrum. Referring to situ hyperspectral reflectance measurements, we present examples from different satellite and airborne sensors used to measure bloom intensity in Monterey Bay, California. We discuss inconsistencies between measurements made across different sensors, and provide examples of how these results have described red tide bloom dynamics in the region.

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THE STATE OF THE OCEAN CLIMATE: CLIMATE INDICES AND THEIR UNCERTAINTY AS A MEASURE OF OUR ABILITY TO OBSERVE THE OCEAN

The ‘State of the Ocean climate’ web site gives a rapid overview of ocean climate indices. This site has been developed by the Ocean Observations Institute, USA, www.oceanobs.org (2008). The site is a collaborative project, with contributions from the National Oceanic and Atmospheric Administration, the University of Delaware, National Aeronautics and Space Administration, the National Ocean Survey, and the National Geophysical Research Institute. The State of the Ocean Climate site provides a web interface for accessing the Ocean Observations Information System (OIS) data. The OIS provides a comprehensive collection of oceanographic data from the ocean surface to the ocean floor.

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OVERVIEW OF THE COMMUNITIES ASSOCIATED WITH OIL, GAS, AND BRINE SEEPAGE, AND ASSOCIATED HARD GROUNDS IN THE DEEP GULF OF MEXICO

Hydrocarbon and brine seepage driven by salt tectonics is widespread on the continental slope of the Gulf of Mexico. Production of massive carbonates and hard grounds on the sea floor is a common byproduct of the activities of microbial consortia in areas of active methane seepage. In 2006 and 2007, 15 cold-seep/hard-ground sites at depths between 1000 and 2,850 meters and distributed over a 620-km E-W span were sampled using Alvin and/or Jason II. Of these, 10 had not previously been visited and were initially identified from a combination of geophysical and geochemical data collected from satellite observations and surface operations. Chemosynthetic fauna, including species harboring chemoautotrophic symbionts, were found at every site visited and several exceptional communities were encountered. These included a very extensive and dense aggregation of seep sponges (covering approximately 8,000 m2), numerous areas in the deepest sites where some of the most reduced sediments we encountered were occupied by the aggregation of large coraline crustose red algae, and aggregations of large sponges, tunicates, and rugose corals.

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MODERN AND HISTORIC MERCURY DEPOSITION: INSIGHTS FROM DATED LAKE SEDIMENTS AND A VARIED ESTUARINE CORE

The geochemical cycling of Hg and assessing impact associated with human-related Hg emissions on its natural cycle. Dated lake sediments have been the primary source of secular data for reconstructing Hg accumulation / depositional patterns associated with preindustrial to the modern era. These lacustrine natural archives are particularly well suited for examining the global/regional nature of atmospheric Hg dispersion, deposition, and anthropogenic interferences. Here we present an evaluation of the impact of Hg contamination on calanoid copepods could not be explained by either UV or foodweb effects alone.

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EVIDENCE FOR LATE PLEISTOCENE/EARLY HOLOCENE JÖKULHAUPS USING MODERN AND HISTORIC MERCURY DEPOSITION: INSIGHTS FROM DATED LAKE SEDIMENTS AND A VARIED ESTUARINE CORE

Contemporary and historical Hg depositional information is important for understanding the biogeochemical cycling of Hg and assessing impact associated with human-related Hg emissions on its natural cycle. Dated lake sediments have been the primary source of secular data for reconstructing Hg accumulation / depositional patterns associated with preindustrial to the modern era. These lacustrine natural archives are particularly well suited for examining the global/regional nature of atmospheric Hg dispersion, deposition, and anthropogenic interferences. Here we present an evaluation of the impact of Hg on local to global scales. The accumulation ratio or “anthropic global increase,” relative to preindustrial levels, is remarkably uniform at 3 ±1 based on 182 cores and 90 lakes from remote locations. Localized enhancements are evident in urban areas.

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Contemporary and historical Hg depositional information is important for understanding the biogeochemical cycling of Hg and assessing impact associated with human-related Hg emissions on its natural cycle. Dated lake sediments have been the primary source of secular data for reconstructing Hg accumulation / depositional patterns associated with preindustrial to the modern era. These lacustrine natural archives are particularly well suited for examining the global/regional nature of atmospheric Hg dispersion, deposition, and anthropogenic interferences. Here we present an evaluation of the impact of Hg on local to global scales. The accumulation ratio or “anthropic global increase,” relative to preindustrial levels, is remarkably uniform at 3 ±1 based on 182 cores and 90 lakes from remote locations. Localized enhancements are evident in urban areas.
Hollander, D. Frisian Island chain. This observation could be used for the establishment of a water circulation in between the normal behavior. The dominant semidiurnal tide is totally balanced by wind and pressure estimated up to 50,000 m³. The current field during the storm is characterized by an ab storm conditions was a moot oceanographic question, approached by X-band observation. Ziemer, F. Oceanic islands with high topography drastically affect both atmospheric and oceanic flows. Sharp horizontal wind shear lines form on the edges of the island wake, resulting in rapid variations of wind stress and Ekman transport in the ocean, strong Ekman pumping, and mixed layers. Lumpkin, C. Atmospheric and oceanic flows associated with mountainous islands: Hawaii. Oceanic islands with high topography drastically affect both atmospheric and oceanic flows. Sharp horizontal wind shear lines form on the edges of the island wake, resulting in rapid variations of wind stress and Ekman transport in the ocean, strong Ekman pumping, and mixed layers. Schwartze, G. Potential for benthic primary production on Ship Shoal, Louisiana, USA. As a shallow (5-14 m) sandbank, Ship Shoal may support benthic microbial populations that are rare or absent in the phytoplankton-based benthos of deeper waters. To assess the potential for benthic production on Ship Shoal, we took samples for sediment and water column chlorophyll a (Chl a), light levels, and sediment algal composition during cruises in 2005 and 2006. The percent of surface light reaching the bottom was greater than 5% at most stations during spring 2006 and greater than 20% at most stations during the summer. Overall, sedimentary algal biomass was highest in August (33.5 ± 37.8 mg/m²) and May (42.4 ± 26.3 mg/m²) in 2005 and 2006, respectively, and was greater at the shallower western and central stations. Benthic chlorophyll a values were equal to or exceeded integrated water column values much of the year, and cell counts suggested that sedimentary algae typically contained less than 10% settled phytoplankton. Our results suggest that benthic microalgae are an important carbon source to the benthic food web on Ship Shoal. Flocks, J. Influence of antecedent geology on barrier island development: Northern Chandeleur Islands, Louisiana. A dense network of high-resolution seismic profiles collected around the northern Chandeleur Islands reveals three seismic facies that dominate the shallow (<100 m) stratigraphy. The first is an acoustically transparent lens-shaped unit with discontinuous reflectors, interpreted as distributary channel deposits associated with the St. Bernard complex of the Mississippi Delta. Stratigraphically adjacent to the first is a unit defined by low-angle parallel reflectors, interpreted to represent fine-grained interdistributary deposits. These two units underlie a seaward-thinning acoustically transparent unit, interpreted to represent fine-grained interdistributary deposits.
SUPPORT THE STEWARDSHIP OF LIVING MARINE RESOURCES

BENTHIC COMMUNITIES, ACOUSTIC BACKSCATTER AND ECOLOGICAL OBSERVATIONS

High-resolution bathymetric and backscatter studies in coastal and estuarine waters near NY are demonstrating that benthic communities and sea-floor acoustic properties, especially backscatter, are closely related. Areas are surveyed with high-resolution multibeam bathymetry and backscatter along with side-scan sonar, and sediments with a range of backscatter characteristics are sampled for sediment properties and for benthic organisms. These studies reveal complex but resolvable patterns in both benthic community structure and bottom sediment characteristics, and statistical analysis shows that benthic communities are highly correlated with acoustic backscatter. We have also observed temporal and spatial variability in acoustic backscatter related to temporal changes in the abundance of the polychaete Axinellidae also called on the inner shelf. This suggests that high-frequency acoustic backscatter may be a useful tool for assessing temporal and spatial changes in benthic communities. Indeed, changes in backscatter could occur if an anoxic event alters benthic communities or if an invasive species such as the tunicate Didemnum covers the bottom. Studies of temporal and spatial variability in acoustic backscatter patterns may be an important component of ecosystems-based management and of the ecological observing systems envisioned for the Integrated Ocean Observing System (IOOS).

Resource managers and researchers interested in obtaining information concerning the marine environment must often navigate and land-use changes and continued population growth threaten to affect community composition and functioning of numerous diverse habitats. My research investigates the connectivity across the land-sea interface and how the inputs from the land affect nearshore marine communities. Community dynamics in nearshore habitats may be significantly influenced by the delivery of dissolved and particulate fluxes from river sources. Effects from rivers can be especially important in short, steep watersheds where little filters the ocean. In two watersheds along the Big Sur coast in central California, I am investigating the role of terrestrial subsidies in nearshore communities by documenting the amount and types of subsidies being delivered, the impact on community composition, and how these subsidies affect habitat function. Data suggest these nearly pristine rivers are important sources of nutrients and particulates during non-upwelling conditions and may contribute to the functioning of this diverse nearshore community.

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DEEP-OCEAN PARTICULATE-MATTER DYNAMICS AS INFLUENCED BY THE ANAXIMENES SEAMOUNT: A WEAK-TIDE ENVIRONMENT

In many parts of the world ocean abyssal hills and seamounts structure the seafloor on spatial scales of thousands of kilometers to tens of kilometers. The mere presence of the topographic features together with flow/topography interactions adds heterogeneity and complexity to the environment. Despite their very likely importance little is known on how these topographic features control the formation of the sedimentary record and ecosystem structure and dynamics. The most important kilometre-scale flow/topography interactions involve residual flow and tides. To help separate the influence of residual flow and tides at topographic features in the open ocean we sampled half a tidal neap-spring cycle at the Anaximenes Seamount in the Eastern Mediterranean which is a deep sea environment with very weak tides. Any signals in the particle-matter parameters analyzed should therefore mainly result from the residual flow. Water samples were taken with a CTD-rosette every 10 m above bottom for the first 50 m and every 100 m above bottom for the second 50 m respectively. Here we present the first data from this experiment judging it the short-lived natural particle-matter tracer 234 Thorium and particulate carbon and nitrogen.

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OBSERVATIONS

BENTHIC COMMUNITIES, ACOUSTIC BACKSCATTER AND ECOLOGICAL OBSERVATIONS

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DELIVERY AND APPLICATION OF OCEANOGRAPHIC SATELLITE DATA TO SUPPORT THE STEWARDSHIP OF LIVING MARINE RESOURCES

FROM RIVERS TO KELP FORESTS IN BIG SUR, CALIFORNIA

Understanding the connections between traditionally disparate systems has recently become an important area of study across disciplines. These studies are especially important in coastal areas where land-use changes and continued population growth threaten to affect community composition and functioning of numerous diverse habitats. My research investigates the connectivity across the land-sea interface and how the inputs from the land affect nearshore marine communities. Community dynamics in nearshore habitats may be significantly influenced by the delivery of dissolved and particulate fluxes from river sources. Effects from rivers can be especially important in short, steep watersheds where little filters the ocean. In two watersheds along the Big Sur coast in central California, I am investigating the role of terrestrial subsidies in nearshore communities by documenting the amount and types of subsidies being delivered, the impact on community composition, and how these subsidies affect habitat function. Data suggest these nearly pristine rivers are important sources of nutrients and particulates during non-upwelling conditions and may contribute to the functioning of this diverse nearshore community.

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Surface concentrations and vertical fluxes of particulate organic carbon (POC) were assessed in Amundsen Gulf (AG) (Canadian Beaufort Sea, Arctic Ocean) from 2004 to 2006 by combining remote sensing and moored sediment trap measurements. Each year between June and September, distinct periods of increased surface POC concentrations (200–500 mg C m⁻³) were observed in southwestern AG. Concentrations distant from this area remained relatively low (<100 mg C m⁻³), suggesting that enhanced POC production on the surface was restrained to a small vicinity. The magnitude and extent of vertical POC fluxes generally followed the spatial and temporal variability of surface POC concentrations. Daily POC fluxes at 100 m depth were recurrently higher in western AG compared to southwestern AG. POC concentrations. Daily POC fluxes at 100 m depth were recurrently higher in western AG compared to southwestern AG. POC at 200 m depth fluctuated however similarly in both regions of AG throughout the three-year study period (1–30 mg C m⁻² d⁻¹). In addition to increased POC production in western AG, we proposed enhanced grazing pressure at the west (i.e. close to the superior food supply) and eastward advection of particles at intermediate depths to explain the variability of vertical POC fluxes in AG.

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QUANTITATIVE AND DYNAMICAL ANALYSIS OF THE EDW VOLUME CYCLE USING AN OBSERVATION-MODEL SYNTHESIS.

The formation of North Atlantic Eighteen Degree Water (EDW) is analyzed using observations and the MIT General Circulation Model (GCM). We focus on the past several years during which there was unprecedented data coverage, including Argo profiles, moored SST, and observations from the CLIMODE project. Employing the (ECCO) adjoint modeling framework, observations are interpolated under GCM dynamics constraints leading to a quantitative and dynamical analysis of observed EDW signals. In the region of EDW formation, the constrained model solution faithfully represents the observed evolution of subsurface chlorophyll and surface outcrops. To realize the EDW volumetric census into perspective and discuss the formation and mixing processes at work, a volume budget of the EDW layer is computed (following Wain, 1982). EDW volume increases dramatically in February and March (35v-year), primarily due to convection triggered by air-sea heat loss south of the Gulf Stream (35v-year). EDW volume decreases in March and April due to air-sea heat gain and mixing during restratification (35v-year). Further EDW volume reduction occurs throughout the year due to internal oceanic processes (65v-year).

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MORPHODYNAMIC HISTORY OF LONGBAY PASS, MANATEE COUNTY, FLORIDA

A study of evolutionary sequences of morphoedaphic features at Longboat Pass, central-west coast of Florida, was initiated to acquire a better understanding of sediment exchange between the ebb-tidal delta, tidal inlet, and adjacent downdrift segments of shoreline. Twenty sequential aerial photographs (1940-2006) were interpreted in a time-series analysis for changes in the position and morphology of the tidal channel and ebb shoal and the response of adjacent beaches to these changes. Little variation in inlet position (migrated within a 250 ft swath) and ebb tidal shoal area (1.22 km² to 1.68 km²) indicate that the Longboat Pass ebb shoal complex has been relatively stable over the 66 year period between 1940 and 2006. Although the area of the ebb-shoal has not significantly changed, the shape of the ebb shoal was deflected downdrift (southwards) 0.79 km. The inlet is classified as morphodynamically stable and the shoal is classified as a “Group 2” type of ebb-tidal delta.

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BIOGRAPHY AND BIOGEOGRAPHY OF BRYOZOA IN COOK INLET, GULF OF ALASKA

Archived samples and specimens collected during intertidal and subtidal surveys in Cook Inlet were used to re-evaluate identifications and to review their geographic distribution, especially to look for similarities between species collected in western Cook Inlet and the parent stocks of Arctic-Boreal species. Specimens of Bryozoa were re-examined as part of an evaluation of disjunct Arctic fauna in Cook Inlet. Forty-six specimens of Bryozoa, collected by Dennis Lee, as part of intertidal and nearshore surveys, were considered. Of the Bryozoa first reported, twenty species were re-identified, and 33 additional species were added to the list. Fifty-four species, including 4 Cyclostomatida, 7 Cladocelida, and 43 Cheilostomatida, were identified from these samples. Thirty-four species have a Boreal-Arctic distribution, found in the seas surrounding the Arctic Ocean.
Nineteen species have a lower latitude Pacific Boreal distribution. Species from the western and northern Boreal, Cook Inlet have a distinct Arctic -Boreal affiliation, and differ distinctly from those on the east side of the inlet.

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INFLUENCE OF THE CONGO AND NIGER RIVER PLUMES ON DISTRIBUTIONS OF FREE-LIVING AND SYMBIONT CYANOBACTERIA

The abundance of 4 diazotrophic populations was examined using a nifH gene quantita- tive polymerase chain reaction (QPCR) method. Samples were collected in the eastern equatorial Atlantic (EEA) during Summer 2007. Richelia associated with Hemiaulius hauckii diatoms was detected in all surface samples and highest abundances (>10^4 nifH copies L^-1) were found NW of the Congo River (CR) plume near the Niger River (NR).

In contrast, the Calothrix symbiont (het-3) of Chaetoceros had low abundances in the surface, but were 3.710^4 nifH copies L^-1 at 40m, in the Equatorial upwelling. This is the first report of the Calothrix symbiont in the Atlantic Ocean. Richelia associated with Rhizosolenia (het-1) were found in the Congo River plume and in the Equatorial upwelling. The highest densities of Trichodesmium spp. (>10^5 nifH copies L^-1) were found further east (>1500 km) of the CR influence. Thus the distribution of these various diazo- trophs, especially the 3 strains of symbiotic cyanobacteria were different, and appeared largely controlled by riverine inputs and upwelling.

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PARAMETERIZATION OF SUBMESOSCALE EDDIES: IMPLEMENTATION AND TESTING

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The spring and summer microplankton communities in the coastal waters off Washington are strongly affected by the presence of floating invasive vegetation. The heat budget of the system is largely controlled by riverine inputs and upwelling.

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VARIBLITY AND TRENDS IN OCEANIC OXYGEN: DETECTION AND ATTEIBUTION USING A COUPLED CARBON CYCLE - CLIMATE MODEL ENSEMBLE

Recent studies have reported substantial variations in oceanic oxygen over the last decades. Yet, the causes of these variations, natural or anthropogenic in origin, remain unresolved. We investigate oceanic oxygen variations along different sections in the North Atlantic and the North Pacific using a six-member ensemble from the NCM CSM1.4 carbon. We focus on the magnitude of natural variability in oxygen and its impact on the detection and attribution of seasonal to decadal-scale oxygen changes. Simulations including natural and anthropogenic radiative forcing result in a good representation of the mean present-day climate. The simulated oxygen inventory decreases with global warming mainly in the Pacific and Indian Ocean at shallow depth, and in the Atlantic at intermediate depth. Volcanic eruptions cause short-term cooling of the upper ocean and considerable increase in oxygen in the upper 500m. Simulated decadal variability compares well with recently observed changes in the North Atlantic, but the model appears to underestimate variability in the North Pacific. These observed changes in oxygen along the transects appear to rather be the result of natural internal variability than represent- ing long-term changes associated with climate change. Considerable natural variability in oxygen masks some of the simulated long term trends that are emerging in the 21st century projections, therefore complicating the detection of anthropogenic climate change using oceanic oxygen.

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THE ROLE OF FRESHWATER ADVECTION, SUBPOLAR CIRCULATION AND ICE IN SPRING PHYTOPLANKTON BLOOMS IN THE LABRADOR SEA

The physical circulation exerts strong control on biological productivity. Across the high- temperate Atlantic, the seasonal cycle of phytoplankton is dominated by a rapid increase in productivity, the spring bloom. It results from the interplay between nutrients, light, mixing and grazing. However, light availability is not simply surface irradiance, but light per organism per day, which depends on stratification and ice cover. Climate impacts like warming and increased runoff affect the bloom, and through it, higher trophic levels. We investigate the variability in the Labrador Sea spring bloom using SeaWiFS chlorophyll-a, Seaglider data, sea surface height altimetry and ARGO data. Four distinct regions of pro- ductivity arise: (1) the central Labrador Sea, blooming late and weak, post deep convec- tion, (2) the West Greenland Current extension, blooming early and most intensely, due to offshore propagation of low salinity water and eddies, (3) the Hudson Bay outflow, with high annual productivity due to a source of nutrients and stratification, and (4) the Baffin Island Current, stratified by cold, fresh Arctic waters, but ice-covered for most of the year. With Sudervis's critical depth, we separate the effects of boundary current strength and other external processes on the bloom's interannual variability. The Labrador Sea bloom is contrasted with the Gulf of Maine and its relation withretreating ice-edges and topo- graphically bound surface fronts.

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MODELING DOLLISHED OXYGEN IN A TIDAL FRESHWATER EMBAYMENT OF INVADE FLOATING VEGETATION WITH A HEAT BUDGET

We modeled the impact of the floating leaved plant, Trapa natans, on oxygen (DO) levels and biogeochemical cycles within a vegetated embayment and, through tidal exchange, the entire river ecosystem. Trapa reduced DO levels because oxygen production occurred primarily in the floating leaves whereas respiration occurred mainly subsurface in the top 1m of midsummer plant biomass, 20% of the 1.2-km wide embayment remained anoxic, while the rest received oxygenated water from the Hudson River main channel for a portion of each tidal cycle. Critical to our model was quantifying advection and dispersion of oxygen- saturated water across the embayment and net exchange between the embayment and river. We constrained the hydrodynamic components of our model with a heat budget, which was possible because the canopy shaded and thus cooled the marsh by up to 4°C. The heat budget was based on five months of continuous, high-frequency temperature and water elevation data collected throughout the embayment and air-bay heat exchange measured from a floating micrometeorological station. Met data included net radiation and eddy covariance sensible and latent heat fluxes.
study we attempt to tease out the biological factors, such as relationships between specific microorganisms and different physiographic species, which influence overall community patterns, in concert with the physical effects of the Columbia River Plume that inhibit or augment these biological interactions.

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ON THE ACCURACY OF MODIS SEA SURFACE TEMPERATURE RETRIEVALS IN UPWELLING REGIONS

The measurement of SST by satellite-based infrared radiometry is a relatively mature subject and current uncertainties in the retrievals (bias errors of <0.2K with a scatter of 0.3-0.5K) approach those that are required for climate research. However, these estimates of accuracy are specified on a global basis and result from the application of global, empirically optimized atmospheric correction algorithms. There is evidence that the accuracy of the retrievals could be markedly improved by developing such algorithms with regional and temporal optimization, especially in situations, which are known to introduce larger errors into the current retrievals. One of these areas corresponds to upwelling regions, where anomalously large air-sea temperature differences exist and larger systematic errors in the SST retrievals can be expected. In this study we investigate the accuracy in SST retrievals in upwelling areas through the rigorous ship-based validation of the ocean surface and geophysical variables. Results from coastal and oceanic upwelling are presented.

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INTEGRATION OF CURRENT-OFF-THE-SHELF (COTS) TECHNOLOGY INTO LOW COST COASTAL SENSING PLATFORMS

Real-time observation of near-shore, coastal environments has a variety of applications from science to educational outreach to environmental management. Sensors and networking capabilities have been developed, but their deployment is often hampered by the expense of the hardware, the initial installation, and the continued maintenance. We will present two novel instrument platforms with integrated telemetry and networking capabilities using readily available, low-cost components. The first platform is a swan-like data buoy designed with input from the students at the Pierce Middle School, and deployed in Turner’s Pond, Milton, Massachusetts to monitor water quality parameters in real-time. System design and analysis of environmental data were integrated into the seventh grade geometry curriculum (http://www.umb.edu/data/turndown.html). A second instrument package is a low-cost near-shore data buoy designed to monitor temperature at different depths in real-time and photysynthetically active radiation (PAR). Three such buoys were deployed in Nantucket harbor (http://www.umb.edu/data/nantucket.html) in support of an ongoing spot study by the local scallop fishermen. The data will be transmitted to a launchable platform, making XML-based web services and offered in a georeferenced graphical user interface (GUI).

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SHIFTS IN THE ABUNDANCE OF AMMONIA-OXIDIZING ARCHAEA AND BACTERIA ACROSS ESTUARINE PHYSICAL/CHEMICAL GRADIENTS

Nitrification plays a critical biogeochemical role in coastal/estuarine systems. Despite its importance and free-stressing methods, it is not well understood how and why the system changes with the physical and chemical changes of the water column. In this study we report on the relative abundance of ammonia-oxidizing bacteria (AOB) and ammonia-oxidizing archaea (AOA) in freshwater and coastal systems and across different biotopes. The results of the present study indicate that the communities of AOB and AOA differ significantly in the same location and conditions of sampling. Our results suggest that these distinct flow branches and fronts may play a significant role in the ecology of a variety of commercial species, further suggesting the use of SST as a tool for fisheries management.

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WAVE-CURRENT BOUNDARY LAYER INTERACTIONS

Wave-current bottom boundary interactions are examined using a quasi-three-dimensional non-hydrostatic numerical model, Dune. Dune resolves the Reynolds-Averaged Navier-Stokes (RANS) equations with one of several second-order closure schemes. The models are coupled with free-surface flows, and mean and low-frequency flows are prescribed at the bed. Dune’s unique structure allows for complex topography at a given angle. Dune simulations are compared to three applied engineer ing wave-current bottom boundary layer models (Grant-Madsen (1994), Soudby (1993), Styles-Glenn (2000)). Simulations are performed over both flat and rippled beds for wave-current angles ranging from 0 to 90 degrees and both free stream wave and mean velocities from 5 to 100 cm/s. The models are assessed with the non-dimensional mean bed stress, typically used to parameterize energy dissipation in circulation models, as well as the peak bed stress, used to quantify sediment transport. Dune predicts that an obliquely approaching current does not significantly impact the peak bed stress, but will affect the mean bed stress under large wave forcing. Predictions of the mean and peak bed stress by Dune and the engineering models are generally of comparable magnitude, with the exception of cases where the wave velocity is greater than the free stream velocity.

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VISION IN THE DEEP

During research cruises funded by the NOAA Ocean Exploration Program (Operation Deep-Scope 2005 and 2007), novel collecting techniques were used to collect live deep-sea benthic crustaceans. Collections were made from the HBOI Johnson-Sea-Link (JSL) submersible under red and orange illumination, making it possible to collect animals without blinding them. Shipboard measurements of spectral sensitivity and temporal resolution were made from the photoreceptors of the anomuran crabs, Gastrocythus spinifer, Eumunida picta, Munidopsis tridentata, the brachyuran crab, Bathynectes longispina, the decapod shrimp, Eugonotopus crassus, and the isopod, Booralana tricarinata. The spectral sensitivity data indicate that all of these species have blue-sensitive visual pigments, but G. spinifer also appears to possess a UV sensitive visual pigment. The temporal resolution of all these eyes is quite low, indicating that these photoreceptors have a long integration time. The temporal resolution of B. tricarinata is so low that it is unlikely that this isopod could track any moving object. Rather, its photoreceptors appear to be designed for finding bioluminescence that glows rather than flashes, such as detritus covered with bioluminescent bacteria.

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REGIONAL AND BASIN-SCALE ECOSYSTEM FLUCTUATIONS ASSOCIATED WITH THE NORTH PACIFIC GYRE OSCILLATION

The North Pacific Gyre Oscillation (NPGO) is defined as the second EOF/PC of sea-surface height anomaly. Decadal fluctuations in the NPGO are driven largely by variations in the surface wind stress. These variations control the strength and spatial patterns of upwelling and downwelling in the Northeast Pacific and beyond. Models and data from the California region show that changes in upwelling associated with the NPGO account for much of the decadal variability of nitrate and chlorophyll in the California Current eastern boundary system. Spatial and temporal variations in upwelling and nutrient fluxes exert a strong control over the size structure of the phytoplankton: higher nitrate fluxes lead to an increase in the total biomass, and an increase in the fraction of large plankton. Given the large-scale structure of the NPGO, we explore the evidence that these decadal fluctuations in upwelling and planktonic ecosystem structure in the Northeast Pacific are coherent with ecosystem fluctuations throughout the Pacific Ocean.


**Requires simultaneous measurement of physical and biological properties at high vertical resolution.**

Investigation of the relationship between thin plankton layers and their physical context is needed. Case studies featuring some of our most interesting and accomplished colleagues who are putting their Ph.D.s to work in extraordinary ways may surprise and inspire you.

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**Using Optimal Multiparameter Analysis to Assess Mixed-Layer Iron Transport in Southern Drake Passage.**

Water mass distributions in the Shackleton Fracture Zone and the Ona Basin in Drake Passage are estimated on an isopycnal surface and in the mixed layer using Optimal Multiparameter (OMP) analysis of CTD and nutrient data. The OMP method is modified to account for non-conservation in the mixed layer by using estimated air-sea fluxes. For the most stations, the adjusted method shows improvement relative to the unadjusted case. The results suggest the presence of three distinct water masses. Water from the Antarctic Circumpolar Current (ACC) predominates off the shelf west of the ridge, as well as in the northern part of the region east of the ridge. Shelf waters from near the South Shetland Islands and the Weddell Sea are confined to the shelf west of the ridge, but spread off-shore to mix with the ACC downstream from the Shackleton Gap. These shelf waters deliver sedimentary iron off-shore and appear to play an important role in the high levels of phytoplankton productivity in the Ona Basin compared to the region upstream of the basin.

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**Active Microbes in the Orinoco River Plume.**

In order to elucidate how physical/chemical gradients influence planktonic bacterial communities, a study of the Orinoco River Plume was initiated. The Orinoco plume forms an isolated surface layer with a sharp salinity gradient and high chl a signals extending thousands of kilometers into the Caribbean Basin. In October 2006, samples were collected from 12 stations at 4 depths along the plume axis and screened using ribosomal RNA genes by TRLFL. Both intact ribosomes and DNA (165 and 185) were analyzed to separate the active microbial community from the populations that were present but not growing. Initial comparison of 165 RNA fingerprints to their corresponding DNA fingerprints indicated between 58 and 70% of the population was active. Meanwhile, resident populations along the plume ranged in similarity from 56 to 61% in prokaryotes and 10 to 77% in eukaryotes. Additional effort in cloning/sequencing of samples is underway. It is hoped that by examining shifts in active microbes under dynamic conditions, our ability to understand the forces driving marine microbial diversity and how microbial community structure relates to function will be enhanced.

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**Autonomous Investigation of Thin Phytoplankton Layers and Their Physical Context.**

Investigation of the relationship between thin plankton layers and their physical context requires simultaneous measurement of physical and biological properties at high vertical resolution, over large horizontal areas, and for extended periods of time. We report here on hydrographic profiles collected in Monterey Bay during the summers of 2003-2006 using fleets of high-endurance autonomous gliders. These measurements (physical, optical, and many of the chemical highlight variables) were taken in concert with optical sensors deployed at several kilometers, and vertical scales from centimeters to a few meters. We use synoptic horizontal maps, vertical sections, and statistics derived from nearly 50,000 multivariate water column profiles to characterize the vertical structure, spatial distribution, and temporal variability of thin phytoplankton layers.

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**The North Atlantic Shelfbreak Current: An Adveective Link For Climate Variability.**

The North Atlantic shelfbreak front and jet form an extensive connected system that extends many thousands of kilometers, establishing an adveective link between the subarctic and subtropical domains. Through this pathway, the shelfbreak current transports high-latitude climate-driven variability equatorward. However, because the front acts as a barrier that inhibits cross-shelf exchange, it is not clear exactly how these signals are communicated to the interior of the Atlantic where they might have an impact on the larger climate system. Recent studies suggest that there are select geographical regions along the path of the current where mass and freshwater are lost, however little direct evidence of these pathways exists. In this study, 100 years of historical hydrographic data are used to investigate the role of the shelfbreak current in the propagation of climate signals, focusing on how and where such anomalies leave the boundary. Particular focus is placed on the current branching that occurs at the Tail of the Grand Banks of Newfoundland.

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**Phytoplankton and Zooplankton Dynamics in a Buoyant River Plume.**

Rivers flowing through urban watersheds represent a major conduit of anthropogenic nutrients and contaminants. The fate of these materials is controlled, in large part, by physical dynamics as the buoyant, riverine plume moves over the coastal shelf and also by associated chemical and biological processes. During the Lagrangian Transport and Transformation Experiment (LaTTE) of April 2005, nutrient-laden water from the Hudson River was recirculated in a nearshore eddy before propagating seaward to mix with relatively saline water along the New Jersey coast. Within the eddy, phytoplankton rapidly assimilated nutrients resulting in extremely high rates of productivity (> 10 mg C m-3 h-1), with approximately 75% of carbon fixation ultimately attributed to large chain-forming diatoms (200 microns). Analysis of the phytoplankton community indicated a change in taxonomic composition and a downward shift in the size frequency distribution as recirculated, plume water became entrained in the southward flowing coastal current. There was a disproportionate accumulation of trace metals in the smaller phytoplankton size classes. Size-specific and taxon-specific microzooplankton grazing rates highlighted specific biological interactions with consequences for metal accumulation in the food web.

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**The Fate of New Nitrogen Prior to and During a Trichocephusium Thiebaudii Bloom in the Subtropical Waters of the SW Pacific.**

It is well established that diazotrophs such as Trichodesmium species are an important source of new nitrogen to surface waters in the low latitude ocean. Evidence from stable isotopes of nitrogen suggests that the diazotrophic activity during the bloom of Trichodesmium is a major source of new nitrogen to surface waters in the low latitude ocean. Stable isotopes signatures point to the eventual conversion of a significant proportion of this new nitrogen to nitrate over longer timescales (years to decades). Although both laboratory culture and field experiments have revealed that there is considerable release of nitrogen, fixed by Trichocephusium, as dissolved forms including DON and ammonium, few studies have examined its short-term (days) fate. Here, we report the findings of two experiments, one prior to and the other during a bloom of nitrogen fixers in the subtropical LNLC waters north of New Zealand, in which the fate of diazotrophic-fixed nitrogen was tracked, using a range of approaches, through the pelagic ecosystem.

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INFLUENCE OF COASTAL WAVE FIELD DEVELOPMENT ON ATMOSPHERIC DRAG
Air-sea momentum flux data were collected at the Field Research Facility pier of the US Army Corps of Engineers located in Duck, NC. The pier extends 560 m into the New Atlantic Ocean and is an ideal platform for both atmospheric and oceanographic measurements. Two sets of momentum flux instrumentation, including sonic anemometers and humidity sensors, were mounted at different heights and locations at the end of the pier. The directional wave field was measured by a nearby pressure gauge array in 8 meters water depth. Drag coefficients are inspected to determine deviations from open ocean parameterizations. In addition, drag coefficient dependence of wind speed, stability, and coastal wave field during high wind events are investigated. Wave influences are studied by isolating individual wind-sea and swell components and correlating drag features with wave field characteristics. The primary objective of this effort is to identify the critical factors influencing coastal wind drag.

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DOES THE FALL PHYTOPLANKTON BLOOM CONTROL RECRUITMENT OF GEORGES BANK HADDOCK, MELANOGRAMMUS AEGLEFINUS, THROUGH PARENTAL CONDITION? In 2003, the Georges Bank stock of haddock experienced the largest recruitment event recorded during its assessed history. Several hypotheses have been advanced to explain recruitment variability in this much scrutinized stock including variability in the retention of eggs and larvae on Georges Bank, the timing of haddock spawning, and variability in the spring bloom, which influences larval growth and survival. Although these processes may contribute to the formation of successful year classes, none of the factors associated with these previous hypotheses provides an adequate explanation of the 2003 recruitment event. We analyzed data on the dynamics of the fall phytoplankton bloom the year prior to spawning and showed it to be highly correlated with subsequent recruitment. We suggest that the fall bloom affects recruitment through enhanced condition of adults and by increasing the quantity and quality of their reproductive output, which leads to a higher probability of survival of their offspring. Although synthetic data on the fall bloom are limited and our analyses are correlative, our purpose is to stimulate a rigorous test of this promising parental condition hypothesis.

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SATELLITE-BASED BASINWIDE ESTIMATES OF SURFACE PCO2 IN THE NORTH ATLANTIC : A METHODOLOGICAL STUDY
A high resolution coupled-ecosystem model of the North Atlantic is used to simulate VOS-line floats and the relative sensitivity of PCO2 related parameters such as SST and Chlorophyll. We examine the quality of Neural-network (Kohonen Feature Map) based basin-scale mapping of PCO2 with regard to VOS-line and float coverage, remote sensing errors and the interpolation of missing data due to clouds. For a sampling corresponding to 2005 VOS-lines and cloud patterns, the neural net can reproduce PCO2 from remotely sensed SST and Chl with a basin-wide RMS-error of 11.9 ppm for a non-clouds scenario and 14.5 ppm when climatological surface temperature and chlorophyll values are used to fill in areas covered by clouds.

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MUDRED: MULTI-DISCIPLINARY BENTHIC EXCHANGE DYNAMICS Controls on seabed erodibility and suspended particle properties are the two largest unknowns limiting accurate prediction of fine sediment transport in muddy coastal environments. These two parameters are difficult to predict in large part because biological effects fundamentally impact them over short temporal and spatial scales. The MUDRED study, funded by the NSF CoOP Program, is placing real-time observing platforms at locations of contrasting intensities of sediment transport and benthic biological activity within the York River estuary. Virginia, in order to gain insight into biological and physical controls on seabed erodibility and suspended particle properties. A combination of acoustics and video imaging of the sealed and lower water column, along with rapid-response and ground-truthing via direct sampling, are being used to identify changes in biologic activity, deposition, erosion, suspended sediment properties and bedform evolution that, in turn, trigger or otherwise indicate changes in bed erodibility. Open source numerical modeling of water column processes, erosion and deposition, and sealed evolution are being coupled to the observing effort with the goal of fundamentally advancing the predictability of fine sediment transport.

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ASSESSING THE SKILL OF MARINE BIOGEOCHEMICAL MODELS THROUGH DATA ASSIMILATION Application of biogeochemical models to the study of marine ecosystems is pervasive; yet objective quantification of these models/performance is rare. One strategy for assessing and comparing the skill of these types of models involves the implementation of the variational adjoint method of data assimilation. Using this technique, data such as chlorophyll-a, nitrate, export and primary productivity are assimilated into biogeochemical models, and key biogeochemical rate parameters, such as growth, grazing, mortality and remineralization rates, are objectively optimized. By running multiple lower trophic level models in identical 1-D physical frameworks and optimizing each to the same degree, it is possible to quantitatively assess and compare the relative skill of these various models. Here cross validation experiments are used to assess the skill of marine biogeochemical models characterized by varying levels of ecosystem complexity in multiple pelagic regimes. Emphasis is placed on identifying why certain models and model formulations are best at the fit available observations.

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DETECTION AND DISCOVERY OF CRUSTACEAN PARASITES BY 185 RNA TARGETED DENATUREN HIGH PERFORMANCE LIQUID CHROMATOGRAPHY (DHPLC)
The significance of parasitism and disease in nature is broadly recognized, however, methodological limitations have hindered the exploration of the ecological significance of parasitism in most natural environments. In this study we present the development of a new PCR-based approach for parasite detection and discovery utilizing Denaturing High Performance Liquid Chromatography (DHPLC) technology. As a model, a DHPLC assay to detect protozoan parasites of the blue crab (Callinectes sapidus) was developed. Evaluation of 76 crabs caught in Wassaw Sound Georgia (USA) indicated a 97% correspondence between parasite detection by standard PCR and DHPLC. During these studies we discovered one crab infected by a kinetoplastid parasite. Phylogenetic analysis of the parasite indicated that it is most closely related to the free-living cryptobid, Procryptobia sorokini. Kinetoplastid parasites are well-known parasites of vertebrates, but to our knowledge this is the first report of this organism in a decapod crab and of P. sorokini exhibiting a parasitic life history. The availability of novel and robust DHPLC technology, we predict, will herald a new era in the study of parasitic and trophic interactions in nature.

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THE INTERACTION BETWEEN PHYTOPLANKTON, ICE, ICE ALGAE AND KRILL (PIKA) MODELING WINTER ICE ALGAL BIOMASS IN RELATION TO SEA ICE AND PHYTOPLANKTON DYNAMICS
The role of sea ice microbial communities (SIMCO) in supporting krill energetics during their furculia/irrivalle stages is recognized. However, specific information relating SIMCO biomass with krill feeding, growth, survival and recruitment over winter seasons is lacking. We are presently evaluating the dynamic interactions between phytoplankton...
Reviewing the impact of space-time-lagged correlation in SSH anomalies from merged altimeter data, the presence of more than one satellite altimeter simultaneously in the past 15 years has been crucial. Recent studies, such as the work by Fu, L. L., have described the new ZPulse technique and gone through deployment results. The technique reduces ping number by 50% when using two frequencies, thereby decreasing the time required for deployment and reducing the potential for marine growth.

Major advantages of the Doppler principle are accuracy, low or absent calibration drift, and low or absent drift from marine growth. The technique can provide high-resolution data even in areas with low visibility, making it suitable for monitoring the dynamics of the ocean's response to external forcing. The prospects of a wide-s swath altimeter based on radar interferometry for studying the ocean variability are promising.

Understanding the spatial distribution of such planktonic size structure in the Eastern Tropical Pacific can provide insights into the potential carbon sequestration along the ORP. Observations suggest that internal ocean dynamics can convey to the Southern Ocean a perturbation induced by surface buoyancy change restricted to the Northern Hemisphere or just to the North Atlantic sector. Specifical y, while keeping the surface conditions in the Southern Hemisphere fixed, a hypothetical northern hemisphere surface warming induces the weakening of the deep AMOC that causes an increase of the ACC transport and the Southern Ocean overturning circulation. A change of the Atlantic Meridional Overturning Circulation (AMOC) on multidecadal and centennial time scales has a potential to significantly modify the intensity of the Antarctic Circumpolar Current (ACC) and the Southern Ocean overturning circulation with a substantial climate impact. In the ocean, the AMOC transports freshwater to the Southern Ocean, and its interbasin exchange and ventilation rates in the Southern Ocean therefore modify the ocean's role in climate dynamics. The result is present in both single- and two- basin configurations containing a circumpolar channel in the Southern Hemisphere, and robust to variations in vertical mixing and parameterization of mesoscale eddies.

The planktonic biomass size structure of tropical and subtropical oceans has been studied to exert significant control on the ocean's atmospheric carbon sequestering potential. Understanding the spatial distribution of such planktonic size structure in the Eastern Caribbean waters, under the influence of the Orinoco River Plume (ORP), may provide further insight on the role of the latter in carbon sequestration. Phytoplankton and zooplankton biomass, size structure and taxonomic composition were estimated in the ORP, and the results suggest that the planktonic community structure and planktonic biomass size structure are influenced by the ORP. Planktonic biomass size structure and taxonomic composition were estimated in the ORP, and the results suggest that the planktonic community structure and planktonic biomass size structure are influenced by the ORP.

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Caloosahatchee responds rapidly to hydrodynamic forcing over timescales from a tidal cycle to few weeks. Along the estuary, DO levels vary dramatically and are associated with the rapidly moving ETM. Chlorophyll concentration, a proxy for phytoplankton density, is associated with along estuary variations in hydrodynamic forcing. The data also predict the level of heavy freshwater discharges that can completely flush the ETM out of the river and introduce large pulses of suspended sediment into the adjoining San Carlos Bay.

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THE VALUE OF ADDING OPTICS TO ECOSYSTEM MODELS: A CASE STUDY
Optical processes have been incorporated into an ecosystem model for the equatorial Pacific region. The bio-optical model is able to reproduce many measured optical properties and key biogeochemical processes in the region. In order to achieve such good agreement between data and model results, however, key model parameters, for which no field measurements are available, have to be constrained. Coupling explicit optics to ecosystem models provides advantages in generating: (1) a more accurate subsurface light field—which is important for light regulation on biogeochemical processes, (2) additional constraints on model parameters that help to reduce uncertainties in ecosystem model simulations, and (3) model results which are comparable to basic remotely-sensed properties. Sensitivity analysis of the model results to optical parameters reveals a significant role played by colored dissolved organic matter through its influence on the quantity and quality of the ambient light. In addition, the coupling of biogeochemical models and optics paves the road for future assimilation of ocean color and in-situ measured optical properties into the models.

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SALINITY VARIABILITY IN THE TROPICAL AND SUBTROPICAL PACIFIC IN THE MIR MULTIVARIATE OCEAN VARIATIONAL ESTIMATION (MOVE) SYSTEM
Multivariate Ocean Variational Estimation (MOVE) System is an ocean data assimilation system developed in Meteorological Research Institute (MRI). MOVE system adopts a 3DVAR scheme for coupled Temperature-Salinity (T-S) Empirical Orthogonal Function (EOF) modes, and can therefore estimate salinity variability from temperature and satellite altimetry observations through coupled T-S variability even when there is no salinity data. This scheme appropriately reproduces the variability of the subsurface high salinity maximum in the equatorial Pacific (i.e., South Pacific Tropical Water: SPTW), although some research report that this maximum is analyzed much lower in the conventional analysis scheme in which the model salinity field is not corrected with the result of objective analysis with observation data. In the system, the amount of SPTW oscillated according to ENSO cycles. The analysis of salinity budget shows that the oscillation is caused by the change of the easterly trade wind and the equatorial upwelling. Relationships between near-surface heat content and the thickness of the barrier layer is also, clearly reproduced in MOVE System.

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MECHANISMS OF MIXED-LAYER TEMPERATURE BALANCE IN THE NINO3 AREA ON ANNUAL TO INTERANNUAL SCALES
The mixed-layer temperature (MLT) in the eastern equatorial Pacific Ocean is studied using an ocean data assimilation product for the period from 1993 to 2003. We focus on the mechanisms of the large-scale changes over the NINO3 area (150°W, 90°W, 5°S-5°N). We especially elucidate the role of advection by explicitly evaluating it with the assimilation product. The seasonal cycle of advection is that the zonal, meridional, and vertical advection cool the area due to the large-scale inflow of cold water from surroundings. On interannual scales, the meridional advection tendency is dominated by the variations in the Ekmans advection through the meridional boundaries of the NINO3 domain. The zonal advection tendency is one of the dominant terms in the NINO3 MLT balance during the 1997-98 El Nino. The three advective contributions are governed by the large-scale circulation associated with large-scale wind forcing rather than eddies. On interannual scales, the three advective contributions are in phase with NINO3 MLT change. The signs and strengths of the advective contributions differ from the balance analyzed at point-locations (and from the spatial average of them).

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EFFECTS OF THE COLUMBIA RIVER PLUME ON THE DYNAMICS OF UPWELLING OFF OREGON
The Regional Ocean Modeling System (ROMS) has been utilized to study the effects of the plume from the Columbia River (CR) on the dynamics of upwelling south of the river mouth over the Oregon shelf, where the river water is advected with a coastal current. The study period is summer 2001, for which observations from the COAST and GLOBEC programs are available to verify the model, including shelf mooring observations and hydrographic sections. Effects of the CR are analyzed by comparing simulations with and without CR. The depth of the surface boundary layer (SBL) and the level of turbulent kinetic energy in the SBL are influenced by both the enhanced vertical stratification and increased vertical shear in the horizontal velocity, which is related to the plume-induced horizontal gradient of density. Within the plume, the Ekman transport is distributed in a thinner SBL, resulting in larger surface cross-shore velocities. Analyses in an idealized alongshore-uniform configuration show that if the plume is attached to the coast, upwelling is concentrated closer to the coast than in the case without the fresh water layer.

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HOT FLASHES AND DYNAMIC LANDSCAPES - TRACKING THE FATE OF NITROGEN THROUGH SPACE AND TIME IN A DELTAIC COAST
The fluxes of dissolved inorganic nitrogen and dinitrogen gas have been measured in a variety of environments along the Mississippi River deltaic coast of Louisiana. Previous work has shown that benthic mineralization could contribute approximately 40% of the nitrogen needed by phytoplankton in the Louisiana shelf system; and a significant portion of river nitrate can be transformed in shallow coastal bays and wetlands. Now, almost two decades later we are re-examining the fate of nitrogen in this ecosystem with an emphasis on the role of dinitrogen gas. A historical analysis of wetland, sub-tidal, shallow coastal bay, deltaic, and river plume benthic nutrient and dinitrogen gas fluxes will be compared with recent measurements in these environments. Particular attention will be paid to highlighting spatial and temporal patterns of intense nitrogen cycling (hot spots and hot moments). These modified budgets of benthic fluxes will evaluate the importance of benthic remineralized nitrogen in stimulating water column productivity in this deltaic coastal system.

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GLOBAL MAPPING OF WIND-INDUCED INTERNAL WAVE ENERGY IN THE DEEP OCEAN
The distribution of wind-induced internal wave energy in the world’s oceans is investigated using a full three-dimensional primitive equation model. The model is driven by JRA-25 winds for 1 year; although wave-mean flow interactions as well as wave-wave interactions are both not taken into account. Emphasis is placed on the global energy input to the surface mixed layer and the downward energy propagation into the deep ocean. We find that the distribution of near-inertial energy in the mixed layer agrees with that from the slab model, and the depth-integrated equatorward energy fluxes of internal waves are consistent with the observations. It is also found that most of the wind-induced energy resides in high vertical modes, 70-80 % of which is dissipated in the upper 150 m. This implies that the contributions of wind-induced internal waves to deep ocean mixing is much less than previously expected.

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SPATIAL AND TEMPORAL GENETIC CONNECTIVITY OF A DEEP-SEA HYDROTHERMAL VENT SIBOGLINID TUBEWORM, RIFTIA PACHYPTILA
The decoupled nature of hydrothermal vent systems from processes at the sea surface suggests that observed patterns of connectivity are determined in part by processes outside of the influence. Nevertheless, processes at deep-sea hydrothermal vents on fast-spreading mid-ocean ridges are punctuated by frequent physical “disturbance” often accompanied by population turnover. Despite local extinction events, larval dispersal among disjunct vent sites facilitates the persistence of sessile invertebrate species in these geologically and chemically dynamic habitats. Regional population extension and rapid recolonization by the siboglinid tubeworm, Riftia pachyptila, have been well documented along the East Pacific Rise and the Galapagos Rift. In order to resolve patterns of population connectivity in time and space, eight microsatellites were used to assess the genetic structure of the East Pacific Rise and the Galapagos Rift. In order to resolve patterns of population connectivity in time and space, eight microsatellites were used to assess the genetic structure of the
infrastructure programs such as the International Ocean Drilling Program and the Ocean success rate for NSF proposals has dropped from 30% to 20% over the past six years. Major changes have occurred in the funding of ocean research and education. The

NEW APPROACHES FOR THE SUPPORT OF OCEAN SCIENCES RESEARCH

cies specific identification of organisms in the soundscape. A sensor management system, produced sound to provide an index of habitat quality. The second approach provides spe

automated processing of the acoustic signals drawn from the growing digital acoustic /server platform, based on the Crossbow Stargate processor, to automate the collection

soundscape. T o this end, we have developed a monitoring system comprising a sensor

Kasten, E. P.

overwintering depth was at about 800 meter, but the variability was large and relatively
discussion of the results from the first survey with the multi sampler platform. The mean
neous vertical sampling of plankton and hydrography using a MULTINET, a Laser Optical

NORTHEASTERN NORWEGIAN SEA

The habitats of overwintering zooplankton in the Lofoten basin has been monitored using a multinet every January since 2000. T o explore the potential of sampling zooplankton in deep water with higher resolution, a new instrument platform which combined simulta

gradient. The compact size of the system not only documents the short spatial variability

be increased pressure on the funding of small projects. New approaches for funding ocean science are needed. An increased need for funds from private sources and industry will require acceptance of focused initiatives. New models such as the large BP grant to University of California at Berkeley and the Exxon/Mobil grant to Stanford University are examples of this new paradigm. A discussion of these issues with some new approaches for university partnering in seeking private funds will be presented.

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GRADIENTS OF ANTHROPOGENIC IMPACT ON PERIPHYPHYTON ABUNDANCE AND COMPOSITION IN THE FLORIDA COASTAL EVERGLADES

Periphyton is a ubiquitous feature in South Florida wetlands, with high rates of produc

which regulates water column concentrations of gases and nutrients, fuels detrital and consumer food webs and influences soil formation and quality. Patterns and drivers of

geochemical processes shows that simulated anoxic zones are typically much more intense than actually observed. Although this may be partly due to poorly resolved physics, we propose that these models are missing important facets of the biogeochemical dynam

mechanisms that determine the distribution of oxygen-depleted waters is critical if we are

and are either transformed into waves of elevation as the depth decreases or broken into

CHINA SEA

Very large amplitude Nonlinear (and nonhydrostatic) Internal Waves (NLIWs) are gener

GRADIENTS OF ANTHROPOGENIC IMPACT ON PERIPHYTON ABUNDANCE AND COMPOSITION IN THE FLORIDA COASTAL EVERGLADES

Humans constitute an important and complex, but surprisingly often overlooked and neglected, element of Arctic ecosystems - except, perhaps, as the cause of perturbations in the “ecosystem” as a whole. Monitoring changes in this human component of the ecosystem, whether such changes are due to natural or anthropogenic causes, pres

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turbulent boils. We use the NRL-MIT nonhydrostatic modeling system to hindcast Northern Hemisphere Internal Waves (NHIs) in the region of Dongsha Island. The MIT model is nonhydrostatic with horizontal resolution of O(100m). It is forced at the open boundary with data from the hydrostatic NRL LPS64 model, with 41 vertical levels and 1/64th degree (approximately 2km) horizontal resolution.

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LONG-TERM PHYTOPLANKTON DYNAMICS IN THE RHODE RIVER, MARYLAND (USA)

Studies of phytoplankton biomass in the Rhode River, a mesohaline tributary of Chesapeake Bay, date back to the early 1970's. More recent studies include phytoplankton species identifications, light saturation curves, and nutrient concentrations. For some parameters, such as light-saturated photosynthetic rate normalized to chlorophyll, inter-annual differences are as large as seasonal differences. The main factor governing interannual variability in planktonic productivity is the presence or absence of extraordinary spring blooms of the dinoflagellate, Prorocentrum minimum. In years with extraordinary blooms, primary production peaks in spring with the high biomass of P. minimum, in contrast with the main stem Chesapeake Bay, where primary productivity always peaks in summer. Long-term trends in summertime phytoplankton chlorophyll have not been observed, though temporary directional trends related to precipitation patterns have sometimes persisted for a decade before reversing. Currently there appear to be a trend toward reduced water clarity and increased chlorophyll during winter, though the cause is not presently known. These observations underscore the need for multi-decadal observations to document trends and anthropogenic impacts in coastal systems.

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ZONOSTROPHIC TURBULENCE: A PARADIGM OF ZONATION IN THE EARTHS OCEANS AND ON GIANT PLANETS

The regime of zonostrophic turbulence is a subset of geostrophic turbulence with a small-scale forcing and is distinguished by a strongly anisotropic internal energy cascade and zonation, i.e., the emergence of stable systems of alternating zonal jets. Being discovered in barotropic flows, this regime can also develop in the barotropic mode of fully three-dimensional baroclinic flows. This regime can explain the physics behind the generation and maintenance of the zonal jets in the terrestrial oceans and on solar giant planets. By analyzing the spectral energy transfer it will be shown that anisotropization and zonation are intrinsic properties of zonostrophic turbulence. Consideration of the energy and enstrophy spectra and corresponding spectral transfers sheds light on many aspects of this strongly anisotropic and complicated flow regime. Using spectral analysis in the frequency domain, we shall classify different kinds of waves inherent in zonostrophic turbulence, their interactions amongst themselves and with turbulence. This interaction can be described neither within a theory of weakly anisotropic nor wave turbulence. We shall identify a parameter space conducive to the development of the regime of zonostrophic turbulence and outline some basic features of the horizontal diffusion characteristic of this regime.

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EXTREME BURIAL EFFICIENCY OF TERRESTRIAL CARBON IN THE HIMALAYAN SYSTEM

The Himalayan erosion generates one of the largest sediment flux to the ocean. Each year, 1 to 2 billion tons of sediments are exported by the Ganga-Brahmaputra (G-B) fluvial system and delivered to the Bengal fan turbiditic system. The corresponding terrestrial organic carbon (Corg) flux represents 10 to 20 percent of the global burial flux and must have a significant impact on the global C cycle. A comprehensive Corg budget including Himalayan source rocks, G-B fluvial sediments and Bengal fan oceanic sediments shows that terrestrial Corg burial efficiency is almost complete. This contrasts strongly with other deltaic systems, such as the Amazon, where up to 70 percent of terrestrial Corg is oxidised prior to burial. In the Himalayan system, extreme Corg burial efficiency is sustained by intense physical erosion of the Himalayan range producing high sedimentation rates and low O2 availability in the Bay of Bengal. Enhanced physical erosion of active orogenic systems therefore favours有助periodic Corg burial that buffers atmospheric CO2 thereby exerting a negative feedback on the long term climate.

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TOPOGRAPHICALLY INDUCED UPWELLING INTENSIFICATION OVER THE SHELF IN THE NORTHERN SOUTH CHINA SEA

The processes and forcing mechanisms governing the intensification of upwelling (IOU) in the northeastern South China Sea (NCS) are investigated by observational and a three-dimensional modeling studies. The prevailing IOU in the NCS occurs over a distinctly eastward widened shelf (EWS) where the shelf topography veers abruptly offshore. The IOU is formed by an intensified upslope advection of dense deep waters that crosses the mid shelf over the EWS toward the inner shelf. The advection is amplified by the converging isobaths of shoreline convex isobaths (SCI) at the head of the EWS over the mid shelf and by the coastline and near-shore topography at the lee of the coastal cape over the inner shelf. The strong shoreward cross-isobath transport over the mid shelf of the EWS is formed by a westward-along-isobath pressure gradient force (PGF) as a result of the net rate of the momentum influx over the converging isobaths of the EWS, and by an intense bottom frictional transport induced by the momentum contributions near the SCI. The transport is subsequently advected toward the inner shelf where the PGF, formed by the variable coastline and the near-shore bottom topography, regulates upward motion over the inner shelf. These quasi-barotropic pressure gradients geostrophically alter cross-shelf transport in the interior and in the boundary layers. The study demonstrates the interactive effect of topographically induced cross-isobath transport over the inner and mid shelves.

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THE APPLICATION OF AN OPERATIONAL CIRCULATION MODELING SYSTEM TO THE MID-ATLANTIC REGION

The basic elements of a prototype operational data assimilation modeling system employing the Harvard Ocean Prediction System model includes protocols for (1) the production of model initial fields from an objective blending of climatological and feature model hydrographic data with Slocum glider temperature data, (2) the “warm start” of the model to provide a realistically initial model fields; (3) converting the initial model fields into forecast wind and/or operational wind measurements to model wind stress forcing fields; and (4) the assimilation of satellite-derived sea surface and glider-derived temperatures. These protocols are shown herein to evolve the initial model fields, which were dominated by climatological data, toward more dynamically balanced, realistic fields. This data assimilation model system was applied to the Cape Cod to New Jersey segment of the Mid-Atlantic Coastal Ocean System (MACOOS) domain using satellite SST temperature measurements from the first glider transit from Massachusetts to New Jersey in March 2007, 28 day trip. The model system was applied to the winter-like conditions of March-April 2007. The model/ CODAR-derived observed surface current comparisons will be presented.

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EXTENSIVE NITROGEN LOSS FROM PERMEABLE INTERTIDAL WADDEN SEA SEDIMENTS

Sandy sediments dominate the intertidal region of the Wadden Sea but, so far, little is known about their role in the coastal N-cycle. We investigated the potential N-loss rates along a coastal transect from the Netherlands to Germany by using a modified whole core incubation technique. In view of the high permeability and strong pore water advection in these sediments, the percolation method better represents the in situ conditions and we observed high rates of N-loss, ranging from 3.2 to 21.2 mmol N m-2 d-1 at all investigated sites. Denitrification was identified as the main N-loss process with less than 13% being attributable to anaerobic ammonium oxidation (anammox). Denitrification rates in Janssland, as a typical research site of the Wadden Sea, varied across the sand flats, with rates near the low-water line exceeding those of the middle and upper flat. In contrast to the conventional views, our preliminary results indicate that permeable sediments could play a significant role in N-removal from the shelf environments, which account for 50-70% of oceanic N-loss.

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GENETIC VARIABILITY OF ACROPORA CERVICORNIS AND A. PALMATA IN PUERTO RICO

Genetic variation of natural populations may be used as a proxy for the long-term survival of populations or species. Effective conservation and management planning for the rapidly declining scleractinian species Acropora cervicornis and A. palmata requires an understanding of the standing genetic variability. Over 100 colonies of Acropora cervicornis

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Garcia-Pineda, O.

indicate whether low levels of turbulence lead to increased ingestion, grazing, and development of post-oral arms, midline, stomach and horizontal rod lengths. Results will determine whether turbulence affects grazing, morphology, and development of larvae in still controls. The methods involve exposure of larvae to turbulence using simple Couette flow, and calculation of ingestion rates based on changes in cell concentration of larvae in the turbulence treatment will change their morphology and develop faster compared to control-prey interactions by affecting food availability. The purpose of this experiment is to determine whether turbulence affects grazing, morphology, and development of larvae in still controls. The methods involve exposure of larvae to turbulence using simple Couette flow, and calculation of ingestion rates based on changes in cell concentration of larvae in the turbulence treatment will change their morphology and develop faster compared to controls.

Latz, M.

utilizing voltage measurements on a submarine cable to estimate Florida current transport operationally: A real-time observing system

Submarine cable measurements have been used since 1982 to monitor changes in the Florida Current transport at 27°N. For most of the first twenty years of this well-known NOAA project the data was collected in a research mode, and was only made available for outside scientific analysis years after it was collected. Recently this program, presently in the Western Boundary Time Series project, has sought to transition the collection and processing of the voltage data from research mode into a real-time operational mode. This transition has led to some important changes in the processing methodology for the voltage data. Details of the removal of tide and magnetic field fluctuations will be presented and discussed in the context of other geomagnetic data sets. Calibration of the cable voltages into volume transport is done via comparison with ship section data collected in the same area. Submarine cables provide new tools for managers to cope with climate change.

Garcia, S.

BIOGEOGRAPHY AND PATHOGENICITY

Labyrinthula has been described as an agent involved in seagrass mass-mortality events during episodes of high salinity, temperature, and siltate porewater concentration. However, Labyrinthula also has been found widely in healthy seagrass beds, although there has been no systematic study of biogeographical distribution of the organism. Thus, the distribution and pathogenicity of Labyrinthula in the Mediterranean is unknown, preventing an evaluation of the potential role of this agent in the widespread decline of Posidonia oceanica is experiencing in the Mediterranean. In this study, we assessed the distribution of Labyrinthula in seagrass meadows of the Balearic Islands, and tested the pathogenicity of the isolates on seagrass species from the Mediterranean (Posidonia oceanica, Zostera noltii and Cymodocea nodosa), the temperate Atlantic (Zostera marina), and the Gulf of Mexico (Thalassia testudinum). The pathogenicity of isolates was tested through cross infection experiments on healthy shoots of these five seagrass species. The results show a widespread distribution of Labyrinthula in the Balearic Sea and some isolates being able to infect most seagrasses tested.

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EVALUATION OF GROUNDWATER DISCHARGE INTO A KARSTIC COVE IN THE WESTERN MEDITERRANEAN SEA USING RA ISOTOPES

Many karstic Mediterranean islands have limited water reserves that are intensively exploited by the demographic and tourism pressure. In Minorca (Balearic Islands, Spain), the most important aquifer is highly eorostilized by karstification processes, with springs visibly discharging in some coastal areas, such as the Akuafar cove. Concentrations of radium isotopes (226Ra, 228Ra and 222Rn) were determined in water samples from the cove, sea, submarine springs and wells. The relationship between Ra and salinity points out an evident mixing process occurring between springs and seawater endmembers. Two detectable groundwater flows out through the sea bed. Ra mass balances of the four radium isotopes provided very comparable estimates of the groundwater fraction in cove waters, averaging 17 ± 4 %. Taking the Ra-derived residence time for cove waters of 1.6 days, a submarine groundwater discharge (SGD) flux of 2–105 m³ s⁻¹ was estimated. When extrapolating this groundwater flow to the entire karstic coastline of the island, a total SGD of approx. 4 × 10⁷ m³ s⁻¹ was estimated, in good agreement with estimations derived from hydrological balances.

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SUBSURFACE SOURCES OF CHROMOPHIC DISSOLVED ORGANIC MATTER (CDOM) ASSOCIATED WITH THE MISSISSIPPI RIVER PLUME

PREVALENCE

REEF TRACT: SPATIAL VARIABILITY IN CORAL BLEACHING AND DISEASE

KRAMER, P.

Significant spatial and temporal variation in bleaching and disease prevalence has been correlated to thermal stress, light, and bleaching history. While the exact causes of this variability remain poorly quantified, the underlying predictability of this variability itself may provide new tools for managers to cope with climate change.

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QUANTIFICATION OF OIL SEEPS IN THE NORTHERN GULF OF MEXICO BY SATELLITE REMOTE SENSING

Satellite Synthetic Aperture Radar (SAR) has proven to be a successful tool for identifying ocean features. Natural oil seeps can be detected as elongated, radar-dark “slacks” in SAR images. Use of SAR images for seep detection is enhanced by a supervised texture reaction filter classifier algorithm, which delineates areas where layers of floating oil spread and reduces scattering. The effect is strongly influenced by wind strength and sea state. Statistical analysis of multiple images is used to partition variation in discharge from environmental effects. The goals of the analysis are to determine the following: 1) total number of individual seeps, 2) their geographic location and association with geological features, and 3) the temporal variability of discharge from individual seeps. Analysis of 176 images from Radarsat-1 in Standard and Wide Beam Mode covering Green Canyon areas from 1997 to 2007 are underway. Preliminary results show persistent seepage from many tens of discrete locations. Numerous of the identified seeps correspond to locations of known geophysical anomalies and/or chemosynthetic communities. Others remain un-explored. Temporal comparisons indicate episodic variation in the discharge rate of individual seeps.

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LABYRINTHULA IN WESTERN MEDITERRANEAN SEAGRASSES: BIOGEOGRAPHY AND PATHOGENICITY

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THE EFFECTS OF TURBULENCE ON LARVAE OF THE WHITE SEA URCHIN

Marine invertebrates commonly have a planktonic larval stage that is important for dispersal. Dispersal depends on planktonic predator interaction in larvae that affects food availability. Fluid turbulence is considered to play an important role in planktonic predation behavior. The purpose of this experiment is to determine whether turbulence affects grazing, morphology, and development of larvae of the white sea urchin Lytechinus pictus. The hypothesis is that low levels of turbulence, which theoretically increase rates of encounters between predator and prey, leads to increased grazing and ingestion. We predict that due to increased ingestion, larvae in the turbulence treatment will change their morphology and develop faster compared to larvae in still controls. The methods involve exposure of larvae to turbulence using simple Couette flow, and calculation of ingestion rates based on changes in cell concentration of the algae Rhodomonas lens. Larval growth and development will be determined by measuring post-oral arm, midline, stomach and horizontal rod lengths. Results will indicate whether low levels of turbulence lead to increased ingestion, grazing, and development of L. pictus larvae. In conclusion, turbulence may be an important environmental factor that can affect development and dispersal of sea urchin larvae.

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UTILIZING VOLTAGE MEASUREMENTS ON A SUBMARINE CABLE TO ESTIMATE FLORIDA CURRENT TRANSPORT OPERATIONALLY: A REAL-TIME OBSERVING SYSTEM

Submarine cable measurements have been used since 1982 to monitor changes in the Florida Current transport at 27°N. For most of the first twenty years of this well-known NOAA project the data was collected in a research mode, and was only made available for outside scientific analysis years after it was collected. Recently this program, presently in the Western Boundary Time Series project, has sought to transition the collection and processing of the voltage data from research mode into a real-time operational mode. This transition has led to some important changes in the processing methodology for the voltage data. Details of the removal of tide and magnetic field fluctuations will be presented and discussed in the context of other geomagnetic data sets. Calibration of the cable voltages into volume transport is done via comparison with ship section data collected using a droopsonde float, which is a free-falling float that carries a GPS receiver. The methods of processing and tide correction for the droopsonde float observations, and the error estimates inherent to the droopsonde system, will also be presented.
High resolution, four-dimensional measurements in and below the Mississippi River plume were conducted in August 2007 utilizing the Unmanned Boston ECOShuttle, a small, undulating vehicle providing in situ measurements and a continuous pumped flow of uncontaminated seawater. This survey revealed the presence of subsurface layers with elevated concentrations of colored dissolved organic matter (CDOM) relative to the regional CDOM-salinity mixing curve. In some, but not all, cases these layers coincided with subsurface chlorophyll maxima. The layers will be characterized by its situ fluorescence, temperature, salinity and optical backscatter data. An AC-9 (Wet Labs, Inc.) absorption/attenuation instrument plunged into the water flow will provide additional insight into the nature of the CDOM maxima. Discrete samples obtained from the flow allow verification of the in situ measurements as well as determination of the relationships between CDOM fluorescence and dissolved organic carbon (DOC). The relationship between the distribution of these subsurface layers and the Mississippi Canyon as well as the movement of these layers over time will be discussed.

Lozier, M. S.

The nearshore transport of terrestrial inputs to the ocean is an issue of growing concern from Elkhorn Slough, California

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SOURCEnE CURRENT MAPPING PRODUCTS TARGETED FOR TWO EVENTS IN THE GULF OF THE FARALLONES

The California Coastal Ocean Currents Monitoring Program (COCMP) responded with targeted products to two events in the Gulf of the Farallones since the systems were installed in late July of 2006. These are the NOAA sponsored SeaSonde’06 (SSS06), a simulated oil spill drill off the Golden Gate in August 2006, and then in October 2007 monitoring the potential plume from the San Francisco Public Utilities Commission sewage outfall off Ocean Beach after the failure of the discharge pipe endcap. For each of these events, the COCMP team produced different products to assist the regulatory agency in charge of the events. During SSS06 three products were delivered: vector fields for the previous 24 hours, a 24 hour current forecast, both in netCDF format, and vector fields for import into GIS programs. In October 2007 the failure of the service endcap on the San Francisco Public Utilities Commission sewage outfall prompted concerns that a buoyant plume could possible foul beaches. Two different plume tracking products, one for 24 trajectories of the input of a plume, and a second with continual input allowed tracking of the potential plume reaching shore. The product development for these events assisted with management decisions, ultimately illustrating the process of providing targeted products for regulators.

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THE ROLE OF LANGMUIR SUPERCELLS IN SEASONALLY TUNED CROSS-SHELF TRANSPORT OF BIOACTIVE MATERIAL

Langmuir supercells are arguably the dominant horizontal transport mechanism for sediment and bioactive material on shallow inner shelves. First observed to 15m depth off New Jersey, supercells were recently found extending to 30m on the Georgia shelf. Such large shelf areas on the US eastern seaboard experience episodic, strong and highly directional transports in supercell related events associated with strong wind/wave forcing during storms. Net horizontal transport during supercell events is approximately downwind and associated cross-shelf transport is dependent on the angle between storm wind direction and shelf orientation. Net cross-shelf transport will be modulated by seasonal variability of storm frequency and directional wind. With strong storm winds typically from the NE off much of the US east coast, supercell events offer directed onshore transport across the inner shelf, acting as vectors for springtime movement of bioactive material towards the coastal. Year-class success of fish stocks that spawn near the shelf break but rear in coastal lagoons may be determined by the frequency of storms affecting the inner shelf during a crucial spring period.

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NEARSHORE TRANSPORT OF LAND-BASED CONTAMINANTS EXPORTED FROM ELKHORN SLough, CALIFORNIA

The nearshore transport of terrestrial inputs to the ocean is an issue of growing concern worldwide. Our aim is to define a “zone of impact” for tidal outflow from Elkhorn Slough, recognizing that one can expect a characteristic pattern of transport for all water-borne pollutants. At short time scales, biogeochemical reactions are expected to be secondary to physical transport in defining the spatial distribution of contaminants exported from a given source. Summer transport is primarily due to tidal flows to/from the Slough and nearshore waters, with some variability associated with winds. A 10-km array of near-surface temperature-salinity (TS) sensors was deployed alongside of Elkhorn Slough from August to October 2006. The nearshore outflow water temperature TS values can be defined in TS space and is most prevalent near the source. With increasing distance from the source, exposure time and concentration decrease. A similar decrease in exposure to terrestrial water/contaminants can be expected, including trace metals (monitored using solid-phase DGT devices). This work is directed at obtaining a first estimate of the exposure of sea otters to the water-borne pathogen, Toxoplasma gondii.

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EXPLOREING THE VARIABILITY OF EXPORT PATHWAYS OF LABORATORIUM SEA WATER FROM THE SUBPOLAR NORTH ATLANTIC USING SIMULATED TRAJECTORIES

The Deep Western Boundary Current (DWBC) has long been considered the sole conduit transporting water masses of the northern North Atlantic to the subtropics. Recent RTOFS and RAFOS trajectories and modeling studies, however, have provided evidence for an interior pathway from the subpolar gyre to the subtropical gyre; a pathway first hypothesized from hydrographic data. The interior pathway runs southwest along the western flank of the Mid-Atlantic Ridge and may be eddy-driven. We used simulated Lagrangian trajectories and RAFOS trajectories to examine spatial and temporal patterns in the mid- and lower frequency pathways from the Labrador Sea to the subtropical gyre. As in previous studies, few particles (real or simulated) follow a path along the western boundary of the North Atlantic. In multi-year simulations, most particles seeded in the DWBC in the Labrador Sea enter an eddying region off the Grand Banks, pass through the subtropical gyre interior; and return to the DWBC south of Cape Hatteras. We quantify interior pathway variability with trajectory clustering techniques. Possible mechanisms for the generation and variability of the interior pathway are discussed.

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INTENSE EDDY MIXING AND TRANSPORT IN THE LOFOTEN BASIN

The dynamical role of fresh water, transport and mixing by eddies is clearly illustrated by recent observations taken in the Loften basin during MAIA* and ASOF** (EU funded projects) showing strong interactions between the Norwegian Atlantic Current (salty) and the Norwegian Coastal Current (fresh) at the eddy scale. These observations were based on quasi-lagrangian (isobaric) floats, transient tracers and hydrological data combined with satellites data (Sea Level Anomaly). Eddies are a very efficient mechanism not only to explain how water masses are interacting to exchange properties but also to transport heat, salt and tracers. In this presentation we will describe some relevant and pertinent observations in order to document this process driven by eddies and we will draw some conclusions concerning numerical modelling applications for the general circulation in the northern Norwegian sea and the Barents sea and also the relevance of this process for the ecosystem in one of the most productive area in the world ocean. *MAIA: Monitoring the Arctic Inflow towards the Arctic **ASOF : Arctic Subarctic Ocean Fluxes

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INTERACTION OF A SLOPE EDDY WITH THE SHELBREAK FRONT IN THE MIDDLE ATLANTIC BIGHT: CONTRASTING SUMMER AND SPRING CONDITIONS

The shelfbreak front in the Middle Atlantic Bight is a region of large variability in both stratification and velocity shear. A important contribution to the variability is the interaction of slope eddies with the front. These eddies act to enhance lateral shear near the shelfbreak jet and also alter the waveguide in which internal waves propagate. We compare and contrast observations from two separate time periods: August-September 2006 and May 2007, obtained in the course of the Shallow Water 06/NLIWI/AWACS experiment off New Jersey. An anticyclonic slope eddy was present immediately offshore of the shelfbreak front during both surveys. In late summer of 2006-the near-surface water over the eddy was less dense than that over the outer shelf. Consequently, the sense of vertical geostrophic shear was reversed near the surface, resulting in a maximum jet velocity located deeper in the water column (40 m depth). In contrast, in spring 2007 the shelf water was present in the upper 70 m of the water column within the slope eddy, density gradients did not reverse near the surface, and the shelfbreak front had its more usual configuration with an alongshore velocity maximum at the surface. During the spring 2007 cruise, the mid-depth acoustic duct associated with the Cold Pool water mass over the outer shelf extended a large distance offshore. During the late summer of 2006, this duct abruptly terminated adjacent to the slope eddy.

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FORCING OF SEMIDIURNAL CURRENTS BY TIDES, WINDS AND BATHYMETRY IN A SMALL FJORD IN PRINCE WILLIAM SOUND, ALASKA

From June to August 2007, diurnal (26 hr) tidal currents and hydrography within Simpson Bay, Prince William Sound (PWS) Alaska, revealed a complex flow structure forced by interactions of tides, bathymetry and winds. A prominent feature of the circulation is a northward tidal jet (~0.3 m/s) generated by flow across a shallow shelf on the western side of the mouth. When enhanced by up-fjord winds (7-10 m/s) this inflow results in exten-
sive intrusions of PWS water into the northeastern region of the fjord. A secondary hydro-
dynamic response to sampling with outliers near the eastern shoreend suggesting the eastern shoreend and ultimately re-circulates water via an anticlocky eddy. During ebb tides the cross-channel flow structure is reversed by an outflow of estuarine water from the northern (inner) basin along the western side of the fjord. This current is initially generated by acceleration of the tide through a narrow channel formed by a shallow reef that separates the northern and southern basins. The imbalance in flow generated by the topography possibly forces a net exchange of PWS water into the northern (inner) basin.

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NEARSHORE SPORE DISPERSAL OF GIANT KELP: INSIGHTS FROM THEORY AND EXPERIMENT

Propagules like invertebrate larvae and algal spores are often dispersed across a spectrum of spatial scales using wind, wave, and current vectors. We used water flow models to examine short- and long-distance spore dispersal in the habitat-forming giant kelp, Macrocystis pyrifera. Results of a physically based model were compared to settlement data acquired in the field. Findings indicate that short-distance dispersal patterns quantified over limited durations are noisy and likely due to characteristics of turbulent mixing. Waves smear dispersal patterns in Macrocystis; may exceed 100 million spores per individual. Fertilization and recruitment appear possible at distances beyond 1 km, modulated by current speed, forest size, and the viability of life stages derived from spores. In forests, levels of self-fertilization may reach 10% or more. Such characteristics influence propagation supply, population connectivity, and inbreeding in this key nearshore seaweed.

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SLOWLY VARYING BIAS CORRECTION OF NEAR-SURFACE WIND FIELDS BASED ON WIND SCATTEROMETER DATA

A new approach for blending scatterometer data into NWP surface wind fields driving surface wave and ocean models has been developed, to cope with sparsity of sampling that limits the effectiveness of methods like OI. Temporally/spatially varying bias is corrected using satellite scatterometer, local parameters are estimated from satellite scatterometer data. Alternative model structures, spatial/temporal scales and estimators were evaluated based on predictive skill. In the choice of estimator, robustness against outliers and overfitting are important. We tried (in order of increasing skill) robust regression (total least squares, regression on ordered samples) with outlier removal, a Neural Network technique with advanced training method, and a new highly effective least-squares method which finds a solution along the path of steepest descent based on cross-validation. Experiments with ECMWF surface winds over the Mediterranean using ERS1/ERS2 scatterometer data reprocessed with CMODs show that largest bias reduction is achieved on small spatial (0.5°) and large temporal (month) scales, suggesting local but persistent bias. Additional work on the impact of model structure and use of QuikSCAT 25 km will be presented.

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CREATING SUCCESSFUL COLLABORATIONS TO SUPPORT OCEAN SCIENCE EDUCATION: EXAMPLES FROM THE GLOBE PROGRAM AND THE COALITION FOR EARTH SYSTEM EDUCATION.

Leveraging the resources and capabilities of formal and informal science education organizations to promote Earth System literacy is a primary goal of the Coalition for Earth System Education. Actively engaging students and teachers with scientists in research on the environment at local, regional, and global scales is a primary objective of the GLOBE (Global Learning and Observations to Benefit the Environment) Program. This talk will use examples from both the Coalition for Earth System Education and GLOBE to highlight successes and challenges in creating effective partnerships between diverse scientific and educational stakeholders. More specifically we will discuss lessons learned and used in the following areas: (a) mutual goal, benefit, and priority setting, (b) agreement on roles, responsibilities, and resource allocations, (c) creation and support of scientist, school, and organizational networks, (d) integration of ocean science learning into K-12 classrooms, and (e) development of evaluation metrics to measure the success of collaborations.

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AMS ONLINE OCEAN STUDIES FOSTERING OCEAN SCIENCE LITERACY IN AMERICAN UNDERGRADUATE EDUCATION

Online Ocean Studies is an introductory college-level course in ocean science developed by the American Meteorological Society (AMS) in cooperation with the National Oceanic and Atmospheric Administration (NOAA). This semester-length course explores the ocean in the Earth system via investigations keyed to near real-time environmental data derived from ocean and coastal observing systems. The course, including textbook, investigations manual and course website, can be offered as a traditional lecture/lab offering, hybrid course or totally online. Since 2005, 100 colleges and universities have licensed the course. The AMS was funded by the NSF CCLI-ND program to introduce Online Ocean Studies to undergraduate faculty members from 75 Minority Serving Institutions over three years ending in 2009. Two faculty training workshops have already taken place in Seattle at the University of Washington and NOAA facilities and at the subsequent AMS Annual Meetings. The workshop includes course implementation discussions, presentations by oceanographers on a variety of course topics, and visits to the Pacific Marine Environmental Laboratory and the Northwest Fisheries Science Center. The University of Washington School Of Oceanography is a major partner in the conduct of the faculty workshops.

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A CASE STUDY: THE IMPACT OF THE 1962 NOR’EASTER ON DELAWARE’S ATLANTIC COASTLINE

The 1962 Nor’easter, called by many The Storm of the Century, is Delaware’s most devastating coastal storm recorded in centuries. This project presents a case study of the catastrophic impact of the Nor’easter of 1962 on Delaware’s Atlantic Coast shoreline using historical aerial photographs, flood insurance maps, and building codes. Within a GIS framework, historic aerial photographs were analyzed pre- and post-storm to identify changes in shoreline, beach width, and extent of overwash and the extent of building destruction. The impact across Delaware was compared to earlier storms and other coastal impacts. Correlations were made between pre-storm coastal morphology and observed storm impacts. The historic photographs were then compared to 2002 aerial photographs to determine changes since the storm. Housing codes and Delaware flood insurance maps were used to compare development codes, and evaluate areas of sensitivity. The 1962 Nor’easter had a significant impact on Delaware’s coastline and communities. Forty-five years later, with increased development and better standards of building, when a storm this large occurs again, how susceptible is Delaware’s Atlantic coastline?

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THREE INTERACTING BUOYANT PLUMES IN THE NORTHERN CALIFORNIA CURRENT

The northern California Current is impacted by two freshwater sources: the Strait of Juan de Fuca (JDF) and the Columbia River, resulting in three distinct buoyant plumes: the plume from the Strait, and two plumes from the Columbia, one tending north and one tending southwest of the river mouth. In June 2006, downwelling winds associated with a spring storm were followed by persistent, strong upwelling winds. Moored sensor and satellite data show that the Columbia plume that developed during the storm extended over 200 km northward along the Washington coast and into the Strait. The plume water subsequently folded around Strait water in the IDY eddy. Drifters deployed in the Columbia plume near its origin tracked plume water northward along the coast almost to the Strait, then moved seaward and reversed direction at the onset of upwelling-favorable winds, tracking the aging plume water southward along the coast. As it neared the river mouth, this aged plume water mixed with the newly emerging southwest-trending plume, forming a distinctive ‘suck’ shaped Columbia plume inshore of the water of Strait origin.

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Determined to be 10^-4 m^2s^-1. The diffusion equation is employed to model this change and estimate the diffusion coefficient, with seasonal temperatures in the Bight having greater amplitude and peaking earlier in the year. Dynamics in the Bight differ significantly from those found either to the north or south, with north-western and Sahel. The maximum deposition fluxes were observed during winter when large quantities of dust are carried out of north-western Africa, in particular from Saharan source regions. Winter events account up to one third of the total annual flux to the Canary Basins. Highest Fe/Al and Co/Al ratios were observed during summer dust outbreaks.

Charcteristics of Metal Deposition Fluxes to Northeastern Subtropical Atlantic: Canada Island Region.

African dust transport constitutes a large fraction of the annual atmospheric deposition in the Canary Islands. In this work, an 8-year data record of total suspended particles (TSP) and the possible impact of dust pulses on metal fluxes to the Canary Islands Region are discussed. The TSP samples were collected at three stations on Gran Canaria Island (Talierce at sea level, Tafira 269 m a.s.l. and Pico de la Gorda 1930 m a.s.l.) during CLIMACT and CLIMARCOST (INTERREG IIIB) projects. Spatial and temporal variability of total suspended particles (TSP) as well as the influence of meteorological conditions were examined. The characterization of the collected mineral aerosol and back trajectories of the air masses appear to indicate two main regional African sources of dust: north-western Africa and Sahel. The maximum deposition fluxes were observed during winter when large quantities of dust are carried out of north-western Africa, in particular from Saharan source regions. Winter events account up to one third of the total annual flux to the Canary Basins. Highest Fe/Al and Co/Al ratios were observed during summer dust outbreaks.

Morphodynamics of an Ebb-Tidal Delta in Response to Anthropic Changes.

Prior to the early 1900s, the shorelines of southwest Washington and northwest Oregon accreted at long-term average rates of 1-2 m/yr. This net progradation is attributed to sand supplied from the Columbia River that was temporarily stored in the ebb-tidal delta, then distributed both north and south of the entrance by wave and current processes. Construction of entrance jetties (1885 and 1917) to improve navigation promoted scour, causing the main channel to deepen and stabilize and the ebb-tidal delta to move offshore into deeper water. Concurrent with morphologic changes in the ebb-tidal delta, the shoreline advanced along the beach face to the jetties and then progradation reversed or reversion to erosion during the 1950s to present. A process-based numerical model (OMSI3D) is applied to gain insight into the wave and current processes responsible for sediment bypassing in the vicinity of the inlet.

High Resolution Turbulence Measurements Beneath Young Waves.

The turbulence field beneath surface waves is rather complex and provides great challenges for detailed observations. Only in recent years the direct link between wave breaking and enhanced near-surface turbulence levels has been shown. In a recent field experiment we used simultaneous remote and in situ measurements of breaking waves to test the Duncan-Phillips formulation for spectral energy dissipation. Pulse-coherent Doppler sonars were used to monitor the near-surface velocity field, the surface elevation and the breaking activity. The turbulence field is resolved to within a few centimeters of the free surface, and includes the most dynamically active near-surface regions. Turbulence characteristics and the interplay of turbulence and bubbles as well as the total wave dissipation will be discussed.


Traditional methods for measuring phytoplankton production and mortality, where the organisms are enclosed in containers or transferred to the laboratory, are potentially biased due to their intrusiveness. We developed a non-intrusive, in situ technique, based on measuring the change in phytoplankton density in water parcels tracked for 3-4 hrs. The experiment was carried out at the upper 40m of the photic layer in the oligotrophic Gulf of Aquh (Red Sea). Grazing exceeded production during both night and day, indicating a net heterotrophic state in that part of the water column. To maintain a phytoplankton population in that layer, an allochthonous subsidy must occur, possibly by lateral intrusions or vertical mixing with waters from the deeper productivity maximum. Extensive concurrent measurements of turbulence, currents and CTD profiles allow an evaluation of those sources. Phytoplankton mortality rates measured with our technique were three times greater than those measured with the traditional dilution experiment. Our findings indicate that our understanding of the processes governing the dynamics of phytoplankton in the upper water column may need to be revised.

Profiles of Ocean Heating (POSH): A New Model of Upper Ocean Diurnal Thermal Variability.

In situ radiometric measurements of diurnal warming at the ocean surface and profiles through the diurnal thermocline were utilized to assess the temporal and vertical variability of diurnal warming and to develop a new physics-based model of near-surface diurnal warming. The in situ data and model simulations were inter-compared, with the goal of comprehensively evaluating differences between the data and model results. Based
on these results, the model was refined, while attempting to maintain agreement with the in situ measurements. By modeling diurnal warming profiles, the new model provides a straightforward methodology for modeling differences, due to diurnal warming, between measurements made at different depths (e.g. 1 m in situ, 1 cm microwave, and 10 μm infrared). These results will have direct application to the GODAE High-resolution SST project and will be useful in providing insight into the physical processes in the upper ocean.

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ELWHA RIVER DELTA: GEO MORPHOLOGY OF A MIXED-SEDIMENT BEACH

The Elwha River drains the Olympic Peninsula of Washington and forms a mixed-sediment delta in the Strait of Juan de Fuca. The Elwha River has been damned for almost a century, and a pending dam removal project is expected to reconnect upstream sediment sources to the river mouth. Topographic and grain-size mapping of the sub-aerial delta during 1999-2007 is reported and the geomorphology and shoreline changes of this system are described. The delta is divided into three geomorphic regions: west delta, river mouth and east delta. The river mouth is the most complex region due to the river channel movement, side-channels, and nearshore bars immediately offshore of the mouth. The east and west delta differ in geomorphology and shoreline change rates. The west delta is steep, cuspat, lacks a low-tide terrace, and exhibits little semi-annual or inter-annual shoreline change. In contrast, the east delta has a steep foreslope, a flat low tide terrace dominated by cobble, and has shown a consistent trend of erosion during the surveys. Cuspat formations on the east delta are more spatially variable than on the west delta.

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OBSERVATIONS OF TURBULENT KINETIC ENERGY AND DISSIPATION RATE IN THE OCEAN SURFACE BOUNDARY LAYER

Estimates are made for several terms in the turbulent kinetic energy (TKE) budget in the ocean surface boundary layer in an effort to test predictions made by turbulence closure models. Data were collected at a depth of 2 m below the surface in 16 m of water south of Martha's Vineyard, Massachusetts, at the Martha's Vineyard Coastal Observatory. We estimated the dissipation rate, the magnitude and rate of change of TKE, and the buoyancy production, and we placed bounds on the shear production and Stokes-shear production. As found by previous authors, dissipation rates are enhanced relative to those found in wall-bounded shear flows. The remaining terms in the TKE budget do not balance the dissipation rate, suggesting that the transport of TKE, which is not directly measurable, is important in turbulence energetics in the surface layer. Our estimates of the turbulent kinetic energy are less certain, but are smaller than predicted by turbulence closure models that include a surface flux of TKE from wave breaking. Our estimates of TKE are close to those found in wall-bounded shear flows.

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DIURNAL VARIABILITY OF SURFACE INHERENT OPTICAL PROPERTIES AND FLUORESCENCE, AS MEASURED IN THE NORTHWESTERN MEDITERRANEAN SEA (BOUSSOLE MOORING)

A one-year time series of inherent optical properties and phytoplankton fluorescence has been collected at a deep ocean mooring (BOUSSOLE project) in the north western Mediterranean Sea (60 km offshore Nice, France). All data are simultaneously recorded every 15 minutes at 4 and 9 m depth. This data base allows identification of the shape of the diel cycles of particle beam attenuation (cp at 680 nm) and backscattering (bfp at 442 and 555 nm) coefficients, which vary throughout the phytoplankton annual cycle: stable biomass in summer, growing phase of the vernal bloom, post-bloom decay, etc. Variations in cp reflect the variations of the bulk of all particles, while fluorescence is more directly linked to phytoplankton. In some particular cases, the average time of the day when phytoplankton division occurs is tentatively inferred.

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 PARTICULATE FLUXES OF NATURALLY OCCURING RADIOISOTOPES AS MEASURED FROM SEDIMENT TRAPS AT THE SAN PEDRO BASIN, SOUTHERN CALIFORNIA

A bottom-anchored mooring in San Pedro Basin, CA has been operational since January 2004 with sediment traps at 550m and 800m. Total mass, carbon, and silica fluxes have been measured. Mean mass fluxes in 2004 and 2005 were 559.5 and 606.5 mg/m2-day, respectively. Synchronicity of fluxes in the traps indicates that most of the particle flux settles at speeds of 85-150m/day. Variations of total flux reflect seasonal events such as spring algal blooms, which are dominated by opal-rich rain. Occasional peaks of terrigenous material do not correlate with major rainfall events. Fluxes of the isotopes 210Pb, 228Th and 234Th were measured. Concentration variations of 210Pb and 228Th do not clearly correlate with the total flux or its biogenic fraction. While most of the shorter-lived 210Th isotope fluxes are supported by production in the overlying water, the particulate fluxes of 210Pb exceed the local production rate by a factor of ~5, requiring transport of dissolved 210Pb from offshore and its removal to sediments. The 210Pb flux into traps agrees with the seafloor 210Pb inventory.

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ESTIMATION OF TURBULENCE LENGTH SCALE IN ESTUARINE BOUNDARY LAYER FLOWS AND WAKES

As part of the COHSTREX study of turbulent structure in estuaries, the turbulence length scale was measured in the Snounou estuary using a ship-mounted, rigid mast with a vertical array of turbulence-resolving sensors. Measurements were obtained in stratified and unstratified boundary layer flows and in the wake of a partially submerged jetty. The turbulence length scale, dissipation rate (ε) and turbulent kinetic energy (TKE) were estimated from analyses of the vertical and horizontal velocity spectra between the inertial subrange and the energy-containing scales of the turbulence (frequency range 0.02 – 12 Hz). In the boundary-layer flow conditions, the analysis confirms the transition from wall-layer to log-layer when the Ozmidov scaling Lo ~ z/ε^1/2 (where ε is von Karman’s constant, z is the height above the bed, and h is the water depth). Turbulence production and dissipation were nearly in balance for both the stratified and unstratified measurements. In the wake conditions, the TKE and dissipation were more than an order of magnitude higher than in the boundary layer, and the length scale was approximately twice the boundary-layer value. The measured length scales are consistent with remote-sensing observations of boils at the same location. The energetics of the turbulence were consistent with non-local generation due to the obstacle, with a spatial decay scale of the wake of approximately 100 m based on the magnitude of TKE and ε.

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AN APPROACH TO CORRECT FOR ADJACENCY EFFECTS PRESENT IN MERIS DATA OVER LAKES: EFFECTS ON CHLOROPHYLL ASSESSMENT

Envisat-MERIS full resolution data (pixel-size 300 m) offer an excellent choice in terms of revisiting time, spectral and radiometric resolutions to monitor near-shore and inland water quality. Currently, MERIS data are delivered in two modes: at satellite radiation values (L1b); normalised water leaving radiance plus geophysical product, including chlorophyll-a, suspended solids and yellow substances concentrations (L2b). L2b products may be directly used for monitoring purposes but two main factors limit their use: first, a limitation in the current standard products is the applied atmospheric correction. In particular a problem for the atmospheric correction over lake pixels is the adjacency effect. A second constraint is the bio-optical model used in L2b processing, which does not take into account the broad variety of optical properties of the different water types typically met in fresh waters. This study presents a simple image-based approach to correct L1b data for significant adjacency effects, observed over narrow Sub-alpine lakes (northern Italy) surrounded by steep vegetated sides. Using specific inherent optical properties of the lakes, the effect of such a correction on chlorophyll-a assessment is discussed.

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VERTICAL OCEAN MIXING BY FOSSIL TURBULENCE WAVES

Turbulence is an eddylke state of fluid motion where the inertial vortex forces vwx of the eddies are larger than any other forces that tend to damp the eddies out, where w is velocity and x is vorticity. Therefore irrotational flows are not turbulent, even though they may supply energy to turbulence at Kolmogorov scales where turbulence is produced. Turbulence always cascades from small scales to large by a process of eddy merging driven by vwx forces. Fossil turbulence is a perturbation in any hydrophysical field produced by turbulence that persists after the fluid ceases to be turbulent at the scale of the perturbation. Fossil turbulence waves are radiated near vertically (~45 degrees) from turbulence patches at the Ozmidov scale at fossilization in an efficient mason rager. Secondary turbulence events (zombies) are produced when FWTs tilt fossils of previous FWTs. Zombies patches re- radiate and channel the energy they collect forming mixing chnneys to the sea surface and brightness patterns. Thus information about bottom topography and submerged turbulence can be detected by optical and acoustic sensors. Patterns of mixing enhanced by submerged turbulence from the Sand Island municipal outfall, Honolulu, HI were detected in 2002, 2003 and 2004 international studies using satellite images and microstructure profiles in Mamala Bay. The mechanism appears to be generic to oceanic and atmospheric mixing of stratified fluids.

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DREAMS - ENHANCING RESEARCH, ACADEMIC AND LEADERSHIP TRAINING OF UNDERREPRESENTED STUDENTS IN MARINE SCIENCE

Diversity in Research in Environmental and Marine Science (DREAMS) is a collaborative program between Hampton University (HU) and Virginia Institute of Marine Science (VIMS). The goal of this program is to increase diversity in the environmental and marine sciences fields by providing rigorous research, academic, and leadership training to HU marine science students. By instituting a new curriculum, research seminars, career seminars, ethics activities, presentation skill workshops, and new equipment, DREAMS has brought many new activities and resources to both campuses, greatly improving the research and learning environment for HU students. Each year a selected group of talented students conducts a full year long and summer research under the guidance of faculty mentors from various research institutions. These research internships allow the students to build long-term relationships with their mentors, and to gain in-depth understanding of the science professions. Students share their knowledge with the larger community through presentations, publications, outreach activities, and as peer mentors to K-12th grade students. Since the program began in July 2003, DREAMS students have collected a total of seven awards in regional and national conference presentations, and logged in over 60 days of community outreach. Seven student scholars successfully graduated from the program, six of which have been accepted to graduate or professional schools.

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THE INFLUENCE OF SHOAL/CHANNEL INTERACTIONS IN A SHALLOW, MACROTIDAL ESTUARY ON FRONTOGENESIS, TRANSVERSE CIRCULATIONS AND VERTICAL MIXING

The dynamics of the Snohomish River Estuary are examined utilizing in-situ and remote sensing data collected during July 2006. Results from the field experiment highlight the need for understanding shoal/channel interactions in order to interpret tidally averaged quantities. Moorings with bottom mounted acoustic Doppler current profilers (ADCP); acoustic Doppler velocimeters (ADV); pressure sensors; and conductivity, temperature, depth (CTD) sensors at three depths were deployed for over twenty days. The moorings along with high resolution ADCP and CTD transecting surveys and an autonomous underwater vehicle, REMUS, are utilized to examine the interactions between complex bathymetry induced frontogenesis, transverse circulations, and vertical mixing and stratification in this system. In addition to detailed in-situ measurements, concurrent infrared remote sensing from both near-field oblique views as well as far-field imagery help corroborate the frontogenesis mechanism.

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REGIONAL PREFERENCES OF THE RCA (ROSEOBACTER CLADE AFFILIATED) CLUSTER AND THE SAR11 CLADE: SOUTHERN OCEAN VS. TEMPERATE SEAS

The SAR11 clade ranges worldwide and often dominates the marine bacterioplankton. However, there is still scarce information on the quantitative distribution of this clade relative to other groups in marine waters other than tropical and subtropical regions. The RCA cluster, a narrow phylogenetic lineage of the Roseobacter clade, only occurs from temperate to polar regions, but not in tropical and subtropical waters. We determined the RCA cluster, a narrow phylogenetic lineage of the Roseobacter clade, only occurs from temperate to polar regions, but not in tropical and subtropical waters. We determined the

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DEGRADATION PATHWAYS

Dimethylsulfoxonipropionate (DMSP) is an osmotically produced intermediate that has important implications for the global sulfur cycle and climate regulation. Marine bacteria are able to incorporate and degrade DMSP via one of two pathways. The cleavage pathway converts DMSP to the volatile sulphur compound DMS which is eventually released into the atmosphere. The demethylation pathway converts the sulfur in DMS into methanethiol and eventually into cellular biomass in the form of protein sulfur, which may stay in surface waters or sink to depth. Marine bacteria thus serve as important mediators for the fate of oceanic sulfur. The gene responsible for the demethylation pathway, dimD, has recently been identified, and approximately one third of surface ocean bacteria were previously found to harbor a dmAD homolog. However, the majority of genes involved in the processing and regulation of DMS degradation remain unknown. We examined marine bacterium Silicibacter pomeroyi’s transcriptional response to DMSP, DMS, and acrylate using a whole genome microarray. We identified candidate genes for DMS metabolism, and found that acrylate maybe a signaling compound in regulation of bacte
phlic response at all sites studied, whereas the temperature response of anammox activity was site dependent. Our preliminary results reveal rapid N2 production rates in perennated sediments via denitrification and anammox, and the temperature response of anammox activity appears to change more dramatically across a latitudinal gradient.

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GLOBAL OXYGEN TRENDS IN THE COASTAL OCEAN AND OPEN OCEAN

Despite the commonly held view that oxygen levels are generally declining in coastal ocean bottom waters due to human-induced increases in atmospheric and river nutrient fluxes, this has not been tested in a global analysis of coastal ocean oxygen trends. Oxygen time series from long-term monitoring sites, mostly from the northern hemisphere, were selected for our analyses. We present maps displaying oxygen concentration trends at these sites for 10-year, 25-year and 50-year reference periods. Groupings of these trends by category (estuaries, shelf, open ocean) allow us to compare oxygen trends from diverse time and environment conditions. Our results show that in certain regions of the world ocean, the primary factor driving oxygen trends in the coastal ocean is open ocean forcing.

Consequently, it is important that we improve our capability to monitor oxygen variability and trends in the open ocean in order to anticipate ecosystem impacts on the adjacent shelf and coastal ocean. To this effect, we present preliminary results from a four-year pilot program of oxygen measurements on Canadian Argo floats in the northwest Atlantic and northeast Pacific.

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THE ALLIANCE FOR COASTAL TECHNOLOGIES: SENSOR NEEDS FOR COASTAL OCEAN OBSERVING SYSTEMS

The Alliance for Coastal Technologies (ACT; see http://act-us.info) was established to foster the development and application of new ocean coastal sensor technologies to address the needs of coastal decision makers. New sensor technologies are required to make observations of biological and geochemical parameters that are needed for many management issues in a long-term, sustainable manner. Pilot programs for the US Integrated Ocean Observing System mostly are restricted to observations or models of physical variables, because that is what is possible with present technologies in an automated, sustained fashion. Bio-optical sensors, automated genetic sensors, and nutrient sensors are under development and are utilized in a few pilot projects; however, monitoring for human health by regulatory agencies still requires human intervention. Pilot programs such as manual cell counts. ACT facilitates the transition of new sensor technologies from research to operations through targeted workshops and verification trials of emerging technologies. Recent examples include trials of dissolved oxygen sensors, chlorophyll fluorometers, turbidity sensors, and nutrient sensors.

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DIAGNOSTIC PATTERNS OF SEASONAL AND INTERANNUAL MIXED LAYER DEPTH CHANGE OFF BAJA CALIFORNIA

Seasonal and interannual variations of the isothermal layer depth (ILD) and the isopycnal layer depth (MLD) in the southern part of the California Current are examined using harmonic and EOF analysis applied to the 9 years of IMEOCAL data collected between 1997 and 2006. The sampling interval is approximately 3-month. In agreement with the equatorward geostrophic flow, the mean of each layer is shallower in the zone adjacent to the coast than offshore. The ILD is shallower than the MLD. The layers are parallel, and their phase difference changes with time more or less randomly throughout the day. Although Argo floats sample less frequently in time than moored buoys can, they have the important advantage of collecting measurements more or less randomly throughout the day. Although Argo floats sample less frequently in time than moored buoys can, they have the important advantage of collecting measurements more or less randomly throughout the day.

During April, the seasonal MLD and ILD anomalies show a double-signed structure, where the anomaly is negative at the coastal zone and positive offshore. The spatial distribution of the first EOF of MLD anomalies shows a single-signed loading pattern where the variability increases from the coastal zone to offshore. The first EOF of ILD anomalies shows similar behavior. Those results are consistent with the Lynn and Simpson’s domain. Additionally, data shows that sea surface height is most closely correlated with the MLD. The layers are modulated at interannual time scale by external forcing. As a result of these effects of El Niño 1997-1998, both the ILD and MLD were equal and anomalously deep (90 m). During La Niña 1998-1999, the ILD variability was more intense than the MLD variability.

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ISLAND WAKES IN NUMERICAL MODELS OF SHALLOW WATER REGIONS

During recent years field studies of flow around islands in shallow water have generated detailed observations of wakes and eddy streets. Nellii & Elliott (2004) document one of many applications of a vertically integrated two-dimensional model. In such a model the effect of bottom friction on the flow is expressed through a bottom drag coefficient CD and the equivalent vertical eddy turbulent viscosity generated in the bottom boundary layer can be estimated with a parameterization. With the parameterizations of bottom friction used in two-dimensional vertically integrated models the Island Parameter (Wolanski et al. 1984) becomes independent of the free-stream velocity and is thus not suitable for the classification of island wakes. This presents us with a conundrum: Either the argument of Wolanski et al. (1984) and Tomczak (1988) that the state of flow around islands in shallow water is appropriately described by the Island Parameter is incorrect, or the vertically integrated model owes its success in simulating flow around islands to incorrect model physics. We attempt to clarify this issue with numerical simulations applied to the COHERENS (Luyten et al. 1999). Luyten et al., 1999 MUMM Report, Management Unit of the Mathematical Models of the North Sea, 914 pp. Neill, S. P and A.J Elliott (2004) Ocean Dyn. 54, 324-332. Tomczak, M. (1988) J. Geophys. Res. 88 (C6), 10553-10569. Wolanski, E, J Imberger and ML Heron (1984) J. Geophys. Res. 93 (C5), 5133-5138.

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EVIDENCE FOR SUBMESOSCALE BARRIERS TO MIXING IN THE OCEAN FROM Ocean subsoscale (2-20 km) mixing processes have major impact on the large scale circulation, on the ecologic system, and on the dispersal of pollutants. Observing and understanding such mixing in the ocean is difficult, yet is crucial for devising better parameterizations needed to correctly simulate and predict climate and coastal regions. Most ocean and climate models use diffusion-like parameterization for processes on scales smaller than the grid resolution, which means that mixing is assumed to be isotropic and that dispersion is proportional to the square root of time. We investigate horizontal mixing in a unique data set of surface currents measured by high-frequency radar. Our results show the complexity of ocean mixing on scales of a few km and the existence of temporary barriers to mixing. For the first time, these barriers can also be seen by airphotographs. The existence of such barriers requires a new approach to the way mixing is parameterized in ocean and climate models.

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CHARACTERIZATION OF THE MULTI-ANGULAR POLARIZED REFLECTANCE FROM COASTAL WATERS

Polarization properties of water leaving radiance provide important information about scattering characteristics of marine particles and potentially assist in the retrieval of the atmospheric composition, however, atmospheric-air-water interface and surface roughness impacts must be dealt with. To study these effects, a modified Satlantic hyperspectral radiance sensor with very high sensitivity was used to measure polarization components of the water leaving radiance from a research vessel for viewing angles from -70 to +70 degrees in both scattering planes along several stations in Jamaica Bay and Hudson River, NY, with varying concentrations of chlorophyll and mineral particles. Total reflectance spectra, as well as water absorption and attenuation spectra were also measured at the same stations together with (CHL), organic and inorganic components of TSS from the water samples. Results of these measurements are analyzed and presented together with simulations using a coupled air-ocean polarized radiative transfer code to assess the sensitivity of retrieval to errors in the atmosphere model, as well as sensitivity to coastal water parameters. The results of the analysis are then used to develop criteria for effective polarization sensors.

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DIURNAL SEA SURFACE TEMPERATURE VARIABILITY FROM SATELLITE COMBINED WITH ARGO

The Advanced Microwave Scanning Radiometer for the Earth Observing System (AMSR-E) flies on a sun-synchronous orbit, measuring sea surface temperature at approximately 1:30 am and 1:30 pm local time. In contrast, Argo floats measure upper ocean temperature profiles more or less randomly throughout the day. Although Argo floats sample less frequently in time than moored buoys can, they have the important advantage of collecting measurements at all latitudes and providing full profiles of upper ocean temperatures. For this work, individual Argo temperature profiles were paired with AMSR-E measurements collected within 48 hours before or after the profile. Temperature differences between Argo and AMSR-E show evidence of a clear diurnal cycle, with an amplitude that decreases with increasing latitude, about 0.1°C near the Antarctic Circle and 0.0°C near 60°N. The results suggest that maximum temperatures occur 2 hours after the AMSR-E daytime overpass, around 3:30 pm. Minimum temperatures appear to occur just before sunrise, around 5:30 am, though the precise phasing of the temperature diurnal cycle appears to vary with latitude.

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A CROSS-ECOSYSTEM SYNTHESIS OF THE BIOGEOCHEMICAL CONTROLS ON MEHg PRODUCTION ACROSS DIFFERENT AQUATIC ECOSYSTEMS, AND THE SENSITIVITY OF DIFFERENT TYPES OF ECOSYSTEMS TO CHANGING MERCURY INPUTS.

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DANUBE DELTA: A BIOSPHERE RESERVE AT RISK

Exploited since Neolithic times and engineered for commercial shipping since the early 18th Century, Danube delta has paradoxically remained one of the most pristine deltas in the temperate climate region. For preserving its diverse wetland ecosystem, the delta was established as a Biosphere Reserve in 1998. Economic and environmental interests among and within riparian nations are often divergent, leading to environmental pressure both from upstream factors and from downstream changes in the Black Sea basin. We review the state of knowledge on the development of the Danube delta and its functioning in natural conditions in order to provide a baseline for identifying anthropogenic threats. Long term pressures on the delta include the acceleration of the sea level rise and the chronic deficit of sediments. However, the sediment redistribution inside the delta leading to increased sedimentation and shoaling of deltaic lakes as well as the expansion of commercial navigation inside the delta and the growth of the tourist infrastructure are acute problems that should immediately be addressed if the delta's ecosystem is to be preserved into the next century.

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RELATING MICROBIAL DISTRIBUTION TO GEOCHEMICAL GRADIENTS IN DEEP-SEA HYDROTHERMAL VENT CHIMNEYS

Recent efforts have sought relate the distribution of microbes to geochemical factors in a variety of habitats. Hydrothermal vent sulfides present an ideal setting for such studies due to the defined gradients in temperature and geochemical conditions over short spatial distances. Here we examine the distribution and abundance of microbial phylotypes from the inner to outer walls of a hydrothermal vent sulfide (chimney) at the Juan de Fuca Ridge. Microbial incubators replete with sterile substrates and temperature arrays were deployed in holes drilled within the structures. The inner wall of the chimney are characterized by high temperatures (> 300°C) and high concentrations of energetically-rich electron donors. The outer walls of the chimney are much colder and contain high concentrations of potential oxidants. DNA extractions were performed on a time-series of deployments (from a few days to over 1 year) to examine changes in the microbial community and geochemistry over time. The abundance of select microbial phylotypes were determined using qPCR and FISH. The abundances of phylotypes common to short term deployments (Epuloproteobacteria and Crenarchaeota) changed over time and were correlated to changes in habitat conditions. Other select phylotypes also exhibited significant relationships to geochemical parameters, suggesting links between microbial physiology and temporal shifts in habitat characteristics.

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DENMARK STRAIT OVERFLOW EDDIES AS A PROXY FOR THERMOHALINE CIRCULATION VARIABILITY

Cyclonic eddies observed in satellite sea-surface temperature (SST) imagery are an intriguing feature of the Denmark Strait and have been linked to pulsations in the dense overflow from the Nordic Seas. We report on a survey of 3 years of 1-km resolution imagery from the Advanced Very-high Resolution Radiometer database, concentrating on two annual and interannual variability. As expected, annual cycles are apparent in background SST and sea ice extent, but not in eddy size or frequency. Contrary to expectations, we find that a significant amount of cloud-free imagery of at least part of the Denmark Strait is available in all months of all years, leading to the possibility that the eddies could serve as a proxy for overflow variability. Nearly every cloud-free image revealed the presence of eddies, with only small deviations in position from the principal pathway along the Greenland shelf break and upper slope. The size and shape of the eddies is variable, ranging from simple bumps in the temperature front to fully-developed spirals. This variation appears to be related to pre-existing conditions (including sea ice) as well as to the eddy life cycles as they move through the strait following the overflow. The relationship between these SST eddies and statistics from satellite altimetry and moored current meters is also discussed, along with progress toward automated eddy detection algorithms and monitoring procedures.

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HARMONIC ANALYSIS OF SOUTHEAST ALASKA TIDAL CURRENTS: SUMMER STRAIT AND TONOWEK NARROWS.

NOAA's National Current Observation Program deployed 42 Acoustic Doppler Current Profilers (ADCP) subsurface moorings during the period of May - September 2006 in Southeast Alaska throughout the region of Sumner Strait and Tonowek Narrows. Results of the harmonic analysis of this unique tidal current data set are described. The time span of the deployments varied from 38 to 88 days and the depths of the ADCP stations ranged from 9 to 155 m. Eddy currents predominantly were stronger than flood currents. Maximum mean speeds were registered during the ebb at Sumner Strait (155 cm/s), Warren Channel (139 cm/s) and Tonowek Narrows (123 cm/s) in the upper 10 m of the water column. Tidal harmonic amplitude ratios (K1+O1/M2) indicate a strong semidiurnal signal at almost all locations at all depths. M2 is the dominant constituent followed by S2, N2, K1 and M4. Rotary tidal currents were also encountered during the survey. Rotary reduction analysis showed a more detailed picture of the mean current vectors throughout a complete tidal cycle.

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OCEAN ACIDIFICATION OF THE GREATER CARIBBEAN REGION 1996 - 2006

The global oceans serve as the largest natural sink for increasing atmospheric carbon dioxide (CO2) concentrations. As this CO2 is absorbed by seawater, it reacts to form bicarbonate and hydrogen ions resulting in a reduction in seawater pH (or acidification). This results in a decrease in the availability of the carbonate ion which has been demonstrated to play an important role in calcification processes. Ocean acidification could affect some of the most fundamental biological and geophysical processes of the sea in coming decades. Observations obtained in situ from Volunteer Observing Ships have been extended using satellite remote sensing and modeled environmental parameters to derive estimates of sea surface alkalinity (AT) and surface carbon dioxide partial pressure (pCO2,sw). Pairing estimates of AT and pCO2,sw has permitted characterization of the changes in sea surface carbonate chemistry that have transpired over the past decade throughout the Greater Caribbean Region as a consequence of ocean acidification. The results reveal considerable variability both spatially and seasonally throughout the region. As a consequence of ocean acidification, a secular decrease in aragonite saturation state (Omega_arg) is observed at a rate of ~ -0.12 ± 0.01 Omega_arg decade⁻¹ (r² = 0.97, P<0.0001).

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PRODUCTION AND OCCURRENCE OF SPECIFIC ORGANIC IRON COMPLEXES (SIDEROPHORES AND HEME B) IN THE ATLANTIC OCEAN.

Iron concentrations in the oceans are very low, varying between <0.5 nM in the open ocean to approximately 20 nM in coastal waters. Iron is known to influence productivity and biodiversity in many parts of the world's oceans. A complete understanding of the influence of iron on ocean biology depends on our knowledge of (1) the processes controlling iron inputs and losses from the surface of the oceans and the (2) mechanisms governing iron uptake and iron utilization by marine organisms. In this presentation we describe investigations into two types of iron complexes produced by marine phyto- and bacteriochlorophyll. Siderophores are high affinity iron complexing ligands produced by bacteria as part of their iron uptake mechanism and are iron porphyrins, produced by almost all living organisms and used in many essential metabolic processes. We describe the variation in siderophore production, the distribution of siderophores in the dissolved phase and the distribution of heme b in particulate material across the different biogeochemical provinces of the Atlantic Ocean. We discuss the implications of their distribution for iron biogeochemistry in the Oceans.
OBSERVING STORM-INDUCED SEDIMENT RESUSPENSION PROCESSES IN THE MID-ATLANTIC RIGHT WITH SLOCUM GLEIDERS

Storm-induced sediment resuspension events are examined using physical-optical sensors deployed on Slocum Gliders. Two types of storm response are found. In summer, the intense seasonal stratification limits sediment resuspension even during hurricanes. In contrast, in winter storms, sediment resuspends throughout the full water column. The full transition between seasons starts with surface cooling that preconditions the shelf for mixing during fall storms. Focusing on a classic fall northeaster, sediment resuspension was limited to below the weakening pycnocline early in the storm. After the pycnocline was eroded, particles immediately filled the water column. The optical signals suggest that suspended particles are likely similar materials, which implies the reduced slope of the backscatter profiles is caused by an increase in vertical transport or turbulent mixing. Wave bottom orbital velocities during this time were decreasing, and glider vertical velocities show no indication of enhanced vertical velocities reflecting full water column Langmuir cells. We conclude that enhanced mixing is related to the interaction of the surface and bottom boundary layers as the stratification is eroded, and the observed variability is associated with the tide.

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PRELIMINARY INSIGHT FROM THE FIRST GENOME SEQUENCE OF A HARMFUL ALGAL BLOOM SPECIES, THE BROWN TIDE ALGA, AUREOCOCCUS ANophagefferens

Aureococcus anophagefferens is the causative species of harmful brown tide blooms which have plagued the eastern US seaboard for more than twenty years. While brown tide is sporadic, the concurrent outbreak of massive A. anophagefferens blooms in NY, NJ, and MD during 2007 attested to their persistence and pervasiveness. The sequence of the A. anophagefferens genome has been completed by the Department of Energy's Joint Genome Institute, a process which will facilitate a better understanding of this organism's ecology, as well as provide impetus for the development of novel molecular tools. A combination of expressed sequence tags (ESTs, ~50,000) and raw genomic data (~7-fold coverage of the organism’s 56 megabase genome) have been completed and are undergoing analysis. Preliminary bioinformatic predictions suggest that > 11,500 identifiable genes exist within the genome. The common HAB species tend to be mixotrophic, can take advantage of a range of multiple sources of nutrients, and alter their nutrition strategies with changing light and nutrient conditions as blooms progress. Finally, better monitoring tools are now available, including continuous in situ nutrient sensors to track the dynamic short term changes which these blooms experience.

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SUBMESOSCALE ANISOTROPY (FRONTS, EDDIES, AND FILAMENTS) AS OBSERVED NEAR BERMUDA WITH OCEAN COLOR DATA

Submesoscale and mesoscale physical variability strongly modulate the structure, biomass, and rates of marine ecosystems and their functioning in the ocean. Characteristic time and space scales of key ocean physical-biological phenomena range from the submesoscale (0.3-10 km in space; day-week in time) to mesoscale (10-300km, week-months).

In Doney et al. [2003], we characterized for the first time the geographical patterns of the magnitude and spatial scales of mesoscale ocean biological variability globally for a single year. Now, we present interim results characterizing the submesoscale component of ocean color variability using semivariogram techniques applied to high spatial resolution (1 km), regional satellite data near Bermuda. In the previous work, using SeaWiFS standard mapped level 3 products, we were unable to resolve between a true geophysical signal in the submesoscale versus instrument noise; here we show how the submesoscale (~10km) accounts for approximately 50% of the total resolved variance, the remainder found at mesoscales. Quantification of anisotropic submesoscale variability is an essential first step in deriving physical-biological models with parameters that may deviate significantly from purely physical, conservative tracers.

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BIOLGICAL IMPACTS ON THE GENERAL CIRCULATION: THE ROLE OF WATER CLARITY

This work demonstrates that the carbon cycle (defined broadly) can influence the climate system not only through altering the transmission of longwave radiation in the atmosphere, but through altering the absorption of shortwave radiation in the ocean. A series of simulations was made in a global coupled climate model where anomalous shortwave absorption was removed from different locations. The results demonstrate that anomalous absorption can have profound impacts on the global circulation. Increasing shortwave penetration in the central Pacific subtropical gyres tends to spin up the Hadley circulation, while increasing it over the shadow zones tends to warm the cold tongue and decrease the Walker circulation. The effects of such changes in atmospheric circulation include shifts in gyre boundaries, changes in watermass transformation pathways and shifts in a number of overflows. We explore implications for the feedbacks of climate change on biogeochemical cycles, past changes in climate, and for potential impacts of mitigation strategies such as iron fertilization.

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rays comprising these wavefronts. This paper provides a theoretical explanation of the phenomenon of wavefront stability. It is shown analytically that, at propagation ranges that are large compared to the correlation length of the environmental perturbations, end points of rays launched from a point source and having a given eikonal (phase) are scattered primarily along the wavefront corresponding to the same eikonal in the unperturbed environment. Roles of wave dispersion and of scalar (sound speed, buoyancy frequency, oceanic depth) and environmental inhomogeneities are analyzed. An intuitive physical explanation of the theoretical results is proposed. The relative stability of wavefronts compared to rays is shown to follow from Fermat's principle and dimensional considerations. Implications of the results for ocean acoustic tomography and predictability of tsunami travel times over an uncertain bathymetry are discussed.

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COMPARATIVE HEAVY METALS PROFILES IN BOTTOM SEDIMENTS FROM A STRONGLY CONTAMINATED BAY AND AN ADJACENTE PRISTINE BAY Sepetiba bay is a semi-enclosed lagoon (447 km2) located 60 km western from Rio de Janeiro city. It is severely contaminated with heavy metals, in particular Zn and Cd. In contrast, Ribeira bay, located nearby, is an important tourist resort of Rio de Janeiro state. Although much less impacted, this site receives the liquid effluents from Angra dos Reis nuclear power plants due to the lack of number of private marinas. Bottom sediment cores were sampled at four stations inside Ribeira bay and dated by 210Pb. Constant sedimentation rates were observed with a gradient from its back-end to its discharge opening to Ilha Grande bay, with values from 0.1 cm y−1 to 0.34 cm y−1. Additionally, a sediment core was taken at the Saco dos Cocos, a northern coast, sediment core near the discharge of its two main tributary rivers, taken as its more contaminated area. Lead-210 dating was a show a varying sedimentation rate pattern, with changes coincident with man-made modification on its drainage basin as channeling. Comparing the metal content of sediments from both rivers, only the concentrations of Zn and Cd in Sepetiba bay can be taken as significantly altered in relation to Ribeira bay.

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FROM LOCAL TO EXTREME ENVIRONMENTS (FLEXE) - Bringing the DEEP-SEA TO the GLOBAL NETWORK

While deep-sea extreme environments are a great hook for learning, helping K-12 students understand these complex, remote environments at a deeper level is challenging. FLEXE is an innovative project of the GLOBE Program that involves middle and high school students in engaging environments in which students can explore many important questions that reflect the information on the effects of convection, shear stress, and Coriolis force on the entrainment, in comparison with the nonpenetrative deepening. We also obtained the evolutions of profiles of temperature, salinity, velocity, and their fluxes, and examined the nonlocal mixing of heat and moments. Based on the analysis results, we suggested the parameterization of convective mixing.

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DEVELOPING INSTRUCTIONAL MATERIALS IN MARINE SCIENCE THAT BRING REAL-TIME DATA INTO THE SCIENCE CLASSROOM: A COLLABORATIVE MODEL FOR DESIGN

Ocean Observatory Systems (OOS) make available a diverse array of large data sets that are easily accessible and provide a unique opportunity to develop inquiry-based learning environments in which students can explore many important questions that reflect the interactions of the main circulations of ocean and sea. However, developing educationally sound curricula materials that foster an understanding of ocean science ideas and practices is a challenging endeavor for many reasons. In this session we will describe the efforts of the Centers for Ocean Sciences Education Excellence - Mid Atlantic (COSEE MA) to develop instructional materials, in which students use real-time data (RTD) to generate explanations about important ocean phenomena. We will discuss our challenges and successes in:

(a) developing an effective collaborative design team composed of scientists, educational researchers, and teachers;
(b) using education frameworks to guide the design of scaffolded curriculum materials in science;
(c) developing and implementing teaching supports both in the curriculum materials and in associated professional development workshops;
(d) developing a research agenda for studying the effectiveness of the curriculum materials as they are used in real classrooms.

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INTERANNUAL TRENDS IN PHYTOPLANKTON DYNAMICS IN THE ARABIAN SEA LINKED TO EURASIAN WARMING

For the past seven years, the western half of the Arabian Sea has witnessed a >300% increase in summer-time phytoplankton blooms due to strengthening of the southwestern monsoon winds and intensification of coastal upwelling caused by the warming trend over Eurasia. Our recent observations show that the warming trend is undermining convective mixing responsible for nutrient enrichment during the boreal winter condition of the monsoon cycle. Consistent with the weakening trend of winter convective mixing, winter-time concentrations of phytoplankton have been on the decline in the eastern Arabian Sea. In the western Arabian Sea however, chlorophyll concentrations have been on the rise. We present data to show that this unusual increase in phytoplankton biomass seen in the ocean color data is being caused by unprecedented blooms of N. milii, whose appearance appears to be tied to mesoscale eddy activity and the uplight of sub-surface, nutrient-rich, oxygen-poor waters seen off the coast of Oman.

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CONVEXTIVE DEEPTING OF THE OCEAN MIXED LAYER SIMULATED BY LES

The deepening of the ocean mixed layer under the various conditions of surface cooling, wind stress and Coriolis force was investigated by LES. Analysis of the LES data provides the information on the effects of convection, shear stress, and Coriolis force on the entrainment, in comparison with the nonpenetrative deepening. We also obtained the evolutions of profiles of temperature, salinity, velocity, and their fluxes, and examined the nonlocal mixing of heat and moments. Based on the analysis results, we suggested the parameterization of convective mixing.

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measures including mangrove protection. The results of this study show that coral reef management must focus on integrated watershed approach, in order to minimize the level of destruction to adjacent coral reef communities.

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SEASONAL VARIATION IN NUTRIENTS AND MICROALGAL COMMUNITY COMPOSITION IN MOBILE BAY, ALABAMA, AND THE NORTHERN GULF OF MEXICO

A transect was sampled from Mobile Bay, Alabama to 40 km offshore at monthly to bi-monthly intervals from March, 2007. Horizontal salinity gradients ranged from 8 to 18 PSU in surface waters. Temporal changes ranged from 16 to 32 C. Maxima in chlorophyll-a concentrations and total microalgal numbers were associated with maxima in nutrient concentration. Nutrient concentrations were in turn inversely correlated with salinity, indicating the importance of Mobile Bay as a source. The highest chlorophyll-a concentrations were found in July-August. The highest cell counts were found during a bloom of the dinoflagellate Pyrocystis noctiluca in Mobile Bay. The community composition showed a seasonal succession from dinoflagellate- to diatom-dominance in spring, followed by mixed assemblages of chlorophytes, prasinophytes and cryptophytes in summer. There were also horizontal gradients, with dinoflagellate-dominance occurring only in Mobile Bay during the Prorocentrum. There were higher proportions of prasinophytes in Mobile Bay and higher proportions of chlorophytes offshore in the mixed-dflagel late-assemblage in summer.

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WEATHERING AND CO2 CONSUMPTION POTENTIAL OF ANDESITIC-DACITIC TERRAINS, DOMINICA, LESSER ANTILLES

Previous studies of chemical weathering on high standing islands (HSIs) have shown some of the highest observed rates of chemical weathering and associated CO2 consumption yet reported. Recent geochemical studies of andesitic-dacitic terrains in New Zealand, Guadeloupe, and Martinique have reported silicate weathering rates and CO2 consumption so high that they fall only in the range previously determined for basaltic terrains, which are considered the high end of weathering rates for island systems. The Silicate fluxes and associated CO2 consumption determined from this study are amongst the highest known. Chemical fluxes calculated from this study confirm the weathering potential of andesitic-dacitic terrains and that additional studies of these terrains are warranted.

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CYBERINFRASTRUCTURE AND MIDDLEWARE APPLIED TO OCEAN OBSERVING SYSTEMS

Engineers and scientists at the Monterey Bay Aquarium Research Institute (MBARI), Scripps Institute of Oceanography (SIO), National Center for Supercomputing Applications (NCSA), and the University of Washington (UW) have spent time building technologies to enable science on ocean observatories. From our experience building observing technologies we have learned many valuable lessons about supporting long-term observations consisting of large numbers of heterogeneous instruments. This collaboration is now applying those technologies and lessons learned to the next generation of cyberinfrastructure. This application covers a wide range of observatory functionality from plug and play instrument interfaces, to the application of observatory-wide functionality on an Enterprise Service Bus (ESB). We will discuss how the ESB technology enables us to apply cross-cutting features such as policy enforcement. We will illustrate how we applied this group of cyberinfrastructure technologies to deployed instrumentation and how we are using that existing infrastructure to develop and test other technologies to meet the issues associated with large-scale, federated ocean observatories.

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CHARACTERIZING SUMMER TIME SHELF-SLOPE EXCHANGE PROCESSES ON THE NEW JERSEY SHELF

Fleet of autonomous Webb gliders occupied cross-shelf transects on the New Jersey outer continental shelf during summer 2007. Observations consisted of depth-averaged sweeps at the outershelf crossed the climatological location of the foot of the shelf-slope front. Depth-averaged currents flowed 10 cm/sec along-shelf to the southwest, indicating a transit time of 7-10 days for features through the study site. Four types of slope water salinity intrusions were identified: surface, pycnocline, sub- pycnocline, and bottom-intrusions. The pycnoline intrusions were affected by strong shelf-slope separation. Sub- pycnocline intrusions were possibly associated with the separation of the bottom boundary layer at the foot of the shelf-slope front. The intrusions were persistent and highly variable in space and time, likely forced by offshore eddies. On average the mid-depth intrusions could together account for one-third of the slope water salt in the sampling volume. Tropical Storm Ernesto dissipated and mixed away significant portion of the intrusions. The gliders enabled quantitative understanding of initiation, spatial distribution and dissipation of the highly dynamic shelf-slope exchange process.

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THE ROLE OF THE SHIP OF OPPORTUNITY PROGRAM IN THE GLOBAL OCEAN OBSERVING SYSTEM

The Ship Of Opportunity Program (SOOP) is an international program coordinated by the World Meteorological Organization (WMO) and the International Oceanographic Commission (IOC). The primary goal of the SOOP is to fulfill upper ocean thermal data requirements established by the international oceanographic community. The SOOP is directed primarily towards the continued operational maintenance and coordination of the expendable BathyThermograph (XBT) network, but other types of measurements are also made (TSG, CTD, ADCP, pCO2). Upper ocean observations provided by the program are assimilated into ocean models and the results support the operational needs of global fisheries, shipping, defense industries as well as climate and weather prediction efforts. Ships from the SOOP also deploy other instruments such as satellite tracked surface drifters and profiling floats. In this presentation we emphasize XBT transects maintained by NOAA. These transects are operated in three different deployment modes characterizing the spatial and temporal sampling frequency: low density, frequently repeated and high density. We present a summary of all the XBT deployments made during the last decade in each of these modes along with several key scientific contributions.

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HIGH RESOLUTION RECORD OF ORGANIC MATTER FLUXES IN THE CARIACO BASIN OVER THE PAST TWO MILLIANNA

The Cariaco Basin provides a unique opportunity to investigate climatic and oceanographic phenomena in the tropics at a variety of time scales ranging from seasonal to millennial. The focus of this investigation was to determine the compositional changes in the export of organic matter from the euphotic zone and link them to physical forcings (e.g., upwelling/stratification intensity, precipitation/runoff) and climatic phenomena (e.g., migration of the intertropical convergence zone - ITCZ). In this paper, we evaluate these changes by determining the elemental (carbon:nitrogen ratios), stable isotopic (delta-13C and delta-15N) and biomarker (sterols) compositions of sinking particles and accumulated sediments from the eastern sub-basin of Cariaco. The sample set includes sediment trap samples, collected bi-weekly for several years as part of the Cariaco - Ocean Time series, surface sediments collected via multi-core and deeper sediments collected via gravity core. We examine the seasonal and inter-annual differences in the sinking organic matter flux and composition and use these results to inform our interpretation of the accumulation fluxes and compositions determined from the combined multi-core, gravity-core records. The sediment record, which expands the last 2,000 years or accumulation study, with a time resolution of about 5 years, is used to evaluate changes in the oceanographic conditions in Cariaco Basin during the late Holocene.
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EFFECTS OF STATUS AND DENSITY OF A THREATENED CORAL SPECIES, ACROPORA CERVICORNIS, ON CORAL REEF FISH RECRUITMENT: IMPLICATIONS ON FISHERIES MANAGEMENT

Acropora cervicornis, a "threatened" Caribbean coral species (U.S. ESA, 2006), is an important reef builder. Since it is structurally complex (i.e. density/health status of thickets) and often occurs in large monospecific patches, it is thought to be an important habitat for coral reef fish recruitment, including commercial fishes. Therefore, its recent demise could result in significant reduction in the abundance and diversity of coral reef fish assemblages. This study is aimed to understand the effect of status (i.e. alive/dead) and density (5, 20 and 25 branches) of A. cervicornis on fish recruitment. Fish abundance and diversity were estimated every 2 weeks for 5 months. Data was analyzed following a two-factor design which involved manipulation of coral density (3 levels) and status (2 levels). No detectable effect between live/dead treatments was found; however recruitment was dependent on coral density (G = 41.21, df=2, P < 0.001). Preliminary results show that structural complexity is the major factor affecting fish recruitment being Haemulon spp. the most abundant species (96.52%, n=2588). This highlights the importance of density as a key factor for fisheries management.

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THE INTENSIFICATION OF HURRICANE GEORGES IN THE EASTERN CARIBBEAN REGION THROUGH ITS INTERACTION WITH AN ANTICYCLONIC EDDY

Hurricane Katrina intensified upon moving over an area of positive sea surface height anomaly (SSHA) in the Gulf of Mexico, therefore fueling interest in understanding oceanic mesoscale eddy - tropical cyclone interactions. Oceanic heat content (OHC) in the area where Katrina interacted with the anticyclonic eddy was found to be high, ranging from 23.90 - 33.46 Kcal/cm2. The Western Tropical Atlantic and the Eastern Caribbean region exhibit considerable anticyclonic activity, suggesting the occurrence of particularly elevated OHC areas in this region. A study of four tropical cyclone systems in the Eastern Caribbean (EC) region has shown that SSHA exerts a greater influence on OHC than sea surface temperature (SST) does. In the EC Hurricane Georges was the only one among these four systems that moved over waters with comparable OHC (38.5 to 43.5 Kcal/cm2) to that of the Katrina case and the only system to undergo a similar intensification.

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FROM ALL SIDES - REAL AND PERCEIVED THREATS IN THE BENGAL DELTA

Among a long list of potential threats to sustainability of the Ganges-Brahmaputra delta and its 150 million occupants, which pose the greatest risks? Sea-level rise is regarded as a critical threat to >40,000 km2 of the delta <3 meters in elevation. However, various inundation scenarios do not account for high rates of vertical accretion or morphodynamic feedbacks between the delphian and inner shelf. At least 200 million tons of the river’s annual sediment load is trapped in this zone, largely during the period of elevated sea level and high discharge forced by the summer monsoon. Furthermore, tide-gage records from much of the delta indicate sea-level rise rates less than the global average. Thus, scenarios of large-scale inundation in the coming century may be mitigated through natural system responses and feedbacks. In contrast, anthropogenic effects on the delta are greatest during the 8-month dry season when the sedimentary system is comparatively inactive. At this time, the impact of water diversion on channel stability, groundwater extraction on local subsidence, and resulting saltwater intrusions may represent a greater threat to the regional population.

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EMERGING TECHNOLOGIES FOR PUBLIC HEALTH APPLICATIONS OF COASTAL OBSERVING SYSTEMS

This presentation will provide an overview of how molecular methods offer the possibility of rapidly identifying multiple genetic signatures with the aim of better protecting human health and coastal resources. Targeted nucleic acid extraction on local subsidence, and resulting saltwater intrusion may represent a greater threat to the regional population.

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ASSIMILATION OF HF RADAR DATA INTO OCEAN CIRCULATION MODEL. DURING AN EXTREME WEATHER EVENT

A HF Radar based surface current observation system has been developed in Raritan Bay, NJ and the New York Right Apex, which consist of four standard range (25MHz) Coastal Ocean Dynamics Application Radar (CODAR) Seasonal systems located at Sandy Hook, NJ; Breazy Point, NJ; Bayshore Water Front Park, NJ; and on the south shore of Staten Island, NY. The current work focuses on the utilization of the HF Radar data by assimilating it into an estuarine and coastal ocean circulation model which provides nowcasts and forecasts for the study domain. This model, forced by an extensive real-time observational network, is called the New York Harbor Observing and Prediction System (NYTHOPS), which is based on the Estuarine Coastal and Ocean Model (ECOM). Assimilation of HF Radar data into the NYTHOPS model is performed using a nudging scheme. An extreme weather event of high wind and coastal flooding were considered for the data assimilation experiment. The assimilated model simulations were critically analyzed with respect to density profile variations and coastal upwelling / downwelling processes measured during this extreme weather event.
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DIFFUSION OF PARTICLES IN ISOTROPIC TURBULENCE USING HIGH SPEED DIGITAL HISTOLOGIC CINEMATOGRAPHY

High speed in-line digital histologic cinematography is used for studying turbulent diffusion of several diameter. In several examples, it is observed that diffusion is faster than pure molecular diffusion. The experiments are performed in a 50x50m sample volume in a controlled, nearly isotropic turbulence facility. Diffusion rate is calculated by integration of the Lagrangian velocity autocorrelation. Droplet diffusion rate in horizontal (Dx) and vertical direction (Dz) are found to be significantly lower than that of fluid at low turbulence level and exceeds it at higher turbulence level. Dx is greater than Dy for most of the data due to horizontal droplet velocity RMS exceeding the vertical one. The vertical droplet diffusion timescale (Ty) is higher than the horizontal timescale (Tx). The droplet diffusion coefficient is calculated by quiescent rise velocity (Uq) times turbulence integral length scale, UqT or UqTy monotonically increases as a function of fluid RMS scaled by Uq. Experiments with phytoplankton, in salt water with Kolmogorov scale (k) imm as observed in the ocean, show that since phytoplankton size – (1/15k) their diffusion is similar to fluid diffusion.

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INDONESIAN THROUGHFLOW [ITF] 2004-2006, AS OBSERVED BY INSTANT

The INSTANT program measured the ITF from the Pacific intake at Makassar Strait and Lembata Passage to the Nusa Tenggara export channels to the Indian. The time series began in December 2003, completed in December 2006; during mostly a weak El Niño state, interrupted by a ~6 months La Niña in early 2006. A +1OD event peaked in October-November 2006. A composite view of along-channel speeds within each passage reveals variability across a wide range of scales, marked with month long periods of inflow during November-December 2003, February-March 2004, and February-March 2005. A second goal of this project is to measure cross-shore variations in orientation and rotational direction of tidal ellipses. Here we wish to expand upon previous studies that have showed a switch in the rotational direction of tidal ellipses for certain tidal constituents and a shift in the dominance of tidal constituents at the continental shelf break.

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SPATIAL AND TEMPORAL VARIABILITY IN MOLECULAR COMPOSITION OF RIVERINE ORGANIC MATTER DELIVERED TO THE US ATLANTIC COAST

An assessment of six large rivers along the US Atlantic coast was conducted under low and high flow conditions to identify compositional variability and downstream transformations of riverine particulate organic matter. Lipid biomarkers were used to evaluate the relative intensity from allochthonous and autochthonous sources to each system. A high carbon preference index within the hydrocarbon composition indicated an important terrigenous contribution to the particulate OM pool to all rivers systems. Across-river differences in hydrocarbon abundance were apparent. A significant input from fossil organic matter was also evidenced through short-chain hydrocarbon distributions. Phospholipid content and composition revealed a particle-associated bacterial community that was low in abundance and diversity under high flow conditions in all sampled areas. Overall, allochthonous inputs dominated the organic matter flux during high flow conditions, regardless of land-use patterns or lithology. Current research efforts aim to evaluate the change in organic matter source during low flow conditions.

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THE NAVAL OCEANOGRAPHY PROGRAM: A BUSINESS MODEL TRANSITION AND WORKFORCE TRANSFORMATION COLLIDE

The Naval Oceanography Program (NOP) recently underwent a 29% workforce reduction, from 3900 personnel to 3000. This reduction forced a shift in the NOP business model and the development of a new strategy, called Battlespace On Demand (BonD). These changes increased functional differentiation and led to problems with: (a) control of organizational technology and communications; and (b) management of organizational learning and development of sustained workforce competencies. These problems, and the approaching exodus of 50-60% of the workforce as Baby Boomers retire, require the importance of strategic workforce transition planning. This planning is being conducted as part of the NOP workforce development program, which is designed to prepare a highly flexible, competent, and adaptable body of workers with the knowledge, skills, and competencies required to execute NOP's long-term strategic plans. NOP requires a new cadre of workers armed with the knowledge and competencies to support exploitation of the 21st Century battlespace. This in turn requires national, local, and organizational partnerships to ensure development of a common vision and initiatives for creating the knowledge, skills, and competencies needed to implement BonD.

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A LOOK AT CROSS-SHORE VARIATIONS IN TIDAL CURRENTS USING HF RADAR

Three high frequency radar (CODAR) instruments began monitoring sea surface currents in the Gulf of the Farallones off the Coast of San Francisco, California in May 2006 as part of the State Coastal Conservancy funded Coastal Ocean Currents Monitoring Program (COCMP). This has provided an unprecedented spatial and temporal view of sea surface currents in this region. Previous studies have examined the complex surface currents in the Gulf of the Farallones using Acoustic Doppler Current Profilers (ADCPs) and the results of these studies did not have a year of continuous hourly data nor 3km resolution that is now available. One of the aims of this project is to develop and test a process in which harmonic tidal analyses using T_tide are performed on HF radar sea surface currents to separate out calculated cross-shore currents from meso-scale currents. Once the tidal currents are separated out, the residual currents can be compared to subtidal forcing mechanisms such as wind forcing. Hourly wind direction and wind speed data are provided by NDRC buoy 46026 which is situated within the study region. A second goal of this project is to measure cross-shore variations in orientation and rotational direction of tidal ellipses. Here we wish to expand upon previous studies that have showed a switch in the rotational direction of tidal ellipses for certain tidal constituents and a shift in the dominance of tidal constituents at the continental shelf break.

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NUMERICAL REPRESENTATION OF INTERNAL WAVES IN THE HYBRID COORDINATE OCEAN MODEL (HYCOM)

Internal wave breaking is one of the primary sources for turbulent mixing in the ocean interior and consequently plays an important role in maintaining the strength of the thermohaline circulation. It is therefore important to have a good representation of these waves and their associated mixing in oceanic general circulation models. First, HYCOM is configured for a barotropic tidal flow interacting with a seamount and with isopycnic vertical coordinates. The wave characteristics and tidal rate of conversion derived from the numerical experiments are then compared to the analytical solution. Second, the ability of current diapycnal parameterizations (KPP, Mellow-Yamada, etc.) to represent the mixing associated with internal wave breaking is evaluated in a HYCOM configuration with a realistic tidal flow over Fieberling Guyot. The results are quantified by a comparison to observations taken during the Flow over Abrupt Topography initiative.

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TEN YEARS OF SATELLITE OCEAN COLOR IMAGERY: ASSESSING SPATIAL AND TEMPORAL OPTICAL VARIABILITY IN THE NORTHERN GULF OF MEXICO

We examine optical variability in the northern Gulf of Mexico over a ten-year period (1998-2007) using satellite ocean color imagery (SeaWiFS). We have measured these values with consistent atmospheric correction and bio-optical models to evaluate these data suitable for long-term trend analysis. Weekly and monthly composite images of a broad suite of satellite-derived optical and biogeochemical properties (phytoplankton, detrital, sediment, and colored dissolved organic matter absorption coefficients; organic and inorganic suspended particles; fluorometry) are statistically analyzed. We examine regional-scale spatial variability in several coastal and offshore regions, including coastal Louisiana, Mississippi Sound, Mobile Bay, and the Mississippi River delta. Through examination of temporal anomalies, correlations, analysis of variance, and optical water mass classification, we examine how changes in coastal and offshore regions, the dominant optical characteristics in each region. Across all regions and years, absorption by dissolved organic matter represents the single largest absorbing component. We relate the observed patterns in the optical properties to physical forcing (river discharge, winds, currents) to better understand the oceanographic processes impacting the optical distributions.
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VALIDATION STRATEGY FOR JOINT SSS/SST OBSERVATIONS IN THE CONTEXT OF SALINITY MONITORING FROM SPACE
Historically, strategies for validating satellite observations focused either on subdatasets for which reference in-situ measurements are available, or subdatasets of crossover points. Therefore, most observations are not used in the validation process, and a long time is required to gather the requisite validation data. In the upcoming years, spaceborne radiometers will provide salinity observations with high noise levels and external contaminations. It is thus important to adopt a validation strategy that takes advantage of the entire dataset in order to provide quality assessment with reasonable delays, filtering out spurious data before producing regularly spaced salinity fields.
Consequently, a global salinity validation strategy is proposed and tested with in-situ data. A global Argo profiler dataset is used to derive low-pass filtered salinity and temperature fields and anomalies to these mean fields. Large statistical anomalies are detected. We propose to take advantage of the observed temperature and salinity pair and independent co-located satellite data to validate the observations. Examples are presented using local wind and sea level to check for correlations with the salinity observations. Discrimination of geophysical anomalies from non-geophysical ones is achieved.

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EXPLORE MECHANISMS OF SPECIES COEXISTENCE THROUGH MOLECULAR IDENTIFICATION OF GUT CONTENTS IN HYDROTHERMAL VENT GASTROPODS
Species diversity may be lower at hydrothermal vents than other deep-sea habitats, as result of the steep environmental gradients and chronic disturbance associated with seafloor volcanism. However, the diversity of some taxonomic and functional groups is unusually high compared to analogous shallow-water marine communities on hard substrates. For example, there can be as many as 13 species of grazing gastropods in a single aggregation of Riftia pachyptila, which is just a fraction of the regional gastropod species pool. Some gastropods are ubiquitous and others are found in specific microhabitats, stages of succession, or associated with different foundation species. Despite the abundance and diversity of vent gastropods, little is known about their diet and feeding ecology. We used molecular genetic identification of gut contents to determine the food sources of vent gastropods and to explore the role of gut contents as a mechanism for either species coexistence or species turnover in the spatial and temporal dynamics of vent communities.

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COMPARISON OR MARINE X-BAND RADAR DERIVED SURFACE ELEVATIONS WITH ASSIS BUOY EVOLUTIONS OF NON-LINEAR INTERNAL WAVE EVENTS
During the summer of 2006, the Nonlinear Internal Waves Initiative (NILWI) experiment took place off the New Jersey coast near the shelf break. Extensive in-situ instrumentation were deployed to collect an unprecedented data of nonlinear internal waves propagating onto the shelf. The intensive set of surface and sub-surface measurements also included surface vessels, satellite and ship-based radar. Marine X-band radar images readily detect and image internal waves. During such NILWI events the radar backscatter images were inverted to surface elevations maps and compared to surface elevations from an array of wire wave gauges on the ASSIS buoys. Also estimates of surface currents are derived and compared with near-surface ADV measurements from the ASSIS buoy.

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RECOVERY RATE OF SEAGRASS FROM BOAT PROPELLER SCARS IN MOSQUITO LAGOON, FLORIDA
We have designed a manipulative experiment to compare restoration techniques that maximize habitat recovery when boat propellers scar shallow seagrass beds. This study has identified four propeller scar severities and documented the frequency of each scar severity in Mosquito Lagoon. Out of 110 scars measured, the most severe scars (Type 1) were most common (56%). Type 4, the least severe scars were the second most common (27%), followed by Type 2 (10%) and Type 3 (7%) scars. Scar measurements were used to design an experiment to test the recovery rate of each scar severity and three restoration methods over a one year period. Restoration methods include planting with garden staples in the scar trench, filling the trench with sand, and filling with sand and planting garden staples. Here we present seagrass recovery results for Halodule wrightii after two months: Type 4 scars have recovered to 100% of the surrounding density, Type 3 scars to 20%, Type 2 scars to 3%, and Type 1 scars have shown no recovery. All restoration methods have been eroded or buried after 2 months.

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ARCTIC PRESSURE RIDGES - REFUGIA FOR SEA ICE FAUNA?
The information on the biology of Arctic pressure ridges is very scarce, likely due to the difficulties in sampling this environment. We conducted a survey of the occurrence of sea ice meio- and macrofauna along pressure ridges in the Canada Basin in summer 2005 using ice samples and in-situ counts provided by divers. These results were compared with species occurrence at adjacent levels of the ice. Our data indicate that both sea ice meiofauna (e.g. turbellarians) and macrofauna (mainly amphipods) inhabited the pressure ridges in enhanced abundances compared to the level sea ice. The presentation will discuss likely reasons for this observation and implications for species distribution and survival in a warming Arctic.

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RESPONSE OF MICROZOOPLANKTON GRAZERS TO SIMULATED HETEROSIGMA AKASHIWOO BLOOMS
Heterosigma akashiwo is a bloom-forming, planktonic Raphidophyceae that occurs worldwide and can lead to severe ichthyotoxicity. Negative effects of H. akashiwo on microzooplankton grazers may partially explain how blooms of this harmful species arise. This study describes the effects of a local 2006 Heterosigma akashiwo isolate (CCMP2809) on predator-prey interactions within laboratory cultures and natural planktonic communities. Results suggest that the excess of H. akashiwo was exposed to varying proportions of two algal species: Heterosigma akashiwo and a beneficial dinoflagellate, Heterocapsa triquetra. Ciliate growth or mortality rates and feeding levels were measured to determine the toxicity of H. akashiwo. The response of natural planktonic communities was observed in samples collected from northern Puget Sound, Washington, USA. Samples were exposed to bloom-density concentrations of H. akashiwo for 24 hours. Ingestion of the alga by individual grazer species was measured with episulfurous microscopy. Microzooplankton community responses were determined from abundance changes and feeding rates.

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THE IMPORTANCE OF ALLELOPATHY FOR HAB BLOOM FORMATION AND EXTERNAL FACTORS INVOLVED IN THIS PROCESS
The ability of some algae to produce and release chemicals able to kill or inhibit the growth of other algal species is called allelopathy. The effect of the allelochemics on the target seems to be stronger in ichthyotoxic non-ichthyotoxic species. While for some algal species, like e.g. the flagellate Prymnesium sp., the allelochemics seem to be the same substances as their toxins, for other algae it is not. Although Alexandrium spp. are able to allelopathy, their internal toxins (saxitoxins) are not able to inhibit the growth of other algal species. Allelopathy enables the producer to out-compete other algal species for inorganic nutrients, but for some species, also to ingest the target (even grazers) after immobilising and killing them with the help of the allelochemicals. Allelopathy can be considered as either a N or P deficiency in the same manner as toxicity. We can assume thus that a consequence of the increased input of N and P to aquatic ecosystems, by creating an unbalanced NP situation favor HAB species able to produce higher amounts of allelochemics under such conditions.

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THE BROWNIFICATION OF S SWEDISH LAKES - CAUSED BY INCREASED PRECIPITATION, DECREASED SULFUR DEPOSITION OR CHANGED LAND USE?
Running waters and lakes contain high concentrations of DOC. There is increasing evidence that most of this is of allochthonous origin. DOC concentrations in surface waters are not stable, but show pronounced fluctuations and trends on multyear time scales. In S Sweden DOC concentrations in freshwaters have increased considerably during the last 20 years. If this is a long-term trend, or just decadal fluctuations, and what is the cause, is controversial. There are three, not mutually exclusive candidates: more precipitation (in combination with less ground frost), lower sulfur deposition (reversed acidification) and a change in land use (less agriculture and more coniferous forests). Data for 40 lakes in S Sweden from July 2007, a period with exceptionally high precipitation, indicate that climate factors may be important. However, monitoring data of lakes from the last 20 years are also consistent with the Sulphur Deposition Hypothesis. In a multidisciplinary project we are making experimental manipulations of sulfur deposition, paleoecological reconstructions of lake DOC and land use, and investigating the ecological effects from increased lake DOC on plankton and submerged vegetation.

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CORES, KIDS, CLIMATE AND THE K-T TO POINTS IN THE LEARNING'S School of Rock - 2007 participated in laboratory exercises and field work at the Integrated Ocean Drilling Program’s (IODP) Gulf Coast Repository at Texas A&M, then collaborated on curriculum activities for middle grade, high school and college students at their home institutions. Sample some simple classroom activities that introduce students to Deep Ocean Drilling, and examine field work developed at a late Cretaceous site in New Jersey.
INVESTIGATION OF MESOSCALE BIOLOGICAL INTERACTIONS WITHIN A CYCLONIC EDDY IN THE NORTH PACIFIC SUBTROPICAL GYRE

As part of the 2007 summer training course “Microbial Oceanography: from Genomes to Biomes”, hosted by C-MORE and sponsored by the Agouron Institute, we conducted a 10-day research expedition to study the physical, chemical, and biological properties in and around a cyclonic eddy located at 21.7°N 158.08°W in the North Pacific Subtropical Gyre. The location of the eddy was tracked using satellite imagery, shipboard ADCP measurements, and hydrographic and biogeochemical transects. We sampled inside and outside the eddy to compare microbial abundance, biomass, diversity, primary and secondary production, and export of C, N, P, and Si. We also conducted manipulation experiments to investigate bottom-up and top-down controls on microbial production and diversity. Primary production at the center of the eddy (85 mmol C/m²/d) was nearly twice that at the eddy’s periphery. While particulate silica export at 150 m showed a 3.8-fold increase from the periphery to the eddy’s center, carbon export was high (2.7 mmol C/m²/d) but relatively constant, with a corresponding high PSiPC export ratio (180 μmolSi/mmolC).

Graves, S. J., University of Alabama-Huntsville, Huntsville, USA, sgraves@itsc.uah.edu; Smith, M. R., University of Alabama-Huntsville, Huntsville, USA, msmith@itsc.uah.edu; Conover, H. T., University of Alabama-Huntsville, Huntsville, USA, iconover@itsc.uah.edu; Keiser, K. R., University of Alabama-Huntsville, Huntsville, USA, kkeiser@itsc.uah.edu; SSCOOP DISTRIBUTED INFORMATION MANAGEMENT SERVICES FOR COASTAL MODELING

The University of Alabama in Huntsville is developing a suite of advanced technologies to provide a data and information infrastructure for SSCOOP (SSURA Coastal Ocean Observing and Prediction). Through its SSCOOP program, SURA (Southeastern Universities Research Association) is developing a distributed coastal laboratory, linking oceanographic sensors, models and data. SSCOOP’s goal is to create a scalable, modular system for forecasting storm surge and wind-driven waves, as an Integrated Ocean Observing System (IOOS) test bed. UAF’s Scientific Catalog for Open Research Exchange (SCORE) includes an extensible catalog and inventory of SSCOOP models, forecasts and observations. An interactive user interface integrates semantic searching, browsing and data ordering across the catalog and distributed data archives. Remote software provides direct access to these capabilities in a service oriented architecture. SCORE provides the data and information management foundation for the SSCOOP cyberinfrastructure, which also includes data transport, translation, archives, application management, monitoring, validation and visualization. This infrastructure provides data and forecasts in near real-time, for more reliable, accurate and timely information to help plan for extreme events, facilitate safe maritime operations, and support coastal security.

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Observations of physical characteristics along and across a front in the California Current were made during the AESS 2006 project, focusing on the interplay of dynamics between mixed layer turbulence and submesoscale features. A neutrally buoyant Lagrangian float built at APL/UW measured temperature, pressure and salinity, surface wave spectra, and acoustically tracked position along the front, while the Triaxus towed profiler resolved the three-dimensional volume around the float in the drifting reference frame. A second towed profiler executed larger scale surveys focused on characterizing mesoscale variability associated with the front. Taken together these measurements document frontal evolution at 5 - 10 km scales. The analysis of the combined data sets is compared to existing operational models to assess how well current models simulate the observed mixing and restratification.

Greb, S. B., Wisconsin Department of Natural Resources, Madison, USA, steven.greb@wisconsin.gov; ADVANCING THE USE OF REMOTE SENSING FOR WATER QUALITY

In March of 2007, a workshop on Inland and Nearshore Coastal Water Quality Remote Sensing was held by the Group on Earth Observations (GEO). The goal was to bring together remote sensing data providers and expert users to improve our ability and capacity to remotely assess and monitor inland and nearshore coastal water quality. More specifically, the objectives were to evaluate existing and planned remote sensing capabilities; identify gaps relative to user needs in the acquisition, processing, distribution and utilization of remote sensing data and derived products for water quality research and applications; and formulate potential solutions. This paper presents the outcomes and recommendations of the workshop. The author also presents one example of closing the gap between providers and users in a collaborative effort involving the university, management agency and user groups in Wisconsin. Joining, this group is producing state-wide water clarity maps from remote sensing data (LandSat) and in situ measurements.

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Variable sea ice duration, low seawater temperature, and low zooplankton populations in the spring in the northern Bering Sea result in high export of labile organic carbon to the sediments. Both sediment oxygen uptake (short-term indicator of carbon supply to the benthos) and benthic biomass (longer-term indicator of carbon export) respond at different time scales to organic carbon reaching the sediments. Approximately 60 experimental stations were occupied in 2000 and 2007 on USCGC Healy as part of a continuing multi-decadal effort to assess status and change in the highly productive northern Bering Sea benthic ecosystem. Sediment oxygen uptake ranged from c1-27.8 mmol O₂ m⁻² d⁻¹ and reoccurrence of some stations during the cruise facilitated tracking the timing and impact of export production on the benthic sediment as sediment oxygen uptake rates increased following low carbon export from the spring bloom. Measurements of benthic infan- nual biomass (2.2–48.1 g C m⁻²) show that the dominant bivalve, polychaete and amphipod
communities vary depending upon overlying water masses and sediment type, but overall biomass has declined, possibly as a result of changing environmental conditions.

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ENGAGING TEENAGE GIRLS IN THE OCEAN SCIENCES VIA THE OCEANOGRAPHY CAMP FOR GIRLS: BARRIERS, SOLUTIONS, AND SUCCESSES
This presentation will provide an overview of the barriers encountered, solutions, and successes experienced during the 17-year voyage of the Oceanography Camp for Girls. This NSF model program provides an excellent case study of how to provide an inclusive science program for minority and non-minority students of multiple learning abilities. We will share what has worked, what has not, and what key elements have led to sustained success. Evaluations indicate that intervention has made a difference. Alumna have: 1) taken on math and science courses in high school; 2) gained a realistic and positive image of science and scientists; 3) improved their understanding of the research process; and, 4) strengthened their commitment to pursue careers in math, science or engineering. Nearly 20% of alumna in college are pursuing science-related degrees. Particular attention will be paid to the role of the participating ocean scientists in this program. We will provide a number of strategies developed to achieve successful inclusion of scientists and learners through group learning, team building, open dialogue, positive asset building, and introspection.

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THE ROLE OF SYMBIOTIC BACTERIAL SIDEROPHORES IN PROMOTING PRIMARY PRODUCTIVITY
The development of primary productivitiy in the marine environment is critical to the marine food web and the sequestration of anthropogenic CO₂. While phytoplankton fix CO₂ in to biomass, the remineralization and major biogeochemical cycles are driven by bacterioplankton – the microbial miles that surrounds phytoplankton at various spatial scales. While phytoplankton cells in the field and laboratory culture act as ‘hot spots’ for bacterial activity because of the exudates they excrete, emerging evidence suggests that some bacterial associates of phytoplankton are important to the growth and physiological well-being of algal cells. However, our understanding of the nature of such inter-kingdom interaction is still in its infancy. One hypothesis for such a phenomenon may be that phytoplankton ‘hijack’ iron, an element that often limits their growth, from extracellular siderophores produced by bacterial associates. Here we report the isolation of a range of Marinobacter species from different phytoplankton cultures, and the chemical isolation and characterization of the extracellular siderophores produced, coupled with genomics analysis of one producing strain. Strains belonging to two species clusters were found to produce the dicarboxylic siderophore, Vibrioferrin (VF), and contained genes necessary for its production. Our evidence suggests that VF could have a role in supplying phytoplankton with their limiting nutrient.

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FRONTLINE MENTORING: DEVELOPING EFFECTIVE MENTOR TRAINING FOR POST-DOCTORAL FELLOWS AND JUNIOR FACULTY
Post-doctoral fellows and junior faculty, our front-line mentors, benefit from training in a variety of mentorship skills, teaching pedagogies and assessment strategies, enabling them to effectively meet the challenge of broadening access and participation within the ocean sciences throughout their careers. The Center for Coastal Margin Observation and Prediction (CMOP) piloted a REU program which includes a training component designed to build mentorship skills and foster an interdisciplinary, student- and team-centric approach. Participating post-doctoral fellows and junior faculty received materials and training related to various student development theories, enabling them to collectively design an internship curriculum which features the development of laboratory skills, writing skills, fieldwork techniques, presentation skills, and individual and group problem-solving skills. The REU Program included a structured process for individual and collective communication and evaluation of each student and of the cohort as a team. Challenges include incorporating senior faculty mentors, working across institutional boundaries, and finding time for intentional collaboration in a busy academic environment. With more development and assessment, we expect mentorship training to become an integral part of CMOP academic culture.

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OBSERVATIONS OF THE SPRING BLOOM ON THE INNER SCOTIAN SHELF
The 2002 spring bloom on the inner Scotian Shelf is examined using a mooring array deployed to provide physical, chemical and biological measurements with high temporal and vertical resolution. These measurements are complemented by bi-weekly occupations of a station near the mooring site (HL2). Results show that coastal upwelling played an important role in the initiation of the spring bloom near the coast and, during this period, very strong horizontal gradients in peak chlorophyll were observed. The bloom at HL2 is sustained for most of the mooring period with peak chlorophyll levels reaching 6 mg m⁻³. Following the draw down of nutrients in the upper 20 m of the water column, the surface bloom continued for 9 days and then disappears at the surface but remains at the depth of the nutricline (30-50 m). Mesozooplankton biomass does not change significantly until the very end of the mooring period indicating the grazing by this component of the zooplankton may not have had as important a role in the termination of the bloom as the exhaustion of near-surface nutrients.

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MULTIPLE REGRESSION MODELS FOR HINDCASTING AND FORECASTING MIDSUMMER HYPOXIA IN THE GULF OF MEXICO
Statistical models suggest that spring nitrate load from the Mississippi River and climatic/hydrologic variations in the Basin explain much of the variability in midsummer hypoxic zone area in the Gulf of Mexico. However, managing nutrients across the Mississippi River Basin requires improved understanding of the relative importance of river flow and riverine nitrogen and phosphorous concentrations since both are important in biogeochemical processes leading to hypoxia. Stepwise multiple regression analysis and error estimation was used to evaluate relationships between Mississippi River flow, in-stream N and P concentrations and the midsummer size of hypoxia. Up to 25% of the variability in midsummer hypoxia was explained by river flow alone. Multiple regression relationships incorporating May flow, May nitrate and February total phosphorus concentrations explained up to 60% of the variation in midsummer hypoxia. Model hindcasts suggest that significant hypoxia was present back to 1950. Monte Carlo simulations were used to forecast the effects of changing river flow and reduced N and P concentrations on hypoxia, and included an evaluation of uncertainty resulting from both natural variability and limitations of model skill.

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REVERSAL OF EUTROPHIC CONDITIONS IN TAMPA BAY, FLORIDA, USA
Recovery of seagrass coverage in Tampa Bay, Florida to levels observed in 1950 (15,400 ha) is a long-term goal adopted by local, state, federal and private partners participating in the Tampa Bay Estuary Program. Nitrogen controls initiated in 1980 and continuing through progress (from wastewater treatment facilities, stormwater treatment, fertilizer manufacturer, and power plants) resulted in a 60% TN load reduction compared to the mid-1970s. As a result, annual water clarity and chlorophyll targets necessary to support seagrass recovery are being met, and seagrass coverage in 2006 was the highest recorded since 1950 (but still 5500 ha lower than 1950 coverage). The largest contributors towards future reduction targets are expected to be local power plant emissions controls and reuse of wastewater. However, reductions from many sources will be required to maintain the gains made towards reversal of eutrophic conditions in Tampa Bay, as population is expected to double within the next 10-15 years in the watershed. Public and private members of the Tampa Bay Nitrogen Management Consortium have pledged to collectively meet load reduction targets through 2012.

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OCEAN COLOR CLIMATE CONDITIONS USING MULTIPLE DATA SOURCES AND MODELS
The satellite ocean color data record spans multiple decades. It is potentially a critical resource for understanding how global ocean ecosystems have responded to modern warming. This time series is constructed from many sensors. Unfortunately, global and regional ocean color model estimates from overlapping missions show substantial biases, limiting their use to construct consistent data records. SeaWiFS and MODIS-Aqua differed by >10% globally in overlapping time segments, late 2002-2004. Thus each time series begins and ends with the launch of each mission. We report that mission-to-mission biases can be reduced by using a combination of in situ data and models. Using in situ data in new directly for bias reduction (i.e., calibration) and in post-processing analysis methodologies, along with data assimilation can produce a consistent long-term time series. We define ocean color climate records to meet the broad definitions of NRC, but additionally impose more stringent requirements specific to the science of ocean color: 1) all mission-dependent biases removed or quantified, 2) no obvious interannual discontinuities unattribut-
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LARGE-SCALE AND SMALL-SCALE LABORATORY SIMULATIONS OF GRAVITY-DRIVEN COASTAL CURRENTS

Laboratory experiments simulating gravity-driven coastal currents are described. In natural environments such currents develop when estuarine fresh-water discharges into ocean. Results from three complementing experimental studies are discussed and compared to a new geostrophic model. The first study was conducted in a small-scale (1m diameter) water-filled rotating tank. The other two studies were carried out at the large-scale Coriolis turntables at Grenoble (1m diameter) and Trondheim (3m diameter). Currents were generated by releasing buoyant fresh-water continuously from a small source at the fluid surface. The height, width and length of the currents were studied as a function of the background rotation rate, the volumetric discharge rate at the source and the density difference between fresh and ambient fluid. The small-scale experiments and the Grenoble study focused on the simplest case of currents flowing along vertical coastlines in an, effectively, infinitely extended domain. The Trondheim study generalized these results by investigating how the dynamics are affected when currents flow along inclined coastlines with different inclination angles with respect to the horizontal.

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RESOLVING THE UNRESOLVED COMPLEX MIXTURES OF HYDROTHERMAL PETROLEUM USING COMPREHENSIVE TWO-DIMENSIONAL GAS CHROMATOGRAPHY - TIME OF FLIGHT MASS SPECTROMETRY

Sedimentary organic matter in hydrothermal systems can be altered by high temperature fluids resulting in petroleum generation. These hydrothermal petroleums are compositionally similar to conventional oils except they often contain substantial mixtures of coal-tar products that produce a dramatically rising gas chromatogram termed an unresolved complex mixture (UCM). Little is known about these UCMs or why and how they form. Apolar fractions of four hydrothermal petroleum samples from the Middle Valley, Juan de Fuca Ridge and Escanaba Trough, Gorda Ridge in the NE Pacific Ocean and the Guaymus Basin, Gulf of California were analyzed by comprehensive two-dimensional gas chromatography-Time of Flight Mass Spectrometry (GC×GC-ToFMS). The GC×GC chromatograms of these samples elucidate two hydrocarbon subsets. The first consists of common hydrocarbon series such as n-alkanes, naphthalenes, steranes, and hopanes. The second subset is dominated by UCM forming compounds, which elute as continuous series of configurational isomers that become increasingly refractory with increasing chain length. The effect of estuarine fresh-water discharge to the coastal ocean offshore northern Puerto Rico was studied using long-term time series CTD profiles, dissolved oxygen and temperature data, and observations from a nutating benthic sediment trap located at 17°13'N, 66°10'W. In this highly productive area, bacterial respiration rates range from 3 to 4 mmoles of CO₂ m⁻² h⁻¹, which is comparable to rates reported for tropical coastal oceans. The CTD profiles revealed a distinct seasonal cycle in the vertically integrated (0-250 m) salinity and nutrients, with low values in summer and high values in winter. The high nutrient and oxygen levels in summer are likely due to enhanced upwelling and increased photosynthesis. The sediment trap data revealed a seasonal cycle in the cumulative flux of particulate organic carbon (POC) and nitrogen (N), with high values in summer and low values in winter. The summer high POC flux is likely due to enhanced primary production and increased resuspension of sediments from the bottom. In contrast, the winter low POC flux is likely due to decreased primary production and reduced resuspension of sediments. The seasonal cycle in the cumulative flux of dissolved inorganic nitrogen (DIN) is more complex, with high values in spring and low values in summer. The spring high DIN flux is likely due to enhanced nitrification and enhanced resuspension of sediments from the bottom. In contrast, the summer low DIN flux is likely due to enhanced denitrification and reduced resuspension of sediments. The seasonality of the cumulative fluxes of POC and DIN is likely due to the combined effects of seasonal changes in upwelling, resuspension, and primary production. The seasonal cycle in the cumulative fluxes of POC and DIN is likely due to the combined effects of seasonal changes in upwelling, resuspension, and primary production. The seasonal cycle in the cumulative fluxes of POC and DIN is likely due to the combined effects of seasonal changes in upwelling, resuspension, and primary production.
Food webs on sand shoals may differ substantially from off-shoal locations, because the shallowness of depth and sandy substrate supports the growth of benthic microalgae (BMA), which may serve as an important benthic carbon source rare or not present in the phyto- detritus based benthos of deeper waters. Carbon stable isotopes of BMA are typically different than phytoplankton. Consequently, if importance of BMA and phytoplankton as basal carbon sources differs between on and off shoal locations, it should be reflected in the isotopic values of consumer tissues. To compare benthic food webs on shoal and off-shoal locations, δ13C and δ15N values were determined for several species from multiple trophic levels. Preliminary results indicate δ13C for BMA (-196) and phytoplankton (-197) are similar, while larger differences exist for δ15N (5.1 and 7.3 for BMA and phytoplankton, respectively) and, therefore, δ15N may be a useful indicator of basal food sources. Preliminary results indicated that the δ15N values of phytoplankton feeding mysids and barnacles were ~4‰ higher than sediment burrowers such as lancelets and sipunculids.

The influence of the Mekong River discharge (South China Sea) was investigated during its lowest annual outflow in April 2007. The river plays an essential role in providing nutrients for the adjacent sea. The effects of nutrient inputs (NO3, PO4, Si) on nitrogen fixation (< and >10µm) and phytoplankton community structure were examined. The influence of the Mekong River discharge (South China Sea) was investigated during its lowest annual outflow in April 2007. The river plays an essential role in providing nutrients for the adjacent sea. The effects of nutrient inputs (NO3, PO4, Si) on nitrogen fixation (< and >10µm) and phytoplankton community structure were examined. High nitrogen fixation rates were detected in both size fractions within a salinity gradient (15-33 PSU). Altogether, a clear shift was observed in the composition of phytoplankton (>10µm) from autotroph dominated towards filamentous cyanobacteria. Inside the river plume, Chaetoceros, Rhizosolenia and Hemiaulus dominated and diatoms/cyanobacteria associations were considered to be responsible for the N2 fixation. Nevertheless, the measured N2 fixation rates were in an equal range in both size fractions. Further offshore, at stations with low nutrient concentrations, Trichodesmium probably accounted for the fixation. The measurements indicate that the Mekong River plume sets favorable environmental conditions for diatoms/cyanobacteria associations nearshore.

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ACQUISITION AND ALLOCATION OF CARBON IN BLEACHED HAWAIIAN CORALS

Temperature-induced coral bleaching threatens to significantly reduce coral cover globally within the coming decades. To assess why some corals appear to be more tolerant of bleaching than others, we investigated how carbon is acquired and allocated in bleached Porites compressa and Montipora capricornis corals using 13C-labeled bicarbonate in seawater and 15N-labeled nitrate as labeling techniques. Photosynthetically acquired carbon was taken up from bicarbonate by the zooxanthellae transferred to the host tissue, respired, and taken up by the skeleton at dramatically lower rates in bleached corals relative to controls, but was not incorporated into either the zooxanthellae or host tissue for long-term storage. In contrast, heterotrophically-derived carbon (i.e., rotifers) was rapidly translocated between the zooxanthellae and host tissues in bleached and non-bleached M. capricornis and non-bleached P. compressa (but not bleached P. compressa), and was not a source of carbon for calcification. Thus, long-term recovery from bleaching will depend on a balance to acquire fixed carbon via heterotrophy to support its tissues while bleached, and to regain photosynthesis in order to stimulate calcification.

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CAN WE DETECT A DECadal TREND IN THE SOUTHERN OCEAN CARBON SINK IN DATA FROM THE INTERIOR OCEAN?

Oceanic models and atmospheric data have suggested that the Southern Ocean carbon sink has substantially weakened in the last few decades, primarily as a consequence of an intensification and southward shift of the westerly wind belt. This weakening carbon sink appears to be primarily driven by an anomalous outgassing trend of natural CO2. In the region south of 35°S, our model finds a total loss of natural carbon between 1980 and 2004 of nearly 4 Pg C. Detection of this trend in the available observations represents a formidable challenge, particularly given the presence of a substantial trend in the anthropogenic CO2. Preliminary model-based results suggest that the interior ocean changes associated with the Southern Ocean circulation trends tend to be restricted to the upper ocean, and leave distinct signals that could be exploited in the observations.

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ESTIMATES OF RIVER DISCHARGE BASED ON REMOTELY SENSED SURFACE VELOCITIES AND WATER LEVELS

One promising technique for river runoff estimates from space is the retrieval of surface currents on the basis of synthetic aperture radar along-track interferometry (ATI). The oceanic models and atmospheric data have suggested that the Southern Ocean carbon sink has substantially weakened in the last few decades, primarily as a consequence of an intensification and southward shift of the westerly wind belt. This weakening carbon sink appears to be primarily driven by an anomalous outgassing trend of natural CO2. In the region south of 35°S, our model finds a total loss of natural carbon between 1980 and 2004 of nearly 4 Pg C. Detection of this trend in the available observations represents a formidable challenge, particularly given the presence of a substantial trend in the anthropogenic CO2. Preliminary model-based results suggest that the interior ocean changes associated with the Southern Ocean circulation trends tend to be restricted to the upper ocean, and leave distinct signals that could be exploited in the observations.

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One promising technique for river runoff estimates from space is the retrieval of surface currents on the basis of synthetic aperture radar along-track interferometry (ATI). The German satellite TerraSAR-X, which was launched in June 2007, will permit ATI measurements. Based on numerical simulations, we present first findings of a research project in
which the potential of satellite measurements of various parameters with different temporal and spatial sampling characteristics is evaluated and a dedicated data synthesis system for river runoff estimates is developed. We address the achievable accuracy and limitations of such estimates for different local flow conditions at selected test sites. High-resolution three-dimensional current fields in the Elbe River (Germany) from a numerical model are used as reference data set and input for simulations of a variety of possible measuring and data interpretation strategies to be evaluated. For example, discharge estimates on the basis of measured surface current fields and river widths from TerraSAR-X and water levels from radar altimeter are simulated. We discuss the applicability of the measuring strategies to a number of major rivers around the world.

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ASSESSING IMPACTS OF PROTIST MOVEMENT BEHAVIORS ON FORMATION AND DISPERSION OF THIN LAYERS AND OTHER FINE-SCALE STRUCTURES

Most protists and many other marine microorganisms use active swimming or buoyancy to escape overlying water masses and to search for food. Selective vertical movements can result in high locally aggregated concentrations of protists, as thin layers. However, other mechanisms, such as vertical variations in horizontal transport, can also cause such structures, and both demographic and physical mechanisms can act to disperse layers. It is difficult to understand or predict fine-scale patch dynamics without quantifying these mechanisms. To better assess conditions under which active movements might strongly impact thin layer dynamics, we quantified protist swimming in natural water samples, using laboratory-based observations of water samples with intact vertical structures and also using an in situ protist behavior observation platform. We used motion analysis to quantify swimming characteristics at the level of individual cells. Finally, we applied population-level modeling techniques and scaling analysis to assess impacts of cell-level movements. Our analyses suggest a delineation between regions of parameter space in which active swimming is, or is not, a significant contributor to thin layer dynamics.

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TIDAL EFFECT ON THE DENSE WATER DISCHARGE: A MODELLING STUDY

Numerical studies are carried out to validate our hypothesis, that the tide-induced shear disturbance will not only augment the benthic layer thickness, but also greatly enhance the descent of dense water over the continental slope, based on our previous analytical studies. A primitive-equation, free-surface, coastal ocean model is employed to demonstrate the sharp contrast in the density distribution in model runs with and without tidal components. Results of control runs are consistent with Ekman dynamics theory and lab experiments, which predict dense water does not descend beyond the upper slope. Hence Ekman dynamics is not sufficient for its descent, as dense water would be quickly neutralized through strong diapycnal mixing. Once tides are included, dense water discharge process is rectified in two major ways: 1) the dense benthic layer depth spans several times of the Ekman layer; 2) it descends all the way into the deep basin, far beyond tidal excursion. The separation of benthic layer and shear layer restricts the dilution of the benthic property, and greatly propels the descent process. The model output also agrees well with the observations from ANSlope.

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MODELING OF SEDIMENT TRANSPORT MODES DURING CROSSTEX EXPERIMENT

During the CROSSTEX experiment, various cycles of shoewear and offshore sandbar movement in a large wave flume were documented. Throughout these phases of bed evolution, hydrodynamic information related to waves and currents, as well as bathymetric and suspended sediment concentrations were collected. The present study evaluates occurrences of bedload and suspended load transport during onshore and offshore sediment transport events. Bedload will be estimated via an adaptation of the Meyer-Peter Muller formulation (Meyer-Peter and Muller, 1948). Suspended load will be evaluated with an advection/diffusion model (Fredsoe and Deigaard,1992). To drive these models, wave hydrodynamics are modeled using an extended Boussinesq equations model (Teran Cobo, 2007) and a phase resolving eddy-diffusive boundary layer model (Henderson et al., 2004). Undertow will be computed either from a circulation model like POM, or from recorded data. Comparisons between observed and modeled results for sediment concentration, sediment flux, and bathymetric change, but also wave height and water velocity, will be conducted systematically. Special consideration will be paid to identifying the dominant modes of sediment transport during the different phases of the experiment.

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PSEUDOCALANUS IN SVALSWARD WATERS; DISTRIBUTION PATTERNS OF TWO SIBLING COPEPOD SPECIES

Marine copepods of the genus Pseudocalanus are very common throughout the northern hemisphere. They contribute considerably to plankton biomass and are important in the marine food web as a link between microalgae and planktonivores. Pseudocalanus consists of several sibling species, and two of them (P. minutus and P. acuspes) are known to inhabit the Svalbard area. These two species are hard to discriminate morphologically and are therefore often referred to as Pseudocalanus spp., ignoring potential differences in biogeochemistry and population dynamics. In order to discriminate between these species, we used a combination of molecular analyses, morphology and morphometrics and mapped the distribution of the two species in waters around Svalbard (78 degrees N); an archipelago surrounded by warm Atlantic waters on its western side and by cold Arctic waters on the east side.

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A WATERSHED APPROACH TO MERCURY CYCLING AND TRANSPORT IN SOUTH CAROLINA

Concentrations of total Hg in water were determined from sites along a geographical gradient within South Carolina. Sites with differing watershed characteristics were chosen to identify potential factors governing the spatial variability of Hg levels throughout the state. Overall, there is a spatial west to east gradient in the state, with water column concentrations of fish and organic Hg (10-55 mg) and sediment Hg (0.1-5 mg). The river Q1 moves from the uppermost estuarine region to the eastern coastal floodplain region (Q2: 0.70; p<0.001). Correspondingly, 89% of the SC fish consumption advisories are located within these coastal flood plain regions. There is a significant correlation between increasing fish Hg concentrations and increasing percent wetland area across the state (Q2 = R2: p<0.001). A time series study of mercury speciation within a coastal flood plain river (25% wetland area) indicates that 70-90% of the total and methyl Hg are found in the <0.45 micron size class and dissolved methyl Hg concentrations range from 3-26% of the total Hg in the river and from 4-7% in the seawater end member.

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CIRCULATION AND FLUX OF SUSPENDED-PARTICULATE MATTER (SPM) THROUGH THE CENTRAL CHANNEL, ILHA GRANDE BAY, SE BRAZIL

Ilha Grande Bay (IGB) is located in the southern tip of Rio de Janeiro state, SE Brazil. It is freely connected to the Atlantic ocean. In its central area lies a large, east-west trending island, which is separated from the continent by a narrow and deep feature, the Central Channel. IGBs eastern end is connected to Sepetiba Bay, a shallow, highly polluted environment and a potential source offine-grained, contaminated sediment. The chief motivation of the present study was to identify scenarios conducive to the advection of SPM from Sepetiba Bay into IGB through the Central Channel. A 24 m deep monitoring station was occupied by anchored boats in December 2005, September 2006 and March, April and July 2007 for 25 hours. Instrumentation included a 600 kHz Teledyne RD Stracp and a Seabird CTD integrated with a turbidity sensor (D&A Instrument OBS-3). Water samples were collected at several depths and filtered in the laboratory to determine concentration of SPM in mg/l; these values were then used to convert turbidity (OBS) and echo intensity (ADCP) into water column concentration of SPM.

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HIGH ENERGY, WAVE-INDUCED TURBULENCE AND SLOPE FAILURE ALONG THE MISSISSIPPI RIVER DELTA FRONT

Seafloor sediment instability and slope failure adjacent the Mississippi River Delta Front (MRDF) has gained renewed attention with the passage of several recent tropical cyclones. Hurricanes Ivan (2004) and Katrina (2005) exacerbated prior MRDF shelf failures previously linked to (1) differential loading near river mouths; (2) sediment instability exacerbated by pore water and methane gas; or (3) wave action that weakened unstable sediments, all resulting in failure. This paper focuses on the seafloor morphology impact initiated by five major hurricanes to strike the MRDF from 1965-2005. A 26-km deep monitoring station was occupied by anchored boats in December 2005, September 2006 and March, April and July 2007 for 25 hours. Instrumentation included a 600 kHz Teledyne RD Stracp and a Seabird CTD integrated with a turbidity sensor (D&A Instrument OBS-3). Water samples were collected at several depths and filtered in the laboratory to determine concentration of SPM in mg/l; these values were then used to convert turbidity (OBS) and echo intensity (ADCP) into water column concentration of SPM.
From the river sources to the open sea, the European WFD constitutes one of the most

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CORAL REEF ECOSYSTEM ASSESSMENT USING NASA AIRBORNE AVIRIS AND DCS IMAGERY

To adequately image through a water column and to delineate variation in coral reef ecosystem benthic types, sensors having high spatial, e.g., a Cirus digital camera system (DCS), and spectral, e.g., the Airborne Visible Infrared Imaging Spectrometer (AVIRIS), resolution and high signal to noise are needed. Further, there is a need to better understand the optical properties of coral reefs, seagrass, other benthic types, and water column constituents from field-collected data so current and future satellite and airborne remote sensing can be optimized for coastal zone ecosystem research and management. In August 2004, we flew the AVIRIS and DCS on a NASA ER-2 over the Florida Keys and Puerto Rico. In March 2005, we flew AVIRIS/DCS on the Twin Otter over Kaneohe Bay, Oahu. Also, in December 2005, we flew AVIRIS/DCS on the Twin Otter over Puerto Rico and the US Virgin Islands for assessment of the 2005 Caribbean coral reef bleaching event. For each of these deployments, we collected coincident spectral data from dominant bottom types and coral under various health conditions using a handheld spectroradiometer. These spectral data will be used to classify the benthic types within the AVIRIS imagery. An overview of the airborne missions and coincident field data collection will be presented along with preliminary image and field-collected spectral data products.

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TAXONOMY OF OCEAN OBSERVATORIES BASED ON THEIR CAPACITY OF PARTICIPATION IN A VIRTUAL OBSERVATORY

Over the next few years, ocean observatories such as the NEPTUNE regional observatory will start generating a massive amount of data available to scientists, students, educators and the public at large. In order for the scientific community to perform studies at the global level on topics such as ocean temperature variances, they need to access transparently data and the associated tools from multiple observatories, using a virtual observatory model similar to the one in place for astronomy. This paper proposes a taxonomy of ocean observatories, based on their capacity of participation in a virtual observatory using criteria such as the level and type of services offered, the availability of data and the processing capabilities.

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WAVE HEIGHTS FROM A 3-M DISCUS BUOY IN THE MISSISSIPPI SOUND - DURING HURRICANE KATRINA

In August 2005 the eye of hurricane Katrina passed 49 nm to the west of a 3-m discus buoy, in 20 m water depth, operated by the Central Gulf of Mexico Ocean Observing System (CenGOS). Buoy wave heights were measured with an onboard 6-axis accelerometer and from the displacement of a GPS antenna as measured by Real-Time Kinematic (RTK) GPS. The computed wave heights are compared to the nearby NDBC 42007 buoy and show reasonable agreement for wave heights less than 2-3 m. At higher wave heights there is a potential bias in the wave heights if the buoy’s heel is not accounted for. This is believed to be the result of swell in shallow water, a heel in the buoy caused by wind and currents, and the failure to tilt-correct the accelerometer data.

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THE EUROPEAN WATER FRAMEWORK DIRECTIVE AS AN INTEGRATIVE APPROACH TO THE MANAGEMENT OF THE WHOLE AQUATIC ECOSYSTEMS.

From the river sources to the open sea, the European WFD constitutes one of the most ambitious acts for the integral management of the whole European aquatic environments, specially considering that it’s being carried out from an ecosystem perspective. The ecos-
carbon (DOC), colloidal organic carbon (COC), dissolved inorganic carbon (DIC), and total dissolved nitrogen (TDN). Column chromatography of DOC was lowest in February (344 µM) and highest in July-2007 (344 µM) with a yearly average of 301.3±2 µM. Percentage of COC (1 kDa-0.45 µm) was 61.3% based on the measurements of permeate time series samples and ultrafiltration permeation model. Average DIC concentration was 2460±280 µM with highest concentration (2975 µM) during low-dissolution (September) and lowest (1926 µM) during high-dissolution (January). TDN concentrations varied from 67 to 222 µM, with a mean concentration of 132446 µM. A general increase with increasing discharge. However, there is no correlation between DOC and discharge. Based on the correlation between instantaneous flux and corresponding discharge, annual export fluxes of DOC, DIC and TDN during 2006-2007 were estimated to be 1.45±E+15 gCyr, 9.11±E+15 gCyr and 1.01±E+15 gN/yr, respectively, compared to 2.13±E+15, 13.5E+15 gC/yr and 1.94±E+15 gN/yr using a long-term discharge of 18,280 m³/s between 1981-2005.

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DIRECT NUMERICAL SIMULATION OF TURBULENT INTERACTING WITH AIR-SEA INTERFACE AT SMALL SCALES

The problem of turbulence interacting with an air-water interface is important to atmosphere-ocean momentum transport, gas transfer, and many other mixing and transport processes in air-sea interactions. In order to understand the fundamental dynamics of turbulence near the sea surface at small scales, we perform a mechanistic study using direct numerical simulation. We simulate the unsteady, three-dimensional Navier-Stokes equations subject to air-water free surface boundary conditions. Spatial scales are discretized with pseudo-spectral and finite-difference methods. Time integration is realized through second-order fractional step scheme. From the simulation data, substantial information on the statistics and the structures of the flow field has been obtained. In particular, coherent structures in the flow field are identified. Turbulent kinetic energy and enstrophy budgets are quantified. Finally, effects of turbulence structures on scalar transport near the air sea interface are illustrated and quantified.

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SPATIAL AND TEMPORAL VARIABILITY OF THREE DISTINCT SATELLITE OCEAN COLOR ALGORITHMS TO IDENTIFY HARMFUL ALGAL BLOOMS OFF THE WEST FLORIDA COAST

Near real-time remote sensing imagery has been widely used to identify ocean surface features such as oil slicks, eddies, upwelling, river plumes and harmful algal blooms (HABs). Since toxic blooms of Karenia brevis are observed yearly in the west Florida coast, an accurate technique to remotely detect HABs is highly desired. A NOAA monitoring system identifies areas likely to be classified as HABs, but field samples are still required for confirmation. Two other recent approaches, also based on visible space-borne measurements, have shown promising results for HAB detection. The spatial and temporal variability of these three satellite products are examined to address two questions: 1) How effectively are HABs detected along the entire shoreline, from Key West to Cape San Blas? and 2) Are these algorithms successful year-round? The predictive success of these three satellite-based methodologies is evaluated by comparing with an in situ database of cell counts. Quantifying the uncertainties associated with these algorithms is important to provide guidance for resource management decisions to better plan mitigation actions.

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DYNAMICS OF DISSOLVED NEUTRAL AND ACIDIC SUGARS IN SEAWATER

Carbohydrates are an important component of organic matter in the ocean. Originating from primary production, they are hydrolyzed by the phytoplankton cell as structural components and for energy storage, or released to the dissolved organic matter by exudation, leakage, grazing or cell lysis. It is generally accepted that dissolved carbohydrates (dCHO) are an important food source for heterotrophic organisms, especially bacteria. More recently, it was demonstrated that dCR, and particularly acidic sugars, are also involved in abiotic processes, such as the activation of carbohydrate colloids and their subsequent aggregation into gel particles, or trace metal scavenging. Understanding these processes is prerequisite to better estimate upper ocean particle dynamics and organic matter export. To ascertain dCHO-dynamics and their partitioning into gel particles, we measured the abundances of neutral and acidic sugars and transport-exchange vector (TEP) particles and their subsequent aggregation into gel particles, and field studies. Analysis of dCHO in seawater was performed using High Performance Anion Exchange Chromatography after desalination by dialysis and acid hydrolysis. Here, we show preliminary results on the composition and abundance of dCHO and TEP during phytoplankton blooms dominated by either diatoms or coccolithophores.

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OBSERVED AND SIMULATED DAILY VARIABILITY OF THE MERIDIONAL OCEAN CIRCULATION CAYMAN - ASHES IN THE ATLANTIC

We compare a daily timeseries of the meridional overturning circulation (MOC) estimated from the UK/US RAPID/MOCHA array at 26N to two global circulation models: (i) the coupled climate model ECHAM5/MPI-OM, and (ii) the ECCO-GODAE state estimate. In ECHAM5/MPI-OM, the waters are up to 4C warmer and up to 0.5 more saline than the observations, depending on the depth. In ECCO-GODAE, the waters span the observed temperatures and salinities at all depths below 200m within the range of uncertainties estimated by Forster and Wunsch (2007). A decomposition of the MOC into Florida Current, Ekman and upper mid-ocean geostrophic transports yields a similar level of variability among all estimates: ECHAM5/MPI-OM reproduces the magnitude of the observed variability, standard deviations for the eight ensemble members differ by 1 by at most. ECCO-GODAE shows a smaller variability, but a correlation of 0.9 for the Ekman transport, and 0.6 for the MOC. In both models, the upper mid-ocean transport is closely approximated by the residual of the MOC minus Florida Current and Ekman transport. For future comparisons, we suggest to compare the upper mid-ocean transport from the observations to the residual transport in the models.

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THREE-DIMENSIONAL MODELING OF NEARSHORE HYDRODYNAMICS DURING THE PASSAGE OF WEATHER FRONTS

A five day nearshore field experiment was conducted in December 2003 near Myrtle Beach, South Carolina, providing measurements of waves, currents and bathymetry concurrently with offshore data collection around a shoal. The present work uses two numerical models for simulations of nearshore hydrodynamics to study the comparison between large scale and nearshore flows during the passage of weather fronts. This study uses a Q3D nearshore model (SHORECIRC) and a 3D model (ROMS) with grids resolving the nearshore, using the results of larger scale models as boundary conditions. The wave model SWAN is used for wave transformation and ROMS also simulates large scale flows driven by tidal and wind forcing in Long Bay. Various conditions are simulated, including two frontal passages. The first storm generated waves from the south driving a moderate longshore current. The second front generated waves with a large angle of incidence from the north, driving longshore currents approaching 2m/s. Results from the models are compared with the measurements as well as inter-comparisons between the models to understand the differences between the three-dimensional and the quasi-three-dimensional models.

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PREDICTING OYSTER LARVAE DISPERSAL IN PAMLICO SOUND FROM SURFACE DRIFT BUOYS AND CURRENT PROFILE OBSERVATIONS

Oyster restoration efforts in Pamlico Sound, NC are based on a network of oyster broodstock sanctuaries. The success of these efforts depends on the larval connectivity between these sanctuaries. We can predict oyster larval dispersal envelopes using both eulerian and lagrangian current measurements. Forward integration of the near-surface currents measured by an ADCP allows us to predict paths followed by passive particles. We compare the predicted paths to the actual paths taken by GPS tracked surface drift buoys. Because wind-driven currents are generally stronger near the surface, paths taken by these passive buoys represent the farthest distance oyster larva can travel within the estuary. Dispersal envelopes generated from the current profile data form a range of all possible locations oyster larvae might travel from a fixed location and assess connectivity among oyster sanctuaries constructed by the North Carolina Department of Marine Fisheries.

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SALINITY BIAS IN LEVEL AND LAYER DATA ASSIMILATION RESULTS FOR THE TROPICAL PACIFIC

ENSO has a significant impact on climate variability throughout the world and so has been the key focus to improving coupled forecasts for the tropical Pacific. In previous work, we have shown that assimilation of salinity along with other key variables allow a temporary improvement in the initial state for ENSO prediction (eg. Hackert et al., 2007). Yet, biases in the salinity field and hence the subsurface density field in the ocean still exist. Therefore, we will perform a systematic evaluation of model salinity biases for the period 2002-present using OI (Carton and Hackert, 1989) of all available surface and subsurface salinity data (eg. Argo, XBT, TAO etc.). The assimilation biases that are included in this study are the NCEP Global Ocean Data Assimilation System (GDAS) and our Ensemble Reduced-Order Kalman Filter (ERKOF) results. GDAS is a level model (MOMS) which
assimilates Tz and synthetic salinity profiles from a local climatological T-S relationship using the OI technique of Drizler and Rosati, 1989, whereas EROF utilizes a sigma-coordinate model (Gent and Cane, 1989) which assimilates all available subsurface observations (along with SL and SST) using the Kalman Filter technique. Differences in model and assimilation methodologies will be discussed.

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EFFECT OF SPATIAL AVERAGING ON SPECTRAL CHARACTERISTICS IN THE FREQUENCY DOMAIN OF IN-SITU VELOCITY DATA

Oceanographic velocity point sensors inherently average over some volume to obtain magnitude and direction while acquiring data at a prescribed sampling rate. Spectral analysis is subsequently performed on such data to derive turbulent parameters. Using measurements from the Atlantic continental shelf obtained using a submerged particle image velocimetry (PIV) system, whose data provides a spatial distribution of velocity at a specified sampling rate, permits investigation of the impact on the energy spectrum in the frequency domain due to spatially averaging the data. PIV data were spatially averaged at various scales, and energy spectra in the frequency domain were computed. Spatial averaging has a clear frequency-dependent impact on the energy level at frequencies lower than expected from a simple conversion of the space-to-time scales using Taylor’s Hypothesis. The non-local effect of spatial filtering in the frequency domain is the primary contributor to this result. This has important implications for spectrally derived turbulent quantities, especially for data collected at high frequencies using techniques employing large spatial averaging.

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HIGH-FREQUENCY FLUCTUATIONS IN DENMARK STRAIT OVERFLOW TRANSPORT

The transport of Denmark Strait Overflow Water (DSOW) exhibits quasi-periodic fluctuations immediately south of Denmark Strait with periods of 2-4 days. These fluctuations are visible in satellite imagery of surface temperature which typically shows a train of cold tongues found southwest of Denmark Strait. They have also been observed as DSOW transport fluctuations by moored current meter arrays which show that the transport variability is similar in magnitude to the mean transport itself. Using 2-km resolution, 97-level regional circulation models we explore the kinematics of these fluctuations. The model solutions show realistic variability and clearly reveal how DSOW descends from the Denmark Strait sill in balanced flow in the core of the northerly high-salinity eddies. Lateral engulfment of ambient Fram water is also clear and seems to be the initial process that eventually leads to entrainment and mixing of ambient water into the DSOW plume. The model cyclones are associated with unambiguous signals in sea level and surface temperature. We discuss the prospects for processing the historical record of remote-sensing data at Denmark Strait to construct a time-series of daily DSOW fluctuations. The main challenge is to overcome the instrument noise in the altimetric sea level, but the satellite coverage is adequate to give a useful signal.

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FURTHER IMPROVEMENT OF CLIMATE PREDICTION USING HADC3M

Changing ocean heat content is a key metric for global warming studies but its assessment is made difficult by variable ocean sampling and large advective changes in basin scale heat content on decadal timescales. We present an analysis of ocean heat content change based on isothermal depths and mean temperature above isotherms. We show that we can assess separate contributions to total heat content in this way and furthermore that these quantities have different spatial and temporal characteristics which allows upper ocean heat content to be assessed with reduced errors. We make comparisons of assessments from data with long runs of the HadCM3 coupled model under varying greenhouse forcing.

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SHIFTING SURFACE CURRENTS IN THE NORTHERN NORTHEAST ATLANTIC OCEAN

Analysis of surface drifter tracks in the North Atlantic Ocean from the time period 1990 to 2006 provides the first evidence that the Gulf Stream waters can have direct paths to the Nordic Seas. Prior to 2000, the drifters entering the channels leading to the Nordic Seas originated in the western and central subpolar region. Since 2001 several paths have been present in the drifter tracks leading to the Rockall Trough through which the most saline North Atlantic Waters pass to the Nordic Seas. Eddy kinetic energy from altimetry shows also the increased energy along the same paths as the drifters since 2000. These near-surface changes have taken effect while the altimeter shows a continual weakening of the subpolar gyre. These findings highlight the changes in the vertical structure of the northern North Atlantic Ocean, its dynamics and exchanges with the higher latitudes.

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PHYSIOLOGICAL AND MARINE CONNECTIVITY OF ANTARCTIC SHELF INVERTEBRATE FAUNA

Establishment of the Antarctic Circumpolar Current (ACC) and the Antarctic Polar Front (APF) are hypothesized to be barriers to gene flow into and out of Antarctic waters. Using a multidisciplinary approach that examines both larval distribution as well as the genetic
structure of marine invertebrate populations in Southern Ocean regions, the relationship between gene flow, potential barriers such as the ACC and APE, larval dispersal and geographic history were assessed. Results indicate that isolation has occurred in the past between the South American and the Antarctic continental shelves, but much more recently than dogma contends. Additionally, mtDNA sequence data reveal cryptic speciation in several species, implying that connectivity of populations of ancestral taxa was intermittent since the formation of the ACC and APE. Genetic characterization and temporal distribution of larvae have allowed further insights into the life history of Antarctic benthic forms. The assumptions commonly made about Southern Ocean oceanographic processes and their influence of biodiversity and historical connectivity will be revisited.

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UNSUPervised THRESHOLDING AND Morphological PROCESSing FOR AUTOMATIC OUTLINE EXTRACTION
At least two software packages— DARWIN, Ecker College, and FinScan, Texas A&M exist to facilitate the identification of cetaceans—whales, dolphins, porpoises—based upon the naturally occurring features along the edges of their dorsal fins. Such identification is useful for biological studies of population, social interaction, migration, etc. The process whereby fin outlines are extracted in current fin-recognition software packages is manually intensive and represents a major user input bottleneck: it is both time consuming and visually fatiguing. This research aims to provide automated methods (employing unsupervised thresholding and morphological processing techniques) to extract cetacean dorsal fin outlines from digital photographs thereby reducing manual user input. Ideally, the automatic outline determination will improve the overall user experience and improve the ability of the software to correctly identify cetaceans. To assist with unsupervised thresholding, a new metric was developed to evaluate the

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MECHANISMS CONTROLLING SEASONAL-TO-INTRAANNUAL MIXED-LAYER TEMPERATURE VARIABILITY IN THE EASTERN TROPICAL INDIAN OCEAN
Processes controlling seasonal- to intraannual-mixed-layer temperature (MLT) variability in the eastern tropical Indian Ocean are climatically important, but not well understood. We examined the regional MLT balance using an ECCO ocean data assimilation product, which satisfies heat conservation. We compare two sectors (90°-95°E, 0-5°S and 91°-94°E, 7°-10°S) within the traditionally defined eastern Indian Ocean Zonal Dipole Mode (IOZDM) anti-node (Saji et al, 1999), focusing on dominant mechanisms during the 1994, 1997 and 2006 IOZDM events. These two sectors differ due to local circulation characteristics and must be examined separately: if budget components are averaged over the entire anti-node, effects of regional processes that are important to IOZDM variability are obscured. On the seasonal time scale, surface heat flux assists and dominates MLT changes over the inner shelf, but subsurface processes play secondary roles. On intraseasonal scales, subsurface processes dominate cooling at (90°-95°E, 0-5°S), whereas surface heat flux counteracts cooling; both effects are larger in 1997 than in 1994 and 2006. Horizontal advection opposes interannual cooling at (90°-95°E, 0-5°S), but is the dominant mode of cooling at (98°-101°E, 7°-10°S) for all three events

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CAN REMOTELY SENSE PARAMETERS, COUPLED WITH IN SITU MEASUREMENTS, BE USED TO ESTIMATE THE SIZE AND LOCATION OF HYPOXIA IN THE NORTHERN GULF OF MEXICO
The hypoxic area located west of the Mississippi River outflow in the northern Gulf of Mexico spans 12,000 to 22,000 km² annually. Since 1985, this hypoxic zone doubled in size (Rabalais et al, 2002). Management options to reduce the size of Gulf hypoxia focus on reductions in Mississippi River nitrogen loads (CENR 2000). Riverine nutrient input, chiefly nitrogen, stimulates primary production in the coastal ocean, and the resultant organic matter sinks below the pycnocline, formed from the summer stratification in summer months. Hypoxia occurs when respiration below the pycnocline, in the absence of surface mixing, exceeds oxygen replenishment. Current models for predicting the size and location of the Gulf hypoxic zone focus on riverine nitrogen as the primary input parameter and succeed in explaining up to 88% of hypoxic zone size (Turner et al. 2006; Scavia et al. 2004). Remote sensing data coupled with in situ measurements have been explored previously in the correlation of satellite-derived chlorophyll concentration with river discharge, nitrate load, and hypoxia (Walker and Rabalais 2006). Our focus is to investigate if hypoxia formation is associated with additional remotely sensed parameters such as sea surface temperature, sea surface height anomaly, and ocean color data products. We will employ time-series analysis of sea surface temperature changes, phytoplankton blooms, and other phenomena are correlated with the formation of the Gulf hypoxic zone.

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ABSOLUTE VELOCITY IN THE LABORATORY SEA: ADCP OBSERVATIONS ALONG ARW7
To measure the interannual variability of convection and hydrographic properties in the Labrador Sea, the WOCE/CLIVAR repeat hydrographic line ARW7 has been oc-

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MIXING AND DISSIPATION OF INTERNAL Mens WAV EMON ON A SHELF SLOPE
On the shelf slope north of Scotland the rate of turbulent kinetic energy (TKE) dissipation, calculated from density overturns, is 6±10^-4 W/kg. Using a standard mixing efficiency, this dissipation rate is equivalent to a diapycnal diffusivity of 10^-3 m^2/s, two orders of magnitude larger than typical open ocean background levels. The rate of TKE dissipation cannot be fully explained by local shear and strain measurements so we invoke a far-field source of energy, supplied in the form of internal waves, to drive mixing over the slope. The across-slope internal wave energy flux is 130 W/m^2 at semi-diurnal frequencies with 180 W/m^2 at diurnal frequencies. This can be reconciled with the TKE dissipation rate by assuming all the internal wave energy is dissipated in the ~4.5 km that the pycnocline intersects the slope. The rate of TKE dissipation inferred from this assumption is between 3 and 6×10^-4 W/kg ; comparable to the dissipation rate calculated from density overturns, and emphasizes the role of internal waves in the transfer of tidal energy, not just into the abyssal ocean, but around complex topography.

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AN UPWELLING BESTIARY: OFFSHORE FLOW STRUCTURES REVEALED BY LONG-RANGE, HIGH FREQUENCY RADARS IN CALIFORNIA
As part of the Coastal Ocean Currents Monitoring Program (COCMP), two long-range High Frequency Radar (HF-Radar) units have been installed near Point Arena, California. Combined with standard-range systems, these units provide hourly estimates of surface currents from nearshore to 200km offshore. This radar installation provides one of the largest spatial footprints yet to observe ongoing, real-time maps of shelf and slope surface currents for this major upwelling center. Initial observations reveal a spatial complexity strongly hinted at during previous field programs (CODE, NCCCS, WEST). Coastal currents are not simply related to alongshore wind stress, as suggested by the canonical model of wind-driven upwelling circulation. Filaments from Point Arena, instabilities in the California Current, and mesoscale eddies all influence the currents. These flows impact shelf and coastal waters, leading to large currents even in the absence of strong winds. The relative contribution of such "ermote forcing" to surface currents varies with spatial location, season and year, but can be a substantial fraction of the momentum budget over much of the region.

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SENSITIVITY OF WEST FLORIDA SHELF SIMULATIONS TO INITIAL AND BOUNDARY CONDITIONS PROVIDED BY HYCOM DATA ASSIMILATIVE OCEAN HINDCASTS
The influence of initial and boundary conditions on free-running West Florida Shelf (WFS) simulations is evaluated by nesting HYCOM within three data-assimilative ocean hindcasts and a free-running ocean simulation. The hindcasts were produced as part of the ongoing development of the Navy’s next-generation HYCOM ocean nowcast-forecast system. The evaluation is being performed by conducting nested free-running WFS simulations for 2004 and 2005 and comparing model fields to high-quality observations including ADCP moorings and coastal HF radar measurements. The WFS simulations were run from 2000 to 2005, run on the University of South Florida curvilinear coordinate system, but the nesting boundary was too far offshore to constrain simulated variability over the shelfbreak and continental slope. Another set of experiments was therefore conducted in a smaller domain to perform the evaluation. Initial analysis of 2004 results demonstrates that nesting boundary conditions have little influence on the dominant wind-drive currents over the inner shelf, but do have a modest impact over the middle and outer shelf. At several ADCP mooring sites, nesting within the presumably more advanced NCODA hindcasts slightly degraded the simulated velocity. This surprising result will be further explored, and full analysis of the 2004-2005 experiments will be presented, at the meeting.
SURFACE TROPICAL CALCAREOUS GREEN ALGAE RESPONDING TO OCEAN ACIDIFICATION?

Atmospheric CO₂ concentrations are increasing faster than expected on Earth for the last 650,000 years. Within this century, atmospheric CO₂ will be double pre-industrial levels. Because the oceans are the largest natural reservoir for CO₂, ocean chemistry will change more dramatically in the last 20 million years. Indeed, pH values of the open ocean have decreased by 0.1 since 1980 and are predicted to decrease 0.5-0.6 in the next 80 years. Ocean acidification will likely affect fundamental geochemical and biological processes including calcification and carbonate sediment production. The east and west Florida shelves provide natural gradients from temperate to tropical carbonate sedimentation; these gradients provide natural laboratories to examine the effects of ocean acidification on aragonite production by calcareous green algae. Scanning electron microscopy can reveal ultrastructural details of calcification. Comparison of Halimeda spp. from archived samples collected more than 40 years ago, with specimens collected in ongoing studies, are indicating the influence of declining carbonate saturation over this time span; both sets of samples will provide data for future comparisons.

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ARE SUBTROPICAL CALCAREOUS GREEN ALGAE RESPONSING TO OCEAN ACIDIFICATION?

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SHORT-TERM SEDIMENT DEPOSITION IN A DELAWARE ESTUARY SALT MARSH

The purpose of this study was to determine the relative influences of suspended-sediment concentration (SSC), settling velocity (from particle size) and hydroperiod on tidal deposition rates during a spring tide in a section of the S. Jones River marsh (Delaware). Wind samplers, sediment traps, water-level recorders and a LISST-100 particle-size analyzer were deployed on Spartina alterniflora marsh for five days with samples recovered daily. SSC decreased exponentially from the river levee to marsh interior; and a similar trend was observed for tidal depositional fluxes of sediment. Hydroperiod ranged from 4 to 10 hours. The median grain size of in-situ particle aggregates measured by the LISST (66-170 microns) was about seven times larger than the median of disaggregated samples collected at the same site, and the disaggregated grain size of freshly deposited sediment (10-27 microns) did not vary significantly within the study area during the experimental period. Given the limited spatial variation in particle settling velocity (size) and hydroperiod, it is concluded that the across-marsh SSC gradient was the primary control on observed patterns of sediment depositional flux during the experimental period.

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REDUCING BARRIERS TO ACADEMIC ACHIEVEMENT AND MARINE GEOSCIENCES CAREERS: A MODEL MIDDLE SCHOOL PROGRAM INTEGRATING GEOSCIENCES AND LITERACY

Concurrent with the growing sense of urgency to improve geosciences education, high stakes accountability systems have led to a decline in K-8 science teaching and learning, especially for underrepresented minorities. Poor literacy skills serve as a barrier to participation in science even though science has great potential to improve students'literacy skills. Our presentation describes an NSF-funded project to improve academic achievement of underrepresented middle school students through exposure to marine geosciences integrated with strategic literacy instruction to improve their comprehension and deep conceptual understanding. The project involves students in a super-enriched summer school academy taught by teachers engaged in intensive professional development, then guides these students into carefully articulated work and research internships, after-school programs, field trips and college counseling experiences. Teachers from the professional development effort continue providing enhanced science instruction throughout the academic year. This project will evaluate and document a model program comprised of a variety of critical elements that can be flexibly utilized by scientists and educators in myriad contexts to enhance diversity in the geosciences by improving students'capacity in literacy and science.

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TIDES AND SALINITY IN THE FRASER RIVER PLUME

We utilize a unique dataset to assess the tidal effects on the mean salinity of a highly seasonal river plume. The dataset was obtained by an instrumented ferry which crosses the plume of the Fraser River, British Columbia, eight times per day over the years 2002-2008. Tidal effects for this time series were investigated by applying the Lomb-Scargle periodogram to plume average salinity. The spectrum showed strong lines in diurnal and semi-diurnal bands suggesting that tidally-driven mixing and advective processes are important in determining the character of the plume. The strength of the diurnal lines relative to the semi-diurnal lines is not proportional to their respective strength in currents. In addition, strong sidebands of the main tidal lines appear at 1/4 to 1 year, reflecting the strong seasonality of the flow of the unformed river. Finally, unlike many river plumes, little correlation was found with the wind. Using the ferry record, we estimate the fresh-water residence time in the plume to be about one day, leaving little time for substantial wind mixing.

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OBSERVATIONS OF FINE-PARTICLE TRANSPORT AND DEPOSITION

We summarize results of flume experiments examining the transport behavior of dilute suspensions of non-cohesive silt, flocculating gelatin particles, and bedload. Smooth and rough-granular beds and a highly-permeable bed comprising layered-screen mesh. Considered in terms of a simple model incorporating simultaneous deposition and entrainment, fine-particle transport in suspension is well described by a dimensionless parameter S which reflects the ratio of flow-induced lift (Saffman 1968; J. Fluid Mechanics) acting on the submerged weight of individual particles. Gross rates of fine-particle deposition or arrival at the bed are similar for permeable and impermeable beds alike, scaling with Stokes settling in relatively slow flows but otherwise diminishing linearly with S. In the case of an impermeable bed, all newly-deposited particles reside on the bed surface and the rate of re-entrainment increases exponentially with S. In contrast, particles newly-deposited to a flat, permeable bed find significant refuge and thus show no discernible re-entrainment into suspension.

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EDDY PARAMETERIZATION IN A WIND-DRIVEN CHANNEL WITH TOPOGRAPHY

The extent to which eddy parameterizations can help coarse-resolution ocean models approximate eddy-resolving dynamics is explored in the context of a wind-driven two-layer channel configuration. The model includes a meridional rim and mimics water mass conversion through interface damping at the northern and southern boundaries. It is found that in the presence of topography, the practice of diffusing layer interface heights degrades the coarse-resolution model solution due to its adverse effect on standing eddies. Diffusion coefficients that result in meridional and zonal transports comparable to those of eddy-resolving solutions need to be unreasonably high and alter the horizontal path of the current drastically. Instead of improving results through varying diffusion in space, we attempt to implement a machine-learning-based approach whereby the differences between the fields in fine and coarse-resolution versions of our model are interpreted as eddy fluxes. These fluxes are then related to the coarse-resolution fields through a statistical learning method.

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SEDIMENT-WATER EXCHANGE OF METHYLMERCURY IN NEW YORK HARBOR DETERMINED FROM SHIPBOARD BENTHIC FLUX CHAMBERS

Benthic mobilization is an important pathway by which organisms are exposed to methylmercury (MMHg) produced in sediments. We have developed shipboard benthic flux chambers (SBFCs) to measure MMHg efflux from sediment cores, and used this method at locations in NY Harbor under summer and winter conditions. Fluxes determined with the SBFCs were compared with diffusion-based fluxes estimated from gradients of dissolved MMHg in the same sediments (SBFC:diffusional flux ratio). SBFC: diffusional flux ratios ranged from 0.9 to 1.4 in August and 2.3-4.3 in February. SBFC: diffusional flux ratios were correlated positively with dissolved oxygen (DO) in bottom waters, suggesting that MMHg mobilization is largely diffusional when DO is less than about 80% saturation and enhanced at greater levels. This is consistent with the observed positive relationship between macrofauna abundance and DO. Thus, benthic MMHg mobilization fluxes, which are enhanced relative to diffusion when DO in bottom waters is near saturation, may be linked to increased abundance and/or activity of infauna that irrigate sediment. Improving oxygen conditions, therefore, could increase sediment-water effluxes of MMHg in NY Harbor and comparable coastal marine systems.

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WHAT MAINTAINS THE SILICIC ACID PLUME AT 2.5 KM DEPTH IN THE NORTH PACIFIC?

Deep North Pacific waters contain a plume of high Si near 2.5 km depth. Although this plume was characterized by Talley and Joyce (1992), its dynamics remain incompletely understood. We have recently shown that sources in Cascadia Basin do not supply more than 3% of the input required to maintain the maximum. Sediment traps deployed across the N. Pacific indicate that BiS (biogenic Si) sinking below 1 km depth could dissolve to provide a sufficient flux, but that little dissolution occurs as they sink; dissolution must...
largely occur on the sea floor at depths >4 km. We propose that the plume at 2.5 km is maintained by dissolution of Fe on the seafloor, coupled with near bottom flow and local vertical transport near the Juan de Fuca Ridge. Localized transport should be driven by buoyancy added from below through geothermal heating, and from above by enhanced vertical mixing stimulated by topography. Transport lifts solutes added at depths exceeding 4 km, to the ridge crest near 2.5 km, where they subsequently spread throughout the North Pacific on isopycnals, forming the plume.

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LEVERAGING UNIVERSITY UNDERGRADUATES TO DISSEMINATE OCEAN SCIENCES THROUGH ONLINE DISTANCE LEARNING

Ocean sciences can be disseminated widely via online instruction and distance-learning. COSEE-West and the College of Exploration provided an online workshop on coral reefs for K-12 science teachers, informal educators and the public that leveraged the manpower of undergraduate science majors enrolled in an upper division course, Tropical Oceans and Tropical Reefs, taught by Hanmer. The online workshop presented two research lectures by coral reef scientists and one lecture on the importance of their work to ocean science. Undergraduates who had earned high grades in Hanmer’s course were assigned K-12 teachers to mentor online, adding excitement and verve to discussions of the content. Hanmer added only one new lecture to the workshop; the students from his class provided most of the online mentoring. Subsequently these undergraduates gave talks in local schools for the two days and were role models for future ocean researchers to widely disseminate new discoveries beyond the scientific community, but if our impact is multiplied by our undergraduate and graduate students, we will reach many more K-12 teachers and students.

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ESTIMATION OF HYDRAULIC PARAMETERS AND DISCHARGE OF THE GANGES AND BRAHMAPUTRA RIVERS FROM SHUTTLE RADAR TOPOGRAPHY MISSION DIGITAL ELEVATION MODELS

In this study, the potential of utilizing Shuttle Radar Topography Mission (SRTM) Digital Elevation Model (DEM) data to study the hydraulics of lowland, braided rivers of the Ganges-Brahmaputra basins was evaluated. Landsat TM images at 30m resolution were first classified to identify the water body from braided land areas for the estimation of hydraulic parameters. Water surface elevations measured from the SRTM DEM was found to have standard deviations of 5.59 m and 5.77 m for the Ganges and Brahmaputra rivers, respectively. The minimum reach length required for a reasonable estimate of water surface slope was found to be 131 km for the Ganges and 137 km for the Brahmaputra river. The water surface slope was estimated from a linear fit to the 8.45 cm/km for both rivers. Channel width was computed at each classified Landsat pixel along a center line obtained by threshold holding the Laplacian of an image containing the distance from each channel pixel to the nearest bank pixel. The hydraulic radius was then derived from the channel width, water surface elevation and in-situ bathymetry data. Using an estimate of Manning’s roughness coefficient n, the discharges for the braided rivers were derived and compared with measurements from calibrated rating curves during the low-flow (pre-monsoon) season of 2000.

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DISPERSSION OF EGGS, LARVAE AND PELAGIC JUVENILES OF GRAND BANKS WHITE HAKE IN RELATION TO OCEAN CURRENT VARIABILITY

White hake (Urophycis tenuis, Mitchell 1815) on the southern Grand Banks are found at bottom depths from 50-800 m, associated with 4-8°C ambient temperatures. They are restricted to a narrow band along the southwest edge and into the Laurentian and Hermitage Channels where local bottom temperatures are warmest (> 4°C). We have investigated potential dispersion patterns of eggs, larval and juveniles under climatological monthly-mean circulation fields, M2 tidal currents and associated turbulent mixing, which were computed from a three-dimensional regional ocean circulation model. On the interannual scale, the teachers and were role models for future ocean researchers to widely disseminate new discoveries beyond the scientific community, but if our impact is multiplied by our undergraduate and graduate students, we will reach many more K-12 teachers and students.

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THE BAMBOO WORM INVASION OF SAMISH BAY: ECOLOGY AND CONTROL OF CYLMENELLA TORQUATA IN A NORTHEASTERN PACIFIC ESTUARY

The bamboo worm, Clymenella torquata, is a tube-building polychaete native to the northwestern Atlantic. While not generally known for strong interactions, invasive C. torquata in the northeastern Pacific have impacted salt marsh culture operations. In Samish Bay, Washington, bioturbating worms destabilize sediments, thereby indirectly increasing mortality of oysters that subside under consolidated mud. The present study investigated the ecology of invasive C. torquata along beaches adjacent to an estzned shellfish farm to determine factors affecting worm distribution. At each survey station physical and biologi cal data were collected and compared to worm biomass and tube mass. Survey results corroborate previous observations that a significant negative relationship exists between C. torquata and sediment compaction/firmness; worms also also alter grain composition of the substrate. Biomass of C. torquata increases seaward perpendicular to shore, with highest worm activity at about +30 cm MLLW. In laboratory experiments, temperature affected burial speed and tube contraction rate, and worms produced highest-quality tubes in sediment ranging between 250-500 µm. Our work suggests that the distribution of C. torquata may be limited and physical and control measures might mitigate impacts on aquaculture.

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SANDBAR FORMATION UNDER SURFACE WAVES - THEORY AND EXPERIMENTS

We report a combined theoretical and experimental study of sandbar formation under simple–harmonic surface waves. For coarse grains and weak waves, an established empirical rule of bedload transport is used with an asymptotic theory for the fluid flow. The surface waves are governed by potential theory and a depth-linear eddy viscosity is employed in the turbulent boundary layer at the seabed. The derived bed stress is used to predict the sand–bed evolution. Laboratory experiments and corresponding numerical simulations for both high and low beach reflection are discussed. For weak reflection, the shear stress associated with the return current is found to be important. Partial simulation of a field record in Cape Cod Bay is also described. The dependence of bar morphology on sediment grain size is examined experimentally. In particular, new quantitative data on sandbar formation and sediment sorting on a bed of mixed colored sands of significantly different grain sizes under standing waves is presented to motivate future study.

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EVALUATION OF THE SAN FRANCISCO EBB TIDAL DELTA OVER THE PAST HALF CENTURY

The San Francisco River, situated in the central part of California, USA, is an extremely dynamic environment subjected to large waves and strong tidal currents that are amplified by the large tidal prism of San Francisco Bay and its narrow 1 km wide inlet beneath the Golden Gate Bridge. Wave heights commonly top 5 m during winter storms and peak tidal flows exceed 2 m/s at the Golden Gate. A multi-beam sonar survey recently mapped the bottom morphology in the region of the ebb tidal delta. The new survey enabled the calcu lated of seabed change that has occurred in the past 50 years, since the last comprehensive
survey of the area was completed. This comparison indicates that the delta contracted radially with an average vertical erosion of 60 centimeters equivalent to a total volume change of approximately 92 million cubic meters. Delft3D, a process-based numerical model, was applied to investigate the shape and evolution of the ebb tidal delta, and to explore the mechanisms behind the recent contraction of the delta. The quasi-equilibrium delta shape was determined given the tidal forcing, a simplified wave climate, and variable net sediment flux through the Golden Gate. The effects of changes in the tidal prism of San Francisco Bay are explored, as well as the relative contribution of wave energy and tidal currents to the shape and presence of the ebb tidal shalow and potential effects of rising sea level.

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WATER QUALITY IN INDIAN RIVER LAGOON, FLORIDA: “WET” VS. “DRY” YEARS

Water quality in Indian River Lagoon (IRL) has changed significantly over the past eight decades due to watershed alteration and land drainage patterns. High-frequency water quality monitoring was conducted for two years at four sites. Year 1 had rainfall higher than the historical mean and related high runoff, due to tropical storms and hurricanes, while Year 2 had a severe drought (35% lower rainfall than historical mean). Reduced freshwater inputs during the “dry” year, relative to the “wet” year, resulted in an increased mean salinity from 25 to 32 psu and improvements in the three main attenuators of PAR (chlorophyll, suspended particulate matter, and sediment). These findings demonstrate the tremendous climate-related interannual variability in water quality and can be used in models of expected positive improvements in estuarine health following the reduction of freshwater inputs, which are recognized as the most significant human impacts on this estuary.

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TEMPORAL VARIATION IN FOOD-WEB NITROGEN SOURCE IN THE NORTH PACIFIC SUBTROPICAL GYRE AS DETERMINED FROM COMPOUND-SPECIFIC STABLE NITROGEN ISOTOPE ANALYSES

Mesozooplankton biomass and abundance in the North Pacific Subtropical Gyre (NPSG), as measured by the Hawaii Ocean Time-series program at Station ALOHA (22.4°N, 158°W), has increased significantly from 1994 to 2005. We used amino acid- and species-specific stable nitrogen isotope analyses to determine if the increase in NPSG zooplankton populations was driven by changes in nitrogen source. Our analyses suggest that both biological fixation of atmospheric nitrogen and entrainment of nitrate from the main thermocline supported NPSG zooplankton food webs. However, nitrogen isotopic compositions of the copepod species Euchaeta rima, Pleuroeomorpha xiphias and Neocalanus robustus increased significantly from 1997 through the winter of 2000, indicating that entrainment of nitrate from the main thermocline was enhanced over this time period. Based on the zooplankton nitrogen isotope time-series and the concurrent changes in plankton community structure, we conclude that enhanced nutrient entrainment initiated a NPSG ecosystem shift in 1998.

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SUPEROXIDE SOURCES AND SINKS IN THE GULF OF ALASKA

Superoxide radical can be produced in seawater by biological and photochemical mechanisms, and may play important roles in the redox or oxidation of trace seawater constituents. During a 2007 cruise to the Gulf of Alaska, we measured superoxide concentrations along with rates of production and decay, in surface seawater samples (0-50 m) using the MCLA chemiluminescence technique. Our study area included high-nutrient low-chlorophyll regions, coastal-offshore transects, and offshore regions influenced by transport of coastal water via mesoscale eddies. Sample were collected from GO-FLO bottles and a towed fish sampler. Superoxide concentrations and first-order decay coefficients were on the order of 40 to 500 pM and 0.002 to 0.02 s \(^{-1}\), respectively. Factors governing spatial and temporal variations in the production and decay of superoxide, and the resulting effect on trace metal cycling will be discussed.

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EXCESS NITRATE IN THE UPPER THERMOCLINE WATERS OF THE SUBTROPICAL NORTH ATLANTIC: UNCERTAINTIES AND CONUNDRUMS

A well observed phenomenon found in the upper thermocline of the subtropical North Atlantic is an excess of nitrate relative to phosphate (given Redfield expectations). What is uncertain are the sources of this excess N. Moreover, the mechanisms for introducing it to the thermocline and the rates of input are also not well established. Analyses of various data sets suggest that the sources may be multiple (N fixation, DOM export via subduction, atmospheric deposition) and the rates of similar magnitude (10 \(^{-11}\) mol N yr \(^{-1}\)). Unfortunately, since the mechanisms allowing these distinct processes to similarly accumulate excess N in the thermocline are not known, we cannot be sure that our present understanding of the system is correct. In this presentation, we will assess the likely inputs, and consider the conundrums that remain in understanding excess N accumulation in the subtropical North Atlantic.

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MASS TRANSFER IN CANOPY FLOW: AN INVESTIGATION OF THE EFFECT OF HYDROZOAN COLONIZATION ON THE GIANT KELP MACROCYSTIS PYRIFERA

Hydrozoan colonies on giant kelp form a sparse canopy that modifies boundary layer characteristics and mass transfer dynamics at the blade surface. This has important implications for kelp nutrient uptake, waste removal, and suitability of the blade as a microbial habitat. Controlled lab experiments were conducted in a recirculating flume on individual, bare and colonized kelp blades, under conditions of varying Reynolds number and colony density. Lab measurements included profiles of oxygen concentrations and velocity distributions. Field velocity was also measured within the kelp bed. Dimensionless canopy density (ad) values were 0.011 or less. Concentration boundary layer thickness (CBLT) was calculated using similarity groupings and a hyperbolic tangent fit. Results indicate that CBLT did not significantly depend on average bulk velocity, but CBLT is significantly greater with hydrozoan colonies that within a universal scaling relationship which describes concentration distribution as a function of distance from the blade surface is proposed.

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INTERANNUAL DIFFERENCES IN SIMULATED PRIMARY PRODUCTION IN THE NORWEGIAN SEA CONNECTED TO VARIATIONS IN NAO

Along the Norwegian coast, from 60N to 70N, the primary production in 1995 and 1996 has been simulated using a primary production model coupled to a hybrid coordinate ocean model with horizontal grid resolution of 4.5 km. Over two years (1995/1996) was chosen, because the North Atlantic Oscillation (NAO) changed from positive value in 1995 to negative in 1996. Westerlies (which are strong during positive NAO years) introduces more arctic waters into the Norwegian sea, and limit the extension of atlantic waters. The NAO also influences the volume transport in the North Atlantic Current and therefore changes the distribution of nutrients. Preliminary model results show an earlier spring bloom in 1996 compared to 1995, this is not consistent with the observed values at station MIKE. The differences between observed and modeled results will be explained. The inconsistencies between modeled and observed results are probably caused by the depth of the mixed layer in the model, and runs with different mixed layer formulations will be performed to evaluate this.

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WAVE FORCED SUB-AERIAL BEACH VARIABILITY, OCEAN BEACH, SAN FRANCISCO, CA

Sub-aerial beach surveys were conducted with differential GPS at Ocean Beach, San Francisco, CA, during 2005 and 2006 to determine the impact of various wave conditions at five morphologically unique reaches. The shoreline-normalized volume change was calculated from the survey data, as well as the change of the Mean High Water (MHW) line. An attempt was made to correlate sub-aerial beach response with the measured offshore wave conditions as well as numerical model derived nearshore wave heights. Direct correlations between either the volume or MHW line change between surveys with any of the offshore wave parameters (significant wave height, peak period, and peak direction) or the numerical model data yielded low R2 values. Multiple regression analysis on the most northerly reach of Ocean Beach gave an R2 value of 0.79 when the average wave height and average wave period between surveys is considered. The reason for the low correlation values on the rest of the beach is unknown, but is likely related to rapid beach recovery following storms and the temporal spacing of the sub-aerial surveys.

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THE ROLE OF NUTRIENT GRADIENTS IN THE EPISODIC FORMATION OF THIN PLANKTON LAYERS IN MONTEREY BAY, CA.

Thin plankton layers are often embedded within steep nutrient gradients or associated with transient chemical plumes. However little is known about the mechanistic roles that chemical gradients play in the episodic formation and maintenance of productive, thin plankton layers in coastal waters. What are the critical temporal and spatial scales for the interaction of chemical gradients and such plankton patches? In order to answer these questions it is necessary to make high-resolution measurements of biological, physical and chemical data on comparable scales. Two multi-week summer-time field experiments were conducted during 2005 and 2006 in Monterey Bay as part of ONR's "Layered Organization in the Coastal Ocean (LOC0)" program. The objective was to monitor the vertical and horizontal gradients of nutrients associated with thin plankton layers that develop episodically in Monterey Bay. Multi-channel profiling nutrient analyzers were deployed on high resolution ship-board and autonomous moored profilers. The nutrient profiles were recorded simultaneously with bio-optical, chemical and physical parameters. The comparative observations on the variability of nutrient gradients and plankton patchiness during the two LOC0 field experiments harbor some interesting results.

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AN INSTRUMENTED MODEL TEST BED FOR THE CAROLINAS COAST

An instrumented model test bed has been set along the Carolinas coast to evaluate coastal process modeling technologies. Initially developed to support modeling applications for the US Army Corps of Engineers (USACE) Morphos program, the test bed includes an extensive ground truth data archive, populated by wave, wind, water level and current observing assets operated by the USACE Field Research Facility (FRF) and various governmental and academic partners. Assessment and quantification of numerical model performance is accomplished with the Automated Model Evaluation and Diagnostics System (AutoMEDS). For any predicted quantity, AutoMEDS matches model predictions with observations, performs temporal correlation and quantile-quantile regressions, computes a variety of error statistics and evaluates overall model performance. The test bed has been used to assess the performance of an experimental SWAN forecasting system that is under development for the National Weather Service (NWS) and the North Carolina Floodplain Mapping Program. Model sensitivity runs have been initiated to identify prediction strengths and weaknesses and facilitate parameter selections for final model implementation.

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LARGE EDDY SIMULATION OF UPPER OCEAN MIXING WITHIN A FRONT

Large Eddy Simulations (LES) techniques are used to study upper-ocean mixing in a well-sampled front off Monterey measured during the summer of 2006 as part of the AEOS experiment. A period of driven mixing was followed by rapid restratification of the wind layer. Representative horizontal stratification due to gradients of temperature and salinity within the front are incorporated as a background in otherwise periodic realizations of the dynamics between O(1) and O(1000) m length scales. During the mixing phase, cross frontal turbulent horizontal fluxes induced by wind-driven vertical mixing are shown to be significant, relative to what the fluxes would be in a regional-scale model where horizontal eddy diffusivities are as low as 1 to 10 m/s. Turbulent horizontal fluxes of similar in magnitude are also induced in the along-front direction (i.e. they do not down-gradient). These lateral turbulent fluxes are found to increase with LES domain size, consistent with the expectation that subgrid fluxes in a regional model should decrease with increasing grid resolution.

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HARBOR SEAL MOVEMENTS AND HOT-SPOTS IN THE GEORGIA BASIN REVEALED THROUGH THE USE OF SATELLITE-TELEMETRY

Research in the Georgia Basin, Pacific Northwest, previously suggested that male harbor seals (Phoca vitulina) more <28km from their haul-out site during breeding. However, no data exist on movements of males or females at other times of the year. We employed satellite-telemetry to describe movements of harbor seals in the region during spring and summer. Twenty harbor seals were equipped with SPOTOS and SPLASH tags (Wildlife Computers) during April and May 2007 at three sites: one rocky site (n=5,1M,F) and one mudflat bay (n=3,2M,1F) in northern Puget Sound, and one rocky site in SE British Columbia (N=8M). Preliminary results indicate an average transmission length of 110 days (sd=32, n=30). Seals from rocky sites traveled distances >125km (n=6), with 78% of seals traveling farther than 28km. Additionally, they were found to excursion to the outer coast, an unexpected behavior as the inland and coastal seals are genetically distinct stocks. Conversely, all but one seal from the mudflat site moved <22km from the tagging site. Data suggest that regional seal movements are highly variable and long-term monitoring is needed to accurately assess hot-spots.

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MEASURING BIOAVAILABLE HYDROCARBONS IN THE NEARSHORE BEAUFORT SEA: COMPARISON OF CAGED MUSSELS (MYTILUS TROSSULUS) AND SEMIPERMEABLE MEMBRANE DEVICES (SPMDs)

Measuring dissolved, bioavailable contaminants in seawater is a challenging task in any environment, but is even more problematic in the Arctic. As part of the U.S. Minerals Management Service (MMS) Continuation of Arctic Nearshore Impact Monitoring in Development Area (CANNIDA) multidisciplinary monitoring program, MMS undertook an investigation to compare bivalve (Mytilus trossulus) tissue uptake to passive non-biological Semi Permeable Membrane Devices (SPMDs). The primary objective of the comparisons were to determine which method best characterized bioavailable PAH assemblages in the nearshore Alaskan Beaufort Sea and to estimate relative contributions from offshore oil and gas development activities and other petrogenic (e.g. boat fuel) and biogenic (e.g. combustion PAH deposited from arctic aerosol into coastal soil) PAH sources. Exposure systems were deployed at locations proximate to an active oil production site and several reference areas with varying levels of human activity. Method comparison studies were conducted in 2002 and 2004. Subsequent mussel only deployments were performed in 2005 and 2006. Both systems provided data useful in assessing environmental impacts of oil and gas development activities.

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LONG-TERM TRENDS OF PHYTOPLANKTON IN CHESAPEAKE BAY FROM IN-SITU AND REMOTE OBSERVATIONS

We draw on historical and recent data on floral composition, biomass, and primary productivity in Chesapeake Bay to quantify long-term trends against a backdrop of strong climatic forcing that evokes a high degree of interannual variability in this dynamic estuarine ecosystem. Data sources include historical observations (1950-1983), monitoring cruises (1984-present), individual research programs (1982-2005), and aircraft remote sensing of chlorophyll biomass (1989-present). Decadal patterns of chlorophyll in the Bay are described, reflecting variability of freshwater flow and the effects on nutrient loading and light availability; seasonal to interannual variability of primary productivity; statistical methods to classify regional climate; coincident forcing of floral composition, biomass, and primary productivity by flow/climate; applications of historical and recent data in developing chlorophyll criteria to assess ecosystem responses to mandated reductions of nutrients. Data from these sources are combined with climate analyses and biogeochemical modeling to support our current understanding of phytoplankton dynamics in Chesapeake Bay, leading to predictive capabilities heretofore unrealized for this complex ecosystem.

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DOMIC ACID ASSISTED COPPER UPTAKE BY A NATURAL COMMUNITY FROM HNLC WATERS

Domoic acid (DA), a marine algal toxin responsible for the symptoms of amnesic shellfish poisoning, is produced by various species within the genus Pseudo-nitzchia. While we recognize the toxic nature of this molecule, the physiological reason for its production is unclear but may be linked to its iron- and copper-binding capacity. At Ocean Station PAPA, a known high nitrate, low chlorophyll (HNLC) area, we tested the hypothesis that DA production in non-biological Semi-Porous Membrane Devices (SPMDs) was due to the presence of DA/copper complex and we analyzed the change in the community structure and activity in the uptake of copper. Using shipboard incubations, seawater was amended with DA and a DA/copper complex and we analyzed the change in the community structure and activity in the uptake of copper. Using shipboard incubations, seawater was amended with DA and a DA/copper complex and we analyzed the change in the community structure and activity in the uptake of copper.
Pseudo-nitzschia, suggesting that other organisms incorporated DA from the DA-copper complex. pDA was not found in the DA only treatments, lending support to the current hypothesis that DA is produced primarily as a means of sequestering copper.

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CHARACTERIZATION OF VOLCANISM ALONG THE SOUTHEAST INDIAN RIDGE

With a constant intermediate spreading rate of 7.2 cm/yr, the SEIR allows for us to better isolate other determining factors of its diverse morphology. Increasing gravity anomalies, seismological evidence of a decrease in crustal thickness and geochemical data suggesting a constant mantle source have been used to estimate a 15°C decrease in mantle temperature from 100°C to 110°C. Seismic evidence also shows shallow magma chambers under portions of the ridge from about 100°C to 104°C. With this information, it has been argued that magma chamber presence in the SEIR changes at threshold mantle temperatures. Characterization of its volcanism supports previous claims of threshold changes in the intermediate spreading rate ridge processes and structure, provides further evidence for the importance of magma chamber presence and suggests that the Australian Antarctic Discordance extend 700 km farther west than previously thought.

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COUPLING CLIMATE AND FISH POPULATION MODELS: AN EXAMPLE BASED ON A MECHANISTIC RECRUITMENT HYPOTHESIS FOR ATLANTIC CROAKER

Forecasts of the effect of climate change on fisheries resources are needed to ensure sus- tainable management in the future. Prior work with Atlantic croaker has hypothesized a simple mechanistic chain between recruitment, environmental variability, and population dynamics. Here, this mechanistic chain is incorporated into a population model based on an environmentally explicit stock recruitment function and then linked to global climate models to forecast population abundance and distribution under different scenarios of cli- mate forcing. The coupled population-climate model indicates that even though climate-driven environmental effects result in increases in spawning stock biomass, fishing mor- tality remains the primary driver of population abundance. Further, the model indicates that although croaker have been rarely caught in the northern Mid-Atlantic and southern New England waters in the past 100 years, that under high CO2 emission scenarios, they would become a more regular component of the region’s fisheries. The links between climate and population models developed here can be used as a framework for develop- ing climate forecasts for other species and in other ecosystems and thus contribute to the quantitative understanding of the effects of climate change on living marine resources.

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THE OYSTER AS BIONICINDICATOR OF POPULATION CONNECTIVITY AMONG SOUTHEASTERN FLORIDA LAGOONS

The eastern oyster (Crassostrea virginica) is a keystone species occupying estuarine habi- tats throughout the eastern and Gulf of Mexico coasts of the United States. The oyster’s pivotal role in these ecosystems stems from its reef-forming habit, providing habitat for diverse fauna, and the water clarifying accomplished by the enormous filter feeding capaci- ty of the oyster populations. In the semi-enclosed lagoons of the Indian River and south- eastern Florida, alterations to freshwater flow have had dramatic effects on habitat quality for oysters. Remnant and disjunct oyster populations now exist with an unknown degree of connectivity via larval dispersal. To map oyster population sources and sinks, genetic analyses were conducted on adult and newly-settled oysters collected within lagoons and near ocean inlets in 2007. Genetic differentiation among reproductive adult populations enabled the inference of source populations and migration routes for juvenile oysters dur- ing one recruitment season. Contemporary patterns of connectivity among lagoon oyster populations will inform oyster restoration efforts, help forecast the consequences of fresh- water drainage alterations, and provide testable hypotheses for general larval dispersal patterns among southeastern Florida lagoons.

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UPDATE ON A SCALEABLE, REALTIME NETWORK FOR HF RADAR

Local, state, regional, and federal discussions directed towards the establishment of an Integrated Ocean Observing System (IOOS) continue to emphasize a desire for the in- stallation, development, and operation of a network of surface current mapping systems for use by a broad range of end users. Central to the operational success of a large scale network will be a scalable data management, storage, access, and delivery system. Staff at the Coastal Observing R&D Center at Scripps Institution of Oceanography are research- ing, developing, and implementing a prototype data management system for ocean current information derived from HF radar. The architecture of the HF-Radar Network lends itself well to a distributed and service-oriented networking approach for networking sensors on a global level. This joint university-NOAA partnership is focused on defining and meeting the expressed needs for an IT architecture supporting a national network of surface current mapping data systems, and takes advantage of the existing systems deployed in the U.S., including the California-wide Coastal Ocean Currents Monitoring Program. An update on the capabilities of the system, and opportunities for interna- tional involvement will be presented.

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A MODELING STUDY OF RETRIEVAL BIASES

Comprehensive modeling studies have been carried out to simulate the expected clear-sky SST retrieval error in the AVHRR Pathfinder dataset. The simulations have used the full high-resolution (~1.25 x 1.25) ECMWF Reanalysis data (ERA-40), the JCSIA Community Radiative Transfer Model and the Pathfinder matchup dataset (1985 - 1999) to replicate the sampling and algorithm development methodology as closely as possible. The resul- tant retrieval coefficients have then been applied to the entire ERA-40 for the same time span, using the approximate overpass time for cloud-free grid cells. The resultant SST retrieval bias estimates, derived from over 150 million atmospheric simulations, are eval- uated. The retrieval biases are investigated to determine the underlying physical causes, including the effects of air-sea temperature difference and atmospheric absorption. The annual signal in bias is likely to have an impact on the determination of EOIs for historical SST reconstruction techniques.

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BATHYMETRIC INVERSION FROM SHORE-BASED VIDEO IMAGERY

Models that predict nearshore behavior require as input boundary conditions the bottom profile. Traditionally, beach profiles are measured with differential GPS receivers mounted on amphibious vehicles or small boats. Logistical difficulties in obtaining frequent beach profiles over large nearshore areas have limited their acquisition to a few sites or inten- sive study periods. In this work, we evaluate the ability of remote imaging techniques to measure the beach profile using land-based video cameras. Such techniques have been developed for video systems on airplanes (Dugan et al., JGR, v.106 2001), from which the methodology used in this project is based. The airborne techniques will be adapted for use with a fixed, highly oblique video camera mounted on a 20 m high tower erected on the dune at the USACE Field Research Facility (FRF). Water depths are determined by estimating linear wave theory dispersion curves from image intensity energy surfaces in wavenumber-frequency space. Approximately 30 minute video time series over successive, overlapping square sections of the nearshore (100 m on a side) are obtained from a 6 m depth to near the shoreline. Comparison with bathymetry measured using traditional in situ survey methods by the FRF will be presented and a quantitative assessment of the accuracies and limitations of the video techniques discussed.

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ESTIMATED RATES OF FORMATION OF SUBANTARCTIC MODE WATER AND ANTARCTIC INTERMEDIATE WATER IN THE SOUTHEAST PACIFIC

Large volume cold, fresh water masses of Subantarctic Mode Water (SAMW) and Antarctic Intermediate Water (AAIW) are formed inustral winter in the Southeast Pacific. SAMW forms at outcropping isopycnals within deep mixed layers (>400m) north of the Subantarctic front, and AAIW forms between the Polar and Subantarctic Fronts. These water masses fill the lower thermocline and intermediate oceans of the South Pacific extending to depths of 800-1000 m, ventilating the subtropical gyres. Analysis of physical properties from an August-September 2005 cruise found SAMW and AAIW deepening to 27.4 σθ and 27.06-27.20 σθ, respectively, with AAIW particularly near 27σθ across the gyre. CFC-11 and CFC-12 saturations at the source for both AAIW and SAMW were observed to be in close equilibrium (~95%) with the present atmosphere. Recent CFCs and WOCE Pacific data are used to estimate formation rates for SAMW and AAIW, which are proportional to the CFC inventories divided by the CFC concentrations as a function of time and equilibrium values.

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GIS-BASED ANALYSIS OF NUTRIENTS AND MICROALGAL BIOMASS IN LITTLE LAGOON, ALABAMA, A POORLY-FLOUshed COASTAL LAGOON
We used a combination of flow-through and discrete sampling to map water quality and microbial abundance of three organisms in Littleton, AL. The measured parameters were temperature, salinity, and the concentrations of total phosphorus, total nitrogen and chlorophyll a. All data were matched with the appropriate coordinates and interpolated in ArcGIS 9.2 using Geostatistical Analyst. Interpolations and supporting plots show consistent trends between all parameters. There were strong gradients of salinity and temperature between the ends of the lagoon and the narrow neck that connects it to the Gulf of Mexico. High nutrient and chlorophyll levels were also found at both ends. This indicates freshwater inputs at both ends, which is inconsistent with surface maps. Chlorophyll was highly correlated with both TN and TP and increased significantly per unit N or P between the first and second sampling trips, indicating poor flushing. If the strong relationship between nutrients and microagal biomass (as chlorophyll) persists it may result in adverse effects such as blooms and hypoxia in the lagoon, given the very rapid population growth in the watershed.

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PROTEINS AS BIOMARKERS: USING SHOTGUN PROTEOMIC MASS SPECTROMETRY TO TRACK THE FATE OF ALGAL PROTEINS IN MARINE SYSTEMS

Protein comprises the largest compartment of nitrogen in phytoplankton and thus the largest potential contributor of nitrogen to marine systems. Despite rapid recycling of protein in ocean waters, proteinaceous remnants have been recognised in particles and sediments. We have applied detailed peptide mapping and newly constructed proteomic databases to examine the suite of individual proteins present in the marine diatom Thalassiosira pseudonana, and their fate during degradation by natural microbial communities. The 23 day incubation was analyzed by tandem mass spectrometry followed by computational analyses with SEQUEST search engines specified to follow the fate of several hundred proteins and their potential for preservation. These results provide insight into the mechanisms by which intact proteins are transformed and the potential for identified protein sequences to be identified in the marine environment.

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CONTROLS ON FLOW VELOCITY AND FLOW RESISTANCE IN THE PATTERED FLOODPLAIN LANDSCAPE OF THE EVERGLADES

Surface-water flow characteristics and vegetation density were measured in the Everglades at a location with a landscape pattern that was once common: flow parallel and topographically and vegetationally distinct ridges and sloughs. The purpose was to determine controls on velocity and flow resistance in a way that is generally relevant to floodplain wetlands with laminar to transitional flow conditions, and also to characterize Everglades flow in support of restoration. Continuous measurements over two wet seasons demonstrated that depth-averaged velocity through sloughs is approximately a third greater than on ridges and that unit-width slough discharge is approximately twice that on ridges. The difference relates to interactions between water energy slope, vegetation drag, and water depth, and also to differences in ground-surface elevation and vegetation architecture between the ridges and sloughs. These findings have general implications for predicting hydrological flows on heterogeneous, vegetated floodplains and also specific implications for wetland water managers seeking to manipulate flow velocity to optimize sediment entrainment, sediment redistribution, and other processes contributing to self-sustaining topographical variability and biodiversity in the Everglades.

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TROPHIC CONNECTIONS IN COMPLEX FOOD WEBS: INSIGHTS FROM TERRESTRIAL ECOSYSTEMS

The cryptic behavior, feeding patterns and small size of terrestrial arthropods has led to the development of alternative techniques to study their interactions. Historically, observational, laboratory-based experimentation and visualization of gut or fecal content provided information pertaining to the foraging behavior of these organisms. However, over the last 60 years significant advances in biochemical and molecular technology have led to the integration of allozyme electrophoresis, stable-isotope analysis, radio-labeling and the use of polychlorinated biota in field ecology. Today, two approaches dominate: immunological detection of prey proteins using monoclonal antibodies and PCR-based detection of species-specific gene sequences. The use of these approaches is reviewed in the context of arthropod predation, and comparisons made to studies employing these techniques within marine and freshwater food webs. Furthermore, the ongoing use of antibody-based immunological approaches to study terrestrial trophic linkages will be examined and reasons for their use considered and contrasted to approaches employed in marine biology. Ultimately, although a multitude of approaches are available to ecologists, it appears likely that unless stage-specific interactions are being examined, specific PCR will dominate field research for the foreseeable future.

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REAL AND APPARENT PHYTOPLANKTON BLOOM DUE TO ISLAND MASS EFFECTS

We recently reported a new aspect of Island Mass Effects: the Apparent Phytoplankton Bloom (APB) caused by phytoplankton growth (Deep Chlorophyll Maximum, DCM) as a result of advection to an island wake (Hasegawa et al., JMS in press). In addition to this, nutrients introduced by the vertical exchange stimulate phytoplankton growth; thus both the regular bloom and the APB contribute to the development of enhanced concentrations of phytoplankton downstream from islands. This is expected to influence the Princeton Ocean Model with a passive tracer and an embedded ecosystem model to investigate downstream dynamics given a geostrophically balanced incident flow with the DCM and a relatively small (~10km) island in a 1000m deep flat-bottom channel. Model results showed high tracer concentration in the lee of the island and in the generated cyclonic eddies as the APB. The cyclogeostrophic balance sustained the upwelled nutrient-rich deep water at the surface in the cyclonic eddies then resulted the "real" phytoplankton bloom which proceeded with time as the eddies flowing toward the downstream.

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PREDICTED IMPACTS OF GLOBAL WARMING ON MARINE ECOSYSTEM WITH A 3-D HIGH-RESOLUTION ECOSYSTEM MODEL

To clarify the effect of global warming on marine ecosystems, we have been developing and improving a 3-D ecosystem model, COCO-NEMURO, which consists of NEMURO (North Pacific Ecosystem Model for Understanding Regional Oceanography) of PICES (North Pacific Marine Science Organization) coupled with COCO (CCSR Ocean Component Model). Hashioka and Yamazaki (2007) conducted a global warming experiment using a medium resolution version (1 x 1 degree) of COCO-NEMURO in the western North Pacific, and they showed a significant change on seasonal variation of the lower-trophic level ecosystem. As a next step, we developed a new high-resolution version (1/4 x 1/6 degrees) of COCO-NEMURO as an offline model in collaboration with climate modelers. We are currently conducting a 20th century experiment and a global warming experiment using physical forcing from a high-resolution climate model (the CCSR/NIES/FRCCG coupled Ocean-Atmosphere GCM: K-1 model, which contributed to the IPCC-AR4). Our model well reproduced the seasonal and regional variations of Chl-a concentration associated with meso-scale features in the present-day simulation. We will present the preliminary results of our global warming experiment.

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TEMPERATURE EFFECTS ON DIETARY CHOLESTEROL DEMAND AND CHOLESTEROL CONTENT OF ZOOPLANKTON

Animals require cholesterol for growth, but many taxa are unable to synthesize cholesterol. Cholesterol stabilizes plasma membranes by countering fluidizing effects of elevated temperature and therefore dietary sterol demands and membrane cholesterol content may be affected by temperature. To assess temperature effects on cholesterol requirements, the copepod Eurytemora affinis was raised at 6° and 25°C on Synecococcus baijiensis supplemented with varying cholesterol levels. E. affinis achieves maximum growth rates at higher cholesterol concentrations at 25°C (+0.2 ug/l) than at 6°C (+0.05), indicating greater cholesterol demands at warm temperatures. We also investigated effects of acclimation temperature on cholesterol contents of zooplankton. Cholesterol levels vary over 3-fold (6 to 20 ug cholesterol/ug protein) among the tested species, and are positively correlated with maximum habitat temperature. Individual species responses to temperature acclimation, however, are variable. C. finmarchicus (CV and eggs) has 1.2-fold higher cholesterol levels following acclimation to high temperatures while Acartia tonsa and A. hudsonica have higher cholesterol contents at low temperature. It is not clear whether these results are due to habitat (neritic vs oceanic) or phylogenetic differences.

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FORENSIC MODELING OF MARINE INVASIONS OF AN INLAND SEA USING ECOCLOGICAL CONNECTIVITY ANALYSIS

Range expansions of marine species are associated with natural and anthropogenic environmental change, as well as introductions. When the pace of invasion is rapid relative to ecological time a species is often judged to be introduced, even if the vector is not definitive. The cost of countering marine ecological invasions a posteriori is prohibitive,
so it is important to understand the epidemiology of the invasion before attempting intervention. We use marine ecological connectivity modeling to support such decisions.

Two marine species (Green crab and the MSX haplosporidian parasite) have appeared in a large, inland sea of eastern Canada during the past decade. The vectors are unknown, but the crab is thought to have arrived by larval transport from populations to the SW, while the oyster parasite is thought to have been introduced via ballast water. The distributions of both species in the 1200km2 area is in space-time, with environmental and recruitment limitations invoked but unproven. We use an advanced 3D numerical model of hydrodynamic connectivity and hydrology over a benthic habitat map to predict the vector of invasion and pattern and pace of post invasion dispersion through a heterogeneous ecosystem of variable exchange rates to test hypotheses about mechanisms of arrival and spread of these species through the Bras d’Or Lighthouse. Results of this forensic ecological modeling analysis are amenable to validation by population genetic methods.

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CHEMICAL CHARACTERIZATION OF MUC (MOLECULARLY UNCHARACTERIZED CARBON) IN MARINE AND LACUSTRIINE SYSTEMS: A NEW ANALYTICAL APPROACH

We employ multidimensional NMR spectroscopy with High Resolution Magic Angle Spinning (HRMAS) and Fourier Transform Ion Cyclotron Resonance Mass Spectrometry (FT-ICR-MS) of extracts to examine the molecular composition of MUC in marine and lacustrine sediments. HRMAS swells the organic matter by addition of a solvent (i.e., D2O, D6O-6) to the sample. We then analyze the extract by FT-ICR-MS to obtain highly resolved and accurately calibrated masses from which elemental formulas can be calculated. Elemental compositions of the peaks allow us to propose structures for the multitude of molecules present in the extract, thus providing molecular-level information that reflects the soluble extracts but also the insoluble components.

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IRON FLUXES FROM THE SHELF REGIONS NEAR ELEPHANT ISLAND IN THE Drake Passage DURING AUSTRAL-WINTER 2006

Spatial distributions of dissolved iron, manganese and aluminium in the upper 500m near Elephant Island in the Drake Passage during the 2006 austral-winter are consistent with diagnostically-produced sedimentary sources and data obtained during the 2004 austral-summer. Near Elephant Island elevated levels of dissolved Fe (~5nM) and Mn (~30nM) above the shelf regions are well mixed down to the sediment-water interface. This contrasts with the Antarctic Circumpolar Current (ACC) where very low concentrations of Fe occur with high nutrients and low chlorophyll (HNLC). Phytoplankton abundance is greater offshore than on the shelf, the opposite of the austral summer; and suggestive of a system transitioning from light limitation on the shelf in winter to Fe limitation in the ACC during summer. High productivity downstream, east of the Antarctic Peninsula, is hypothesized to be the result of iron-replete water from the shelf regions being entrained into the HNLC and ACC water, a consequence of hydrographic forcing at the Shackleton Transverse Ridge. Calculations suggest that up to 28.5x10^3 moles Fe yr^-1 could be delivered to the iron-depleted ACC by this route.

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SPRING BLOOM IN THE NORTHEASTERN LABORADOR SEA

A pronounced spring bloom occurs in the Northeastern Labrador Sea between March and May every year. The timing and intensity of this bloom may have a significant impact on the recruitment of zooplankton, and thereby for the ecosystem in the region. The near-surface stratification, required for the spring bloom, can be explained by a large influx of low-salinity water from the West Greenland Current into the bloom region. We find that this plume has a linear structure, for this influx to be the shedding of large anticyclonic eddies (Innringur Rings), which grab the low-salinity water of the Greenland shelf. The link between the biological production and the freshwater stratification opens a new window for monitoring the resistance-to-convection in the Labrador Sea, which is of significant climatic importance.

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OBSERVATIONS OF THE SPATIAL VARIABILITY OF WAVE DIRECTIONAL SPECTRA IN A REGION OF HIGH SURFACE CURRENT VORTICITY USING WERA HF RADARS

A pair of WERA HF Radar (WERA) systems have been observing near-surface currents and archiving echo-Doppler spectra over the Southeast Florida shelf since June 2004 as a part of the Southeast Atlantic Coastal Ocean Observing System (SEACOOS). Wave parameters and directional spectra were extracted over the high surface current vorticity region adjacent to the western edge of the Florida Current. WERA observations were compared with in-situ directional spectral measurements. Additional comparisons with the SWAN directional shallow water wave model exploited the capability of the phased-array HF radar to provide spatial fields of both surface currents and waves. The directional spectra retrievals in the region of the in-situ observations were at large angles to both radar directions and therefore were sensitive to noise contamination. The temporal averaging of the signals was also relatively short (1024 samples, ~5 minutes). This necessitated the development of approaches to eliminate noisy Doppler spectra from processing before averaging multiple sample periods. Longer sampling intervals (2048 samples) and radio frequency interference reduction techniques were tested and their effect on data quality was assessed.

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SEA STATE BIAS IN SATELLITE RADAR ALTIMETRY - REVISED

Sea state bias (SSB) is an effect in radar altimetry that arises both from the fact that wave troughs are better reflectors than wave crests, and from instrumental properties (tracker bias) with similar wavelength dependence, which results in a lower instantaneous sea surface height (SSH) measurement than what is actually there. Typically, SSB is estimated from altimetrically measured SSH, waveheight (SWH), and wind speed (U), differentiated over short times at the same geographic location. We investigate whether this commonly used approach may introduce a spurious value in the estimates of SSB. We use H1 not from any radar altimeter but from a simulation by the ECO2-2 high-resolution ocean general circulation (numerical) model. Therefore, our SSH should have zero SSB, except for random noise. We check this by using a simple parametric dependence on SWH and U, as measured by Jason-1 data during 2003, and consecutive cycle differences. Our preliminary estimates indicate that the factor multiplying the cross term on SWH and U is remarkably stable for any pair of cycles, and overall there is a spurious effect of the order of a fraction of a percent of SWH.

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DECadal predictability of the Atlantic Meridional Overturning Circulation: Estimation of optimal perturbations for a coupled GCM

Future decadal climate forecasts are likely to rely on ensembles initialised using small perturbations to ocean and atmosphere conditions. In order to design efficient ensembles there is a need to identify those perturbations that grow most rapidly. Such perturbations may also be useful to identify where new ocean observations could improve forecast skill. We have employed two different methods to estimate such optimal perturbations for decadal forecasts of the Atlantic Ocean in the HadCM3 GCM. Firstly, we use linear inverse modelling (LIM) to find the initial condition anomalies which grow most rapidly under a particular norm of interest. Significant non-normal amplification is found in the GCM, which distinguishes this model from classical numerical experiments. We also demonstrate that optimal perturbations are sensitive to the forcing, and that basin-scale temperature and salinity fields. Secondly, we are using an ensemble based technique which, unlike the LIM approach, enables optimal perturbations to be estimated for specific initial conditions, e.g. a high or low overturning strength. The latest results will be discussed.

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INTERNAL GRAY WAVES: ANALYSIS USING THE FOURIER, SCATTERING, AND CONTINUOUS WAVELET TRANSFORMS WITH APPLICATIONS TO LONG TIME SIMULATIONS

Analysis of tides and internal waves (IW) from model studies in the South China Sea is done using three techniques. We summarize results from standard Fourier techniques (the FFT), wavelet analysis with the wavelet continuous wavelet transform (WT) and the direct scattering approach (DSCA). IW success in elucidating underlying nonlinear dynamics. We apply these techniques to inverse modelling (LIM) to find the initial condition anomalies which grow most rapidly under a particular norm of interest. Significant non-normal amplification is found in the GCM, which distinguishes this model from classical numerical experiments. We also demonstrate multi-decadal predictability of the overturning strength, and of basin-wide temperature and salinity fields. Secondly, we are using an ensemble based technique which, unlike the LIM approach, enables optimal perturbations to be estimated for specific initial conditions, e.g. a high or low overturning strength. The latest results will be discussed.

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SEDIMENT TRANSPORT PROCESSES IN LAKE ERIE

Time series observations of water temperature, turbidity, current velocity, and wave action were made at sites in the central (max depth ~25 m) and eastern (max depth ~55 m) basins of Lake Erie from September 2004 through October 2005. During the fall and early winter (Oct.-Jan.) increased turbidity in the central basin is correlated with wave and current activity, so most of the increases were due to local resuspension of bottom material. There
no evidence that resuspension occurred in deeper parts of the eastern basin. Instead, increased turbidity was due primarily to advection of material resuspended elsewhere. Wave action stopped after the lake became covered by ice in early February and did not recur until the ice melted. No sediment resuspension, and little advection of suspended material, was recorded during this interval. After the ice melted, smaller resuspension events were observed in the central basin until the water became stratified in mid June. After that time, no resuspension was observed until the lake re-mixed in late September.

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TIDAL CURRENT SCOURING IN INDIAN RIVER INLET, DELAWARE
Swift tidal currents in the Indian River Inlet have generated conspicuous scour holes in dangerous proximity to bridge piers supporting a major coastal highway. It has been suggested that the presence of bridge piers developed the initial conditions causing scour and facilitated the subsequent deepening (to over 30 m) and migration of the holes to their present locations. Recently, current profile data was collected in the inlet using a boat-mounted ADCP over one complete tidal cycle in order to investigate hydrodynamic variability - specifically in the vicinity of the scour holes. Preliminary analysis of the data reveals significant three dimensional irregularities in the horizontal and vertical velocities that appear to be associated with flow constrictions and separations over and near the scour holes. Spatial velocity maps averaged over short time blocks will be presented and used to quantify flow variability in relation to tidal phase and bathymetry.

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CIGUATERA POISONING: INCREASED INCIDENCE ASSOCIATED WITH CORAL REEF DECLINE?
Ciguatera toxins are produced by the dinoflagellate Gambierdiscus toxicus that is typically associated with benthic macroalgae in coral reef environments of the Caribbean and Pacific. These toxins accumulate in the tissues of herbivores that feed on these algae, and biomagnify through the food chain within tissues of larger predatory fish. Consumption of contaminated fish causes considerable morbidity in humans with incidence rates varying according to geographic location. G. toxicus distribution patterns have been linked to temperature, light and coral bleaching events, and continued degradation of coral reef environments. Global warming may favor its growth and lead to more frequent or larger outbreaks. This paper will examine the relationship between ciguatera outbreaks and various measures of coral reef health (e.g. bleaching history, percent coral cover) as well as other environmental measures such as sea surface temperature.

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SEASONAL VARIATIONS IN PHYTOPLANKTON GROWTH AND MICROZOOPLANKTON GRAZING IN A EUTROPHIC COASTAL LAGOONAL SYSTEM IN SOUTH CAROLINA
Coastal S.C. is one of the fastest growing areas in the country. A byproduct of this growth is the construction of over 8,000 stormwater ponds, many of which are highly eutrophic and have large blooms of harmful algae (primarily dinoflagellates and raphidophytes). To determine the importance of microzooplankton grazing as a potential controlling factor of bloom formation/decline, we conducted dilution experiments in 2006 to 2007 in two detention ponds. Pond K1 is the end pond in a series of ponds and Pond K2 is a lone pond. Phytoplankton growth varied seasonally, ranging from 0.78 to 2.14 d−1 and from 0.83 to 1.59 d−1, respectively. Microzooplankton grazing ranged from 0.46 to 2.67 d−1 and from 0.23 to 0.99 d−1, respectively, and on average microzooplankton consumed ~80% of production. Our results suggest that microzooplankton grazing is an important loss process for phytoplankton in ponds that are dominated by harmful algae. Assuming that benthic consumers and mesozooplankton also remove a fraction of the production, then grazing may limit the overall availability of phytoplankton productivity for export to adjacent coastal water bodies from these ponds.

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OCEAN OBSERVING INITIATIVE: THE INTERNATIONAL EFFORT
The US is starting to roll out contracts for elements of the Ocean Observing initia

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RELATIVE DISPERSION FROM A HIGH-RESOLUTION COASTAL AND OCEAN MODELS
Synthetic drifter trajectories computed from velocity data produced by a high-resolution models are used to investigate the scaling of relative dispersion and the distribution of Finite-Scale Lysapovun Exponent fields in the Adriatic Sea and the Gulf Stream region. It is shown that the relative dispersion model used in the Adriatic circulation is well conservative, and that the large-scale dispersion is dominated by persistent separation regions and the controlling influence of the Western Adriatic Current. The effects of varying degrees of spatial and temporal filtering of the input Eulerian velocity fields on the Lagrangian statistics are investigated in order to assess the sensitivity of such statistics to model error. While no clear exponential regime is observed in the full data set, a distinct flattening of the FSE curves are observed for larger-scale spatial smoothing. The role of chaotic advection in determining the small-scale relative dispersion in such cases is examined.

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CLIVAR Atlantic Implementation Panel

DECADAL PREDICTIONS OF THE ATLANTIC MERIDIONAL OVERTURNING CIRCULATION: A CLIVAR PERSPECTIVE
There is a need for decadal predictions, in particular for developing climate adapta

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REGIONAL CABLE OBSERVATORY SOLUTIONS
The North East Pacific Time-series Undersea Networked Experiments (NEPTUNE) is a world premiere for a large scale Regional Cable Observatory (RCO). The Canadian part of NEPTUNE is being installed off Vancouver Island in 2007 and 2008. This new technology concept applied to oceanography enables the Internet under the ocean, along with power distribution. The proven high reliability and long life of the subsea communications equipment offers the opportunity to install permanent observatories for operation for at least 25 years. The paper will provide an overview of the key network & system features and will present progress in the development, construction, and installation of this pioneering system. Alcatel-Lucent are installing the backbone cable system for NEPTUNE, comprising land station equipment, the subsea cable repeaters and branching units and the subsea nodes. The subsea nodes, providing subsea connection points provisioning data and power will provide a gateway between the permanent observatory infrastructure and the instrumentation. This system will provide a robust pioneering infrastructure for long term monitoring and investigation of the Oceans.

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UNDERSTANDING COASTAL CIRCULATION IN THE GULF OF MAINE AND MID- ATLANTIC BIGHT: A REGIONAL MODEL HINDCAST EXPERIMENT
Regional Ocean Modeling System (ROMS) is configured to provide circulation hindcast for the coastal region of the Northeastern United States, encompassing the Gulf of Maine (GOM) and the Middle Atlantic Bight (MAB). Coastal circulation in this region is strongly affected by both local momentum and buoyancy fluxes and a wide range of remote, offshore processes such as Gulf Stream meanders, meso-scale and submeso-scale eddies, and other basin-scale seasonal and inter-annual variability. The hindcast experiment therefore considers realistic surface forcing conditions. To effectively represent the impact of offshore variability, the data assimilative Hybrid Coordinate Ocean Model (HYCOM) solutions are also utilized to provide ROMS open boundary conditions via one-way nesting. Validations of this regional hindcast model and synthesis for coastal circulation during 4-year time period from 2003 to 2007 will be presented. Based on realistic, space and time continuous circulation realizations, we will also report findings/understandings of seasonal and inter-annual variability of circulation and shelf/deep- ocean exchange processes in this coastal region.
Photodegradation of ciprofloxacin and metolachlor in natural and constructed wetlands

Photodegradation of ciprofloxacin and metolachlor was carried out in one natural and three constructed wetlands (Old Woman Creek (OWC), Olentangy River Research Park, Waterman Farm Wetland, and Defiance County Wetland) to examine the effects of natural photolysis and photo-degradation (DPD) on the photolytic organic constituents. Ciprofloxacin underwent rapid degradation through direct photolysis (33.71 and 0.9533 hr⁻¹ at pH8 and pH4, respectively), whereas the degradation of metolachlor was relatively slow (0.01 and 0.0108 hr⁻¹ at pH8 and pH4, respectively). Compared to direct photolysis, wetland waters reduced the rate of ciprofloxacin degradation, especially at pH8, due to light screening by wetland waters. Metolachlor degradation was enhanced 2-15 times in wetland waters, with OWC water acting the most effectively. The addition of a strong iron complexing ligand, fluoride, significantly decreased metolachlor degradation, indicating iron played an important role in photosensitized degradation. The addition of 2.20 µM of iron promoted metolachlor degradation in OWC water by 50-100% at pH4, while no significant enhancements were observed for other wetland waters. Current studies are optimizing the photodegradation through altering the concentrations of different photosensitizers.

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COMPARATIVE ANALYSIS OF THE ECOLOGY OF CALANUS FINMARCHICUS IN CANADIAN AND NORWEGIAN SUB-ARTIC SEAS

The Labrador and Norwegian Seas are both important overwintering areas and distribution centres for Calanus finmarchicus. Both provide springtime source populations to the adjacent shelves and/or shelf seas, which are seasonally ice covered and which are home to commercially important fish and invertebrate stocks. In the Norwegian and Barents Seas there is a greater annual variability in C. finmarchicus abundance, which is linked to the NAO index. A high NAO index is accompanied by strong south-westly winds leading to enhanced influx of Atlantic water, warm temperatures and higher C. finmarchicus abundances. By contrast, in the Labrador Sea between 1994 and 2004 there were no discernible changes in the abundances of overwintered C. finmarchicus in spring, or of juveniles in summer, despite large variations in the NAO and a sustained annual warming trend of >1°C. In both the Labrador and Norwegian Seas areal egg production rates are higher in the pre-bloom period and in both there are spatial differences in the magnitude and timing of recruitment. These latter differences will be discussed in relation to local spring bloom dynamics. The depth of C. finmarchicus from the surface to the overwintering depths appears to be earlier in the Norwegian Sea than the Labrador Sea, perhaps because it is farther north and has an earlier cessation of phytoplankton growth.

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PROJECT INSTAR: LESSONS LEARNED OVER 10 YEARS OF PROVIDING SCIENCE EDUCATION TO K-12 TEACHERS

For ten years, Project INSTAR has engaged over 400 teachers from Miami-Dade County Public Schools in authentic research and field activities with real scientists focusing on coastal, marine and atmospheric environments. The two-week Institute introduces teachers to a wealth of current science topics that enhances their knowledge of scientific content, and exposes them to hands-on field and laboratory research, as well as state-of-the-art equipment and technology that they can use in the classroom. Participants receive 3 graduate credits, as well as, educational materials and classroom equipment that they can use back in the classroom with their students. These teachers have potentially impacted over 60,000 students about the importance and enjoyment in understanding the science, nature, and beauty of the South Florida ecosystems and positively influenced our future workforce and scientifically literate leaders. This presentation will highlight the lessons learned and modifications made over the years that have made this program a success. Examples such as marketing and recruitment strategies, funding avenues, graduate credit issues, collaborations between university departments, and school year follow-up will be emphasized.

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MODELING PROPOSED HABITAT RESTORATION IN SEMI-TROPICAL SHALLOW COASTAL TIDAL WETLANDS

A modeling study of a coastal tidal wetland in Florida is reported which considers the influence of proposed dredged ponds on geomorphology and freshwater habitat. The ponds would connect to the main tidal creek, that runs through the wetland, and be upstream of the existing fresh to salt water interface. The central question is whether the ponds could accelerate past anthropogenic reductions in freshwater habitat without causing other negative environmental impacts. Extensive topographic/bathymetric and habitat surveys of the wetland were made together with a two year monitoring program of water flow parameters. Hydrodynamic modeling in very shallow coastal wetlands faces significant challenges from both the complex topography, and small spatial scales, that control water flow, as well as from the spatially inhomogeneous roughness created by submerged vegetation. The extremely non-linear tidal excursions are found to influence both vertebrate habitat and advective/ diffusive transport in the wetland. The simulated wetland ponds are predicted to cause changes in tidal elevation and deposition which could affect wetland geomorphology especially in the lower reaches, and mouth, of the tidal creek.
centrations at depth during the dark period may be invalid for certain dinoflagellates such as K. brevis, which does not actively migrate downward at night and blooms in coastal areas not characterized by a nitrocline.

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APPLICATION OF ADJOINT METHODS IN OCEAN MODELING

Ocean models have become an ubiquitous tool for investigating key aspects of oceanic circulation and variability. The progress in this area is impressive, and has, at times, left some complementary aspects of modeling out of focus. Whenever gradient information from models is sought, it be to minimize model vs. observation misfits in state estimation, to investigate sensitivities of key oceanic quantities to a very large number of parameters, or to determine normal or non-normal stability, the adjoint method presents itself as a natural tool for efficiently computing such gradients. We provide an overview of adjoint modeling with the MIT general circulation model (MITgcm). The context of automatic differentiation has enabled us to extend our applications in various directions from coupled ocean-biogeochemical to ocean-sea ice modeling, and using various configurations from global coarse-resolution to regional eddy-permitting scales. New developments are discussed, mainly driven by the requirement of a new-generation EICO ocean state estimation system.

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GLACIAL/INTERGLACIAL CARBON CYCLE CHANGES AS DERIVED FROM GLOBAL MODELING OF MARINE SEDIMENT CORES

Marine sediment core data and the ice core record provide the foundation for an understanding of past changes in the global carbon cycle. But how to derive changes in governing parameters of the carbon cycle from these tracer data? In our approach, we carry out a series of forward simulations of the ocean carbon cycle over the last climatic cycle using a coarse resolution global biogeochemical ocean circulation model. The model includes basic parameterizations of the carbon, oxygen, phosphorus, and silicon cycles. The atmospheric carbon dioxide concentration is a prognostic model variable. Early diagnosis is simulated through a sediment module which is interactively coupled to the water column. The sediment model includes the four weight fractions calcium carbonate, organic carbon, opal, and clay. A time transport model was developed which allows proper synchronization of the various sediment weight fractions when leaving the sediment mixed layer down. From the forward simulations, synthetic sediment cores are recovered out of the model sediment for comparison with sediment core data from the real world. A method for deriving best estimates for changes in governing ocean carbon cycle parameters by combining the information from simulated and observed sediment core data is presented. The results will deliver best estimates for changes in ocean carbon cycle parameters due to climate change and a more alkaline glacial ocean as compared to today’s ocean.

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LABORATORY STUDY ON THE RECOVERY OF A STORM PERTURBED UPPER OCEAN LAYER

The effects on the ocean water column due to a storm passage can be characterized as three sequential processes: mixing of the upper layer due to momentum and heat transfer, propagation of energy into the thermocline, and recovery back to the pre-storm state. Recent field observations show that the ocean responds rapidly to a storm, in a matter of hours, while recovery to the initial state takes several days or more. To gain a better understanding of processes governing the recovery, a series of laboratory experiments have been performed. These experiments consider equilibration of the mixed water mass with the adjacent non-mixed water (i.e. region not affected by the storm) by wave propagation and water mass intrusions. A preliminary conceptual model has been developed to describe the recovery of a storm perturbed upper ocean layer that characterizes the recovery process in terms of temporal and spatial scales, including BV frequency and the nature of the forcing mechanism. Laboratory experimental results as well as recent field observations of storm induced water column alteration/recovery will be presented.

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EVALUATING THE SONIC LAYER DEPTH RELATIVE TO THE MIXED LAYER DEPTH

Sound speed within the ocean surface mixed layer increases with depth until (typically) a decrease in temperature occurs, resulting in a local maximum. The depth of this sound speed maximum is referred to as the sonic layer depth (SLD) and characterizes the ability of the upper ocean to trap acoustic energy in a surface duct. A closely related parameter that characterizes upper ocean mixing is the mixed layer depth (MLD). While SLD and MLD often coincide, they are not always the same because of the differences in the sensitivities of density and sound speed to temperature, salinity, and pressure. This analysis evaluates the SLD/MLD differences in space and time for a global set of in situ profiles observations. It is shown that in the northern hemispheric spring when fresh re-stratification events occur, the SLD is 10% deeper (shallower) than the MLD in 39% (7%) of the observed profiles. A parabolic equation acoustic transmission model is used to evaluate the relative skill of the SLD and MLD estimates to predict surface acoustic trapping as measured by a simple metric.

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RAPID GRADUATIONAL ADJUSTMENT OF A HORIZONTAL SHEAR LAYER

Shallow coastal ocean flows frequently involve strong horizontal shear layers in combination with a horizontal density gradient. Examples include estuarine outflows and separating flows around headlands and islands. The stability and evolution of the shear layer formed from the initial state of two co-flowing streams with laterally-varying, but depth independent, velocity and density is explored through three-dimensional non-hydrostatic numerical calculations. In the absence of the density contrast, the shear layer undergoes the classic instability including roll-up of the vertical vorticity into well-defined vortices. The addition of the density gradient results in a lateral gravity-driven flow resembling a lock-exchange. The lateral adjustment leads to tilting (from vertical) and stretching of the emerging shear layer vortices, greatly amplifying vorticity in the vortex cores. This converts horizontal shear into vertical shear and ultimately the rapid break-down of the vortices, large density overturns, and vertical mixing. The work is guided by a simple scaling argument that compares the timescale for growth of the linearly most unstable wave on a pure shear layer to the timescale for the transverse gravitational adjustment. For large values of this ratio the gravitational adjustment dominates and inhibits the shear instability. As this ratio decreases, the shear and gravity-driven flows become increasingly coupled, producing strong mixing.

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THE PHOTOCHEMICAL INTERFERENCE IN OXYGEN-BASED MEASUREMENTS OF PRIMARY PRODUCTIVITY

Measuring oxygen to determine primary production (PP) is the oldest method still in common usage. However, the photochemical reaction of molecular oxygen with chromophoric dissolved organic matter (CDOM) represents a sink that can exceed microbial respiration in highly colored surface waters. This interference can be minimized by using colorimetric photochemical filters that block light at 440 nm or correcting for the interference using abiotic oxygen consumption rates in sterile filtered controls. We utilized oxygen-based measurements of PP with photochemical (filtered) controls in three distinct ecosystems. The Delaware Estuary, mid-Atlantic Bight, and Barra Bonita (a hyper-eutrophic, tropical reservoir) showed photochemical oxygen consumption rates ranging from 0% to 50% of total PP depending on both CDOM concentration and type of container materials used. This correction was of a magnitude similar to (and often greater than) dark respiration. Our results indicate that oxygen-based PP measurements, without proper controls or light filtration, are likely to significantly underestimate environmental PP rates.

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FROM MODES TO MUSSELS: ECOLOGICAL FORECASTING OF COASTAL ECOSYSTEM RESPONSES TO CLIMATE CHANGE

We developed a biophysical-based model that predicts the body temperatures of coastal invertebrates using NOAA and NASA weather station and remote sensing data as inputs. We explored the body temperatures of ecologically important species over a broad range of temporal and spatial scales. Because body temperature is so important to the physiological health of these animals, by comparing predictions of temperature against known physiological tolerances, we could then forecast (and, using historical data) hindcast levels of mortality and thus shifts in geographic ranges of several species. Tests of this approach show that we can hindcast historical range shifts in species distributions with considerable accuracy, suggesting that future range shifts may be predictable. However, the accuracy of the prediction changes with the time scale over which the forecast is made. This result emphasizes the importance of coupling the output from deterministic models within a probabilistic framework that is usable by resource managers.

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TRINITY RIVER, CALIFORNIA: EVALUATING EFFECTIVENESS OF MANAGEMENT ACTIONS ON MIGRATORY SALMON USING AN ECOSYSTEM APPROACH

The Trinity River Restoration Program in Northern California is rehabilitating the river and restoring flows after 40 years of channel simplification. Since the Program manages flow, we are interested in whether increases in flow are beneficial to our salmonids. We forecasted the body temperatures of ecologically important species over a broad range of invertebrates using NOAA and NASA weather station and remote sensing data as inputs. We developed a biophysics-based model that predicts the body temperatures of coastal invertebrates using NOAA and NASA weather station and remote sensing data as inputs. We explored the body temperatures of ecologically important species over a broad range of temporal and spatial scales. Because body temperature is so important to the physiological health of these animals, by comparing predictions of temperature against known physiological tolerances, we could then forecast (and, using historical data) hindcast levels of mortality and thus shifts in geographic ranges of several species. Tests of this approach show that we can hindcast historical range shifts in species distributions with considerable accuracy, suggesting that future range shifts may be predictable. However, the accuracy of the prediction changes with the time scale over which the forecast is made. This result emphasizes the importance of coupling the output from deterministic models within a probabilistic framework that is usable by resource managers.
lene was to separate out variation in both natural and hatchery runs due to ocean or climatic factors from variation due to river management using adult estimates for each species. The approach was to use ENSO indices: primary production, chlorophyll a and sea surface temperatures in the ocean off the north Coast of California (remote sensing data), ocean temperatures near shore (Buoy), in-river temperatures, and flows. Natural Trinity River coho and fall chinook respond to long term changes in ocean conditions and in-river flows. In the case of coho, the runs have positively responded to increased flows in base flows in late summer/fall since 1991. Understanding climatic and regional ocean conditions allowed us to evaluate the effects, over time, of in-river flow management and rehabilitation on our runs.

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**MOUMENTUM BALANCES ACROSS A WAVE-DOMINATED CORAL REEF**

For many coral reefs, circulation is dominated by waves breaking over the reef crest that drive a strong circulation over back reef habitats. Unlike classical work on beaches, where the primary momentum balance is between radiation stress gradients and set-up of the free surface, flows over coral reefs typically have mean flows into a lagoon, and thus friction can also be important in the momentum balance. Unfortunately friction on coral reefs is difficult to estimate a priori due to the remarkably high rugosity. Here we studied a nearly tideless system in Moorea, French Polynesia to isolate the effect of wave force on coral reef circulation. An array of 7 stations spanning the forereef, reefcrest and backreef areas was instrumented with pressure sensors and velocity profilers. The resulting data were used to estimate the contribution of each term in the cross-reef momentum balance, as well as corresponding bottom friction coefficients. Initial results show that the momentum balance varies markedly with distance from reefcrest and transitions from a radiation stress and set-up balance, to a friction and set-up balance.

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**A NEAR REAL-TIME MARINE ENVIRONMENTAL MONITORING NETWORK FOR THE CARIBBEAN**

The National Oceanic and Atmospheric Administration's (NOAA) Integrated Coral Observation Network (ICON), has been operational in the Caribbean since 2000 and has marine environmental monitoring stations for the purpose of understanding coral ecosystem dynamics in the Bahamas, St. Croix, Puerto Rico and Jamaica, with plans for new station installations in Little Cayman, and Antigua in the near future. These stations collect hourly data on all the standard meteorological parameters, as well as sea temperature, salinity, light and (on some stations), partial pressure of CO2 and Pulse Amplitude Modulating fluorescence. The ICON program collects these data and integrates them with satellite data for research-oriented ecological forecasts for marine behavioral events. Through collaborative work with intergovernmental and academic partners, the ICON program hopes to expand its research platforms throughout the Caribbean and enhance its ecological forecasting capabilities.

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**HAVE CLIMATE REGIME SHIFTS ALTERED OCCURRENCE PATTERNS OF MARINE MAMMALS IN THE CALIFORNIA CURRENT SYSTEM?**

Climate variability in the California Current System (CCS) impacts many ecological processes, which can influence top predators such as marine mammals. Climate regime shifts, such as ENSO, PDO or NPGO, have been described as intermittent and decadal fluctuations between cold and warm water regimes with related vacillations in physical and biological properties. A closer examination of sighting records of marine mammals, along with a concurrent assessment of climate record, may elucidate a pattern of shifting marine mammal distributions that correlate with climate shifts. Data from a variety of sources, including NMFS surveys in the CCS in 1979, CalCOFI surveys from 2004-2007, and published occurrence data dating from 1950, was utilized to create a time series of relative abundance of a variety of marine mammal species in the CCS. This time series was then compared to climate records from the CCS (such as in-river flows, along with a concurrent assessment of climate record, may elucidate a pattern of shifting marine mammal occurrence patterns across the CCS (such as in-river flows, along with a concurrent assessment of climate record, may elucidate a pattern of shifting marine mammal occurrence patterns across the CCS). An attempt to test the hypothesis that marine mammal occurrence patterns could be linked to climate regime shifts is underway. An understanding of this relationship could be used to examine top-down forcing on food webs impacted by regime shifts.

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**COMPARISON OF OBSERVED AND MODELED ALONGSHORE-VARIABLE SURFACE CURRENTS**

Surfzone currents observed along 2 km of coastline, onshore of a large submarine canyon, were compared with the predictions of a depth-integrated nonlinear shallow water circulation model. To estimate the radiation stresses that drive mean flows, the wave field observed 12 km offshore in 550 m water depth was shoaled across the inner shelf using a linear refraction model, and dissipated across the surfzone using a standard breaking parameterization. The steep canopy bathymetry produced alongshore variations in the wave field, and corresponding alongshore variations in both observed and predicted currents. Onshore of the canyon, both observed and predicted alongshore currents often were as strong as 0.4 m/s toward the north, while 1 km north of the canyon observed and predicted alongshore currents were as strong as 0.2 m/s to the south. Every half hour, mean alongshore currents observed at 26 locations were regressed against corresponding predictions. Correlations between predicted and observed alongshore currents usually were positive (0.20 of 162 half-hour time series), indicating that the model had some skill in predicting the spatial variability of the alongshore current. However, correlations often were low or moderate (0 < r < 0.85, with mean r = 0.41), possibly owing to errors in the predicted wave forcing, or the presence of low-frequency eddies in observations.

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**RESIDENCE TIME EFFECTS ON INTERNAL ORGANIC CARBON AND NITROGEN LOAD IN A SOUTHEAST U.S. COASTAL PRAIRIE**

Reductions in water turnover rates brought about by increased consumptive use of surface water and changes in broad-scale meteorological patterns can alter nutrient enrichment effects in river eutrophies. Phytotplankton biomass and internal nitrogen loading associated with changes in discharge and residence time in the tidal freshwater reach of the St. Johns, a low-head, blackwater river of the humid subtropical SE U.S. Atlantic Coastal Plain, were examined in simulations with the eutrophication model E-Qual/JCM. Observed data indicate significant positive relationships between seasonal mean algal biomass and increased internal N loading with increased spring and summer residence time. Model simulations indicated that while reduced flow and increased residence time maximized algal biomass and internal N concentration, reduced nutrient input and restricted fresh-water reach area tended to minimize organic carbon and N load to the estuary. Greatest “effective” N and OC loads to the estuary were achieved at moderate low flow that optimized both nutrient supply and residence time. This modeling study concludes that discharge reductions that shift average flow conditions to moderate-low flow will have the greatest potential whole-estuary detrimental effects on water quality.

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**TURBULENT RELATIONSHIPS: IS THERE A RULE OF THUMB PREDICTING THE INFLUENCE OF EPIBENTHIC ORGANISMS ON HYDRODYNAMICS BASED ON THEIR STRUCTURAL PARAMETERS?**

Epibenthic species with structures protruding into the water column modify near bed velocity fields by exerting mechanical resistance to fluid flow. This modification changes the habitat providing benefits but also imposing costs on the organisms. Here we studied the trade-off can be an important evolutionary constraint on the physical structures of such species. We related fluxes through the turbulent cross-reef relationships: is there a rule of thumb predicting the influence of epibenthic organisms on hydrodynamics based on their structural parameters?
A METHOD TO DETERMINE INDIVIDUAL WATER MASS CARBON UPTAKES USING AN INVERSE MIXING ANALYSIS

An inverse mixing analysis is used to calculate anthropogenic carbon uptake in water mass formation regions using the output from two general ocean circulation models. The TROMP method uses a weakly non-linear under-determined system of mixing equations to estimate relative water mass contributions and variations in selected source water properties, namely the DIC. The analysis relies on pre-defined definitions of pre-industrial DIC water mass concentrations. A relation between the delta pCO2 disequilibrium at the mixed-layer base and the atmospheric CO2 content is used as a substitute for a static DIC definition. The anthropogenic carbon uptake in a source water region as well as mean water mass transit times are calculated.

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GEODETIC AND TIDAL DATUMS: TYING WETLAND SURFACE ELEVATION CHANGE TO LOCAL WATER LEVELS

Tying geodetic, tidal, and Surface Elevation Table (SET) datums within coastal wetlands provides a framework for evaluating the sustainability of Mid-Atlantic brackish marshes. A strategic partnership between NOAA, FWS, USGS, and the National Aquarium in Baltimore has developed a high-accuracy vertical reference frame within Blackwater National Wildlife Refuge (Chesapeake Bay) to track surface elevations and water levels over time. Tide stations are used to estimate regional mean sea level trends with respect to upland bench marks. SETs measure localized wetland elevation change with respect to a wetland bench mark. Tying these two components together enables us to monitor millimeter-level changes in wetland surface elevation with respect to both local sea levels and upland elevation. Over time, accurate heights of SET benchmarks also allow us to measure deep subsidence. Initial results at Blackwater are producing high precision, vertically referenced elevation change data and digital elevation models coupled to hydrodynamic models. These data are providing both valuable insights into the sustainability of Blackwater brackish marshes facing local sea level rise, and critical information for future large-scale restoration of this essential coastal habitat.

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INTERANNUAL VARIABILITY OF MESOSCALE EDDY ACTIVITY IN THE GULF OF ALASKA

Mesoscale eddies provide a key pathway for the transport of momentum, heat and nutrients, and strongly influence the time and space distribution of ocean biology. However, quantification, in an objective way, the distribution of eddies, their characteristics and how they change interannually remains a challenge. A novel method for identifying and tracking eddies in satellite sea level anomaly data is applied to the Gulf of Alaska region. The method allows the spatial and temporal variability in eddy activity to be defined, providing the first systematic census of anticyclonic eddies in the region. The Haida and Alaskan Stream eddy corridors are clearly defined, as is an ‘eddy desert’ in the southwest of the basin, where the probability of an eddy occurring is zero. Maps of eddy trajectories for each year show substantial interannual variability in number and propagation paths. Periods of increased eddy activity do not necessarily correspond to El Niño events, but are associated with anomalous downwelling wind conditions along the continental margin. The complex biological response to the anticyclonic eddies will also be discussed.

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SHORT-TERM FOOD VARIABILITY DURING MEROPLANKTONIC LARVAL DEVELOPMENT: EFFECTS ON THE SIZE AND AGE OF METAMORPHIC COMPETENCE

As the larvae of many benthos develop in the plankton, they encounter environmental variability on a range of spatial and temporal scales. To measure the effects of food variability on a scale of days, we performed a food-switching experiment on larvae of the sabellariid polychaete Phragmatopoma. We manipulated phytoplankton concentrations and tested five feeding regimes: a high-food treatment that remained constant throughout larval development, constant low food, and three treatments in which larvae initially fed low food were switched to high food on either day 8, 16, or 20 after hatching. Larvae raised on constant high food became competent to metamorphose 11 days faster than larvae fed constant low food (day 14 vs. 25) and were significantly larger at competence.

Larvae switched from low to high on day 8, 16, or 20 reached competency on day 20, 24, and 28, respectively. The growth of larvae switched from low to high reached competency at the same size as larvae fed constant high food, suggesting a larva’s size at competency is strongly influenced by its recent feeding history.

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SENSITIVITY OF SUBANTARCTIC CORALLINE MACROALGAE TO ELEVATED CO2

The effects of ocean acidification are predicted to occur first and be most severe in calcifying organisms from coldwater environments. However, assessing the impact of altered seawater chemistry on coldwater ecosystems is presently difficult, and requires a comparison of predicted carbonate saturation states, for the next 100 years, with the physiologic effects of calcification in marine organisms. This study is a collaboration between carbonate chemists and marine ecologists and utilizes an inexpensive system that allows realistic modification of seawater carbon chemistry. Most importantly, this system allows for independence among replicates essential for statistical tests and lacking in many studies conducted on ocean acidification to date. In our experiments we exposed the widely distributed coralline Arthrocardia to conditions that mimic the carbon chemistry of seawater today and that predicted for 2050, 2100 at 10°C over 50 years. Corallines are important in many marine habitats at all latitudes, and are likely to be particularly vulnerable if they precipitate soluble high-Mg calcite. Here, we present data on growth and calcification rates, and investigations into dissolution and physiological acclimation to lower pH.

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A COMPARISON OF LOWER TROPHIC LEVEL MODELS FOR THE COASTAL GULF OF ALASKA

As part of the Global ecosystem dynamics program (GLOBEC), we have been examining the coupled physical-biological dynamics of the Coastal Gulf of Alaska (CGOA) using the Regional Ocean Modeling System (ROMS). ROMS now includes several lower trophic level models, e.g. the 4-box NPZD model of Powell et al., the 11-box, multi-size-class NEMURO model of Kishi et al., and the 11-box, multi-size-class NPZ model with iron limitation of Hinckley et al. These models range from the general to the specific; in particular, the Hinckley et al. model has been designed and tuned specifically for use in the CGOA. Here, we compare results among these three models in 3D simulations of the CGOA at 3-km resolution. This comparison of regionally-specific vs. general model performance on the same grid, and their covariance, is intended to inform future model comparisons among GLOBEC study regions (e.g. CGOA vs. Southern Ocean) using globally-relevant NPZ model.

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DIFFUSE LIGHT ATTENUATION COEFFICIENT VS. TURBIDITY TO DETERMINE WATER QUALITY IN RIVERS, ESTUARIES AND OCEANS

Worldwide aquatic ecosystems are being affected by an increased loading of nutrients and pollutants causing environmental and economic damage. The impacts on water quality are usually measured in terms of suspended solids concentration. Currently, the most common field sampling measurement for water quality is nephelometric turbidity (NTU). However, turbidity is not an absolute scientific quantity and is dependant upon most common field sampling measurement for water quality are usually measured in terms of suspended solids concentration. Currently, the most common field sampling measurement for water quality is nephelometric turbidity (NTU). However, turbidity is not an absolute scientific quantity and is dependant upon...
McElroy, K. and Najjar, R., 2008. Oceanic and Atmospheric Modeling in the Western Caribbean Sea: A Case Study of Guajira Coastal Upwelling Region. In OCEANIC AND ATMOSPHERIC MODELING IN THE WESTERN CARIBBEAN SEA: ASLO/AGU/TOS/ERF 008 Ocean Sciences Meeting, Syracuse, USA, kerrymay@wildmail.com; Westby, G., State University of New York, College of Environmental Science and Forestry, Syracuse, USA, gwwestby@gmail.com; Davy, J., Woods Hole Oceanographic Institution, Woods Hole, USA, jacley@whoi.edu; DíTullo, G., University of Charleston, Grice Marine Lab, Charleston, USA, dditullo@ccfsc.edu; Kieber, D., State University of New York, College of Environmental Science and Forestry, Syracuse, USA, dikieber@esf.edu; Kiene, R., University of South Alabama, Dauphin Island Sea Lab, Dauphin Island, USA, rkiene@disi.org; Matrai, P., Bigelow Laboratory for Ocean Sciences, W. Boothbay Harbor, USA, pmatrai@bigelow.org; Simo, R., Instituto de Ciencias del Mar (ICM), Barcelona, Spain, ruismo@icm.csic.es; Vernet, M., University of California, San Diego, Scripps Institute of Oceanography, La Jolla, USA, mvernet@uscd.edu. GROSS BIOLOGICAL PRODUCTION OF DIMETHYLSULFIDE (DMS) AT TWO COASTAL SITES WEST OF THE ANTARCTIC PENINSULA. Upper ocean DMS variability is driven by coupled physical, chemical, and biological processes involved in the marine sulfur cycle. Robust approaches exist for constraining photochemical and biological DMS losses, but direct measurement of gross DMS production is difficult. We used a diagnostic modeling approach to estimate gross biological DMS production at two stations along the Antarctic Peninsula near Palmer Station. The biogeochemical model was constrained with measured values of DMS concentrations and DMS photolysis and microbial consumption - the loss rates were determined in incubations using the 35S tracer method. A well-tested one-dimensional physical model forced with meteorological measurements was used to construct vertical mixing. At each time step, we restored model DMS distribution to match the observations and diagnosed gross biological production from the difference between modeled and observed DMS concentrations. Herrero, S. E., University of South Carolina, Columbia, USA, herrons@mailbox.sc.edu; Benitez-Nelson, C., University of South Carolina, Columbia, USA, cbnelson@geol.sc.edu; Thurnherr, L., University of South Carolina, Columbia, USA, lthurnherr@geol.sc.edu. INSIGHTS INTO SEDIMENT TRAP FLUXES: POSSIBLE UNDERESTIMATION OF OPAL FLUX IN THE SANTA BARBARA AND CARIACO BASINS. In marine systems, the flux of particulate biogenic silica (opal) to depth reflects the biological production of diatoms in overlying waters. This flux may be measured using automated sediment traps, but recent questions regarding trap integrity have arised due to solubilization of particulate matter within trap cups. Our study measured dissolved silicate and particulate biogenic opal concentrations in sediment trap samples collected from the Santa Barbara and Cariaco Basins. Dissolved silicate found within trap samples was compared to trap particulate biogenic silica to calculate a percent loss of 0.6 ± 1.1% for Santa Barbara and 3.1 and 2.9% for Cariaco Basin. Relatively consistent concentrations of dissolved silicate (305 ± 109 μM for Santa Barbara, 273 ± 136 μM for Carico) within the trap samples, independent of flux or deposition period suggest a solubility control, i.e., maximum dissolution is achieved. It remains to be seen whether this is due to saturation or the regularity of super- natant exposed particle surface area. Regardless, this dissolution factor varies spatially and therefore must be taken into consideration for determining opal fluxes to the seafloor. Herrufeld, L. University of Hawaii, Honolulu, USA, lherfeldt@soest.hawaii.edu; Sarno, F. J., University of Hawaii, Honolulu, USA, fsarno@soest.hawaii.edu; Smith, C. M., University of Hawaii, Honolulu, USA, ccm@hawaii.edu; Colgrove, C., University of Hawaii, Honolulu, USA, colgrove@hawaii.edu; Ross, M. M., University of Hawaii, Honolulu, USA, mross@hawaii.edu; Dailer, M. L., University of Hawaii, Honolulu, USA, dalier@hawaii.edu; Vermeij, M. L., University of Hawaii, Honolulu, USA, mvermeij@hawaii.edu. DIURNAL DISSOLVED INORGANIC CARBON, PHOSPHORUS, NITROGEN, AND IRON DYNAMICS IN PERMEABLE BACK-REEF SEDIMENTS OF THE SOUTH SHORE OF MAUI, HAWAII. Nutrient and iron dynamics were examined in a coastal backreef environment on south Maui where chronic eutrophication via terrestrial sedimentation and non-point nutrient inputs via submarine groundwater discharge occur. Because of the high permeability of the sediments, physical factors can greatly affect porewater water column exchange and, hence, porewater concentrations. We examined the diurnal concentration changes in inorganic carbon, phosphorus, nitrogen, and iron in the sediment porewater and the water column, and explored the covariance between solute concentrations and physical forcing (e.g., temperature, wind, current). Preliminary results suggest that both submarine groundwater discharge and sediment biogeochemical processes, coupled with physical forcing, can largely account for concentration changes observed in sediments and the water-column. This study emphasizes the challenge managers and scientists face while assessing nearshore water bodies based on the collection of sporadic discrete water quality samples. Hesser, T. J., University of Florida, Gainesville, USA, hesser@coastal.ufl.edu; Slinn, D. N., University of Florida, Gainesville, USA, slinn@coastal.ufl.edu. MODELING BOUNDARY LAYER DYNAMICS OF SHEET FLOW USING A MIXTURE APPROACH.
Due to the existence of sheet flow during storm events, numerically quantifying sediment transport during sheet flow conditions is an important step in understanding coastal dynamics. Traditional methods for modeling sediment transport requires solving separate equations for fluid and particle motion. We have chosen an alternate approach that assumes a system containing sediment particles can be approximated as a mixture having variable density and viscosity that depend on the local sediment concentration. Here, the interactions are expressed through the mixture viscosity and a stress-induced diffusion term. There are five governing equations that describe the flow field - the mixture continuity and momentum equations and a species continuity equation for the sediment. The addition of a bed-stiffness coefficient to simulate particle pressures in the bed has increased the consistency of the model results. This model which was developed for Crosshox has shown promising comparisons to laboratory data demonstrating the effectiveness of the model mixture in simulating sediment transport in the sheet flow layer.

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SPREADING IN THE NEAR-FIELD MERIMACK RIVER PLUME

A numerical simulation of the near-field Merrimack River plume is used to investigate how buoyant plumes spread within a few kilometers of an estuary mouth. There are three principal findings of this study. First, many properties of the plume are primarily a function of radial distance from the estuary mouth, and are uniform across the arc of the plume. Second, the percent change of plume width (in the cross-flow direction) is proportional to the percent change in radial distance from the mouth; the percent change in width is shown to be about 1.2 times the percent change in radial distance, resulting in a plume with spreading streamlines strongly influencing the core of the plume. Third, plume spreading is related to the local internal gravity wave speed. These finding allow the width of the plume to be estimated as a function of distance from the estuary mouth. These principle findings from the numerical model compare favorably to observations.

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METATRANSCRIPTOMIC ANALYSES OF BACTERIOPLANKTON IN SURFACE WATERS OF THE OLGOTROPHIC NORTH ATLANTIC AND SOUTH PACIFIC OCEANS

Recent metagenomic analyses of bacterioplankton in the open ocean have revealed a wide suite of genomic potential activities, yet there have been few in situ studies of bacterio-plankton assemblage gene transcripts. We conducted bacterioplankton metatranscriptomic analyses of surface waters at several locations in the oligotrophic North Atlantic and South Pacific Oceans during the day and night in an attempt to identify dominant gene transcripts and putative dominant biochemical processes. Separation of RNA from mRNA using commercial mRNA enrichment protocols was in all cases incomplete, and influenced by environmental sample preparation and composition of assemblages. Phylogeny of mRNAs retrieved was congruent with PCR-amplified rRNA phylogeny, and demonstrated dominant expression of nucleic acid metabolic and energy metabolic genes. Furthermore, our results indicate common types of assemblage gene transcripts between locations in both the light and dark phases. Comparison of gene transcript libraries to available metagenomes suggests that dominant gene expression may be used to characterize the physiochemical conditions in which assemblages exist. Moreover, our results demonstrate the potential for metatranscriptomics to elucidate dominant active metabolic processes within oceanic bacterioplankton assemblages.

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HIGH-LATITUDE ATMOSPHERE-OCEAN COUPLING IN SEA-LEVEL RECORDS

Sea-level measurements from bottom pressure recorders and tide gauges in the Southern and Arctic Oceans are used to investigate the existence in the ocean, of counterparts to atmospheric modes of variability, such as the Southern Annular Mode and the Arctic Oscillation. In the Southern Ocean, 19 relatively short time series (c.<15years) of high temporal resolution are detided by band-pass filtering and then subjected to statistical and empirical orthogonal function (EOF) analysis in order to identify recurring and propagating sea-level patterns upon seasonal to interannual timescales. Correlations of these patterns are then made with climate indices, to determine the extent to which they correspond and thereby help to identify the driving mechanisms for sea-level fluctuations. A similar technique is applied to Arctic Ocean sea-level measurements, which, given the greater length and lower temporal resolution of the time series, lend themselves to the study of atmosphere-ocean analogues upon seasonal to decadal timescales.

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ECOHAB PACIFIC NORTHWEST: TOXIC PSEUDO-NITZSCHEA IN THE NORTHERN CALIFORNIA CURRENT

ECOHAB PNW studies have improved our understanding of physical, chemical, and biological processes required to produce toxic conditions in razor clams on the coastal beaches of Washington State. Observations have confirmed that the Juan de Fuca Eddy is a chronic source of particulate domoic acid. As shown by model studies and observations this is due in part to the fact that under downwelling-favorable or weakly fluctuating wind conditions, the eddy is retentive and well supplied with macronutrients, thus allowing cells to become highly concentrated. Toxicity appears related to Cu and Fe limitation, but not to macronutrient concentrations, including silicate. Results confirm that cells can maintain their population and toxicity well past the time that they have escaped from the eddy and been transported southward parallel to coastal beaches, as occurs under upwelling-favorable wind conditions. The cells are thus positioned for subsequent onshore transport to coastal beaches that occur during storms. The role of the plume from the Columbia River has been identified as critical to understanding the specific mechanisms and timing of toxin and cell delivery to coastal beaches.

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TAXONOMIC AND PHYSIOLOGICAL GRADIENTS WITHIN THE PHYTOPLANKTON COMMUNITY OF A STABLE SHELF SEA THERMOCLINE

A deep chlorophyll maximum (DCM) occurs within the seasonal thermocline of many shelf sea regions including the North West European Celtic Sea. Tidal mixing maintains the thermocline (and therefore DCM) at + 9 °C surface irradiance whilst the dissipation of tidally generated turbulence provides the DCM with a supply of nitrate from the bottom mixed layer. The narrow thermocline is subsequently a region of marked gradients in light and nutrient availability. Turbulence profiles obtained with a FLY shear probe across the Celtic Sea confirmed the thermocline to be a region of high stability, with mixing length scales in the centimeter range (c.10m in the surface mixed layer). Vertical gradients in phytoplankton community composition were observed within this stable region. The taxon-specific biomass maxima were decoupled from pigment maxima which occurred at the base of the DCM. Vertical gradients in taxonomy and photophysiology are discussed in terms of mixing timescales. Spectral absorption characteristics and effective absorption cross sections of PSI appear to be possible taxonomic traits that may contribute to the observed gradients.

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MJO-INDUCED RAINFALL VARIABILITY OVER THE MARITIME CONTINENT OBSERVED BY TRMM

The Madden-Julian Oscillation (MJO) is known to be a dominant component of intraseasonal rainfall variability over the tropics on higher latitudes. But the influence of the MJO on the rainfall variability over the maritime continent had not been documented in detail. Our previous work found that significant part of the rainfall variability in Indonesia is...
Our aim was to study patterns of primary productivity in the Arctic Ocean using the 10 year satellite record available from SeaWiFS. A relationship between surface chlorophyll and productivity was developed from in situ data from all Arctic regions, and applied to average monthly chlorophyll retrieved from satellite imagery. Monthly anomalies from the 10 year median are most apparent in April and May, which coincides with the timing of ice retreat, no clear trend towards positive or negative anomalies was observed. The Siberian shelf seas show great interannual variation in anomalies during the summer months compared to the Barents, Chukchi and Beaufort Seas. The annual productivity for the Arctic calculated from satellite imagery ranged from 504 to 570 Tg C yr⁻¹, this is approximately one order of magnitude lower than that quoted in the literature. This could be because the satellite imagery misses the subsurface maximum that dominates summer productivity. Since 2005, summertime ice retreat has been increasing dramatically, however, using the current satellite record no significant difference was observed in the magnitude of total annual Arctic productivity.

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VALIDATING OCEAN SURFACE CURRENT INPUTS FOR SEARCH AND RESCUE

This presentation covers the evaluation of surface current inputs from operational ocean models used for Search and Rescue Applications. The Canadian Coast Guard is routinely in need of adapting to improvements in available surface currents for operational oceanography systems. As a result, there is a need to evaluate the impact of each new available source of ocean current forecast on the success and Rescue drift calculations (CANSARP) with ocean model current input using a defined database of surface current drifters will be presented. A protocol for evaluating the impact of new ocean currents on reproducing observed drift is proposed and results discussed from an inter-comparison of drift methodologies.

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CALCITE SATURATION STATE EFFECTS ON THE MG AND SR DISTRIBUTION COEFFICIENTS OF CULTURED BENTHIC FORAMINIFERA

Field studies suggest that calcite saturation states near and below saturation alter element distribution coefficients in benthic foraminifera. Two separate 8-month benthic foraminiferal culture experiments investigated the response of proxy signatures to three different calcite saturation seawater environments. Total alkalinity was manipulated to modify the culture carbonate chemistry (TA = 2380, 1910, 1320 μeq kg⁻¹). Mixed-species foraminiferal assemblages, labeled with calcine, were inoculated into culture chambers distributed evenly among the control and treatment seawater reservoirs. These cultures were maintained at 7.0±0.2 °C temperature and 36.5±0.3 ‰ salinity. Total alkalinity and dissolved inorganic carbon, measured biweekly, characterized the carbonate system and verified that the calcite saturation state did not vary substantially. Foraminiferal reproduction was observed in each seawater chamber. Terminal calcite chambers precipitated in culture were identified by the appearance of the pre-culture calcine label and were separated by laser microdissection. Separated chambers and seawater samples were analyzed for Mg/Ca and Sr/Ca. Results from the 2005 experiment identified a significant negative correlation between alkalinity and the magnesium distribution coefficient (D_Mg, p-value = 0.095). This research was funded by National Science Foundation grants OCE-0351029, OCE-0350794, OCE-0437366, and OCE-0647891.

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TURBULENT EDDY DIFFUSIVITY ESTIMATED FROM OVERTURNING SCALE OFF ADELIE LAND, ANTARCTICA

Recently, a region off Adelie Land has drawn attention as a source of Antarctic Bottom Water (AABW). In order to understand the formation mechanism of AABW, it is necessary to evaluate turbulent eddy diffusivity K, throughout the water column near the shelf break. To clarify the strength of turbulent mixing near the shelf break, we conducted hydrographic observations off Adelie Land with Sea-Bird Electronics SBE911 plus in austral summer of 2003 and 2005. It is preferable to measure turbulence with a turbulent

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PRIMARY PRODUCTIVITY PATTERNS IN THE ARCTIC: THE 10 YEAR SEAWIFS RECORD

Associated with the MJO and that the influence of MJO is not spatially uniform, by using rain gauge data. However, insufficient coverage of the station data limited our analysis to only small portion of the territory. Therefore, we use pentad-mean gridded TRMM rainfall data from 1998 to 2006. The phase and amplitude of the MJO are defined according to the MJO index based on Wheeler and Hendon (2004), and a composite mean of rainfall anomalies (deviations from mean seasonal change) for each MJO phase is calculated. The MJO signals are clearly identified in most part of the maritime continent. Positive rainfall anomalies are dominant during wet phase and negative anomalies in dry phase of the MJO. This result ensures our previous conclusion that the rainfall variation of this region is significantly influenced by the MJO and that the impact of the MJO is not spatially uniform. Rainfall over the ocean is dependent more clearly on the MJO phase than over the large islands. Such a pattern suggests different rain causing mechanisms between ocean and land.

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DISSOLUTION OF BIOTIC: SILICA IN PERMEABLE COASTAL SANDS

In the shallow shelf, a large fraction of the diatom production is decomposed in the sediment, and large areas of the sea bed in this environment are covered by permeable sands. We conducted flume and column experiments to determine how pore-water flows affect the degradation of diatoms embedded in permeable Gulf of Mexico sands and the distribution of silicic acid within the sediment. Our results show that pore-water flows increase the distribution rate of diatoms in the sediment and the subsequent release of silicic acid to the water column. These findings emphasize the importance of coastal permeable sediments in the cycling of marine silica.

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CHARACTERISTIC LENGTH IN MARINE POPULATIONS: THE INTERPLAY OF LARVAL DISPERSAL AND ADULT POPULATION SUCCESS IN DETERMINING DISTRIBUTION

The ratio of variance in dispersal to the strength of selection is termed the characteristic length (lc) and is proportional to the width of genetic lines. Several properties of clines can be related to lc including the fact that populations cannot respond to changes in selection on co-dominant loci across the entire length of the cline. We apply the concept of characteristic length to explore the interplay of larval dispersal and reproductive success in determining the distribution of adult populations. Geographic gaps in reproductive success must exceed the lc to be reflected in the distribution of the population. Gaps that exceed the lc may lead to abrupt changes in abundance and may result in the coincident geographic limits of species with dissimilar relationships to environmental gradients. This limits attempts to predict changes in distribution in response to changes in the environment, including global warming. Ecologically relevant components of lc are possible to estimate empirically. We illustrate the potential utility of this concept with several examples.

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CLOSING THE WATER CYCLE OVER THE OCEAN USING A CONSTELLATION OF SATELLITES

We are in the final stages of completing our Passive Microwave Water Cycle (PMWC) product for the NASA Energy and Water Cycle Study (NEWS). The purpose of this product is a full characterization of the atmospheric branch of the water cycle over the global oceans using accurately intercalibrated passive microwave data. The product uses data from nine different satellites: SSM/I (on F08, F10, F11, F13, F14, F15), AMSR (on AquA and Mopor-I), TMI (on TRMM); and will add additional passive microwave sensors as their data become available. The product is a monthly, 0.25-degree product currently spanning the last 20 years: 1987-2007. The product contains six maps: water vapor transport divergence, precipitation, and water vapor transport divergence, evaporation (D), precipitation (P), and water vapor (WV). The development of this product has generated many science questions. We will discuss the differences between passive microwave rainfall retrievals and what the hydrological cycle implies about precipitation, with particular emphasis on mid- and high-latitudes. We will discuss the water cycle balance and trends in the water cycle. We will examine these trends in terms of the global energy budget and against climate model predictions. We will explain our technique for calculating water vapor transport divergence, show some results, and explain what it implies for ocean–land exchanges.

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PRIMARY PRODUCTIVITY PATTERNS IN THE ARCTIC: THE 10 YEAR SEAWIFS RECORD
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CONTRIBUTION OF COMMERCIAL FISHING TO THE DECLINE IN HAWAIIAN MONOCHASUS SCHAUINSLANDI.

Recorded declines of Hawaiian monk seals (Monachus schauinslandi) have occurred over the past half century in the Leeward Chain of the Hawaiian Islands. Preliminary evidence from stable carbon (13C/12C) and nitrogen (15N/14N) isotope ratios in bone collagen from the seals (n=20) shows a shift in both isotopes between the 1910s and 1970, indicative of a diet switch, possibly from a benthic diet (crustaceans, mollusks) to a more pelagic diet (fish), as well as a potential environmental change. We surmise the advent of commercial fishing of potential prey items post-World War II led to the decline of preferential prey items and forced the seals to utilize prey species potentially less nutritious and/or which require more energy to capture. Less nutritious prey could be at least partially responsible for the reproductive failure and overall decline of Monachus throughout its range. These historic isotopic values are compared to modern seals and potential prey from the main Hawaiian Islands with the current assumption that the isotope signatures are similar with the Leeward Islands of the chain.

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MEAN SEA SURFACE HEIGHT FIELD IN THE NORTH PACIFIC.

Altimeter data observed by TOPEX/Poseidon are provided as sea surface height (SSH) anomalies from mean SSH field averaged for a certain period, since the geoid of the earth cannot be specified at present. On the other hand, using hydrographic data, we can calculate sea surface dynamic height (SSDH). If both observation time and location are matched each other, then we can obtain mean SSH averaged for the period by subtracting SSH anomaly from SSDH. This method proposed by previous study was so unique. But they could not help depending on statistical method with not being interpolated or extrapolated data. So in the present study, we use Argo float data as hydrographic data, distributed densely in time-space domain in the world’s oceans. In order to determine the match-up conditions, time-space decorrelation scales are estimated from the along track data. With these conditions, 44/135 match-up data are found in the North Pacific. The locations are distributed in almost the whole North Pacific. We estimated on each point estimation term. This field seems to be similar to World Ocean Atlas 2005, although we used the Argo profile data only for 6 years. It is expected from our results that more realistic and finer mean SSH field will be available when the Argo floats provide more hydrographic profiles in the future.

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OBSERVATIONS OF OCEAN SURFACE CURRENTS IN THE WEST OF OKINAWA.

We conducted the observation of the surface currents in the west of the Okinawa Island by high-frequency (HF) radars in 1999 and 2000. The observation area is the east of the Kuroshio in the East China Sea. We found that the time-averaged surface currents were almost southward. We confirmed the observation result by HF radars using the assimilation data of Japan Coastal Ocean Predictability Experiment (ICOPE) from 2003 to 2005. The currents west of Okinawa are also southward in the ICOPE data. We inferred the beginning of the southward current from the ICOPE data. It is inferred that currents in the east most eastern part of the Kuroshio are bifurcated southward, and flow into the west of Okinawa Island. The currents are controlled by the bottom topography. The wind stress curl in the area, where the bifurcated current can be seen in ICOPE data, is negative because of lesser SST, while the curl is positive in the eastern part of the Kuroshio because of higher SST. The Kuroshio recirculation southward currents are sometimes enhanced. The currents are enhanced when positive and negative wind stress curls are also enhanced.

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FLOW SYSTEM AND DENITRIFICATION OF SHALLOW GROUNDWATER IN THE DOZEN PLAIN, SAJOI, JAPAN.

Major ion concentrations, nutrients and stable isotopes in shallow groundwater have been measured to understand the groundwater flow system, and characteristics of the denitrification process with groundwater flow and salt water intrusions processes. These measurements were made in the Dozen plain, which is a major part of Sajio city, located in the north of the Shihoku Island, southwestern Japan. The main feature of the groundwater systems in this area is that is an artesian in the coastal area, where there are tidal flats, have existed at least 400 yrs. The artesian flow system in these area may be the past submarine groundwater discharge system. The groundwater in the plain may be recharged by either precipitation over the plain or by four river waters from the east to the west (R. Uzui, R. Kam, R. Nakaizaya and R. Daimyoujin). Even in the eastern part of the plain, the contribution of the Daimyoujin river water (high silicate concentrations), which flows from a granite mountain, influenced by denitrification (low oxygen and nitrate concentrations), is relatively larger than local precipitation or water from the other rivers.

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PRODUCTION AND RESPIRATION RATES IN KARENIA BREVIS.

Kareния brevis is the dinoflagellate responsible for harmful algal blooms in Florida coastal waters. Field and laboratory rates of photosynthetic carbon uptake have been measured in this species, but few reports exist of its respiration or net production rates; these are essential to refine models to predict development and maintenance of coastal blooms. We are conducting a study of the carbon physiology and genomic signatures of K. brevis in cultures and natural populations. Net community production and respiration rates from light-dark bottle incubations of K. brevis populations from a coastal site in Sarasota Bay reinforced this conclusion. Enhanced respiration rates at dusk were attributed to a close coupling between Karedia and the microbial loop, and the potential for light-enhanced dark respiration. Culture studies are underway to verify production and respiration rates, and the genomic signatures, of a Sarasota Bay clone where growth is regulated by light.

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DYNAMICS OF NUTRIENTS AND PHYTOPLANKTON BIOMASS IN HONG KONG WATERS BEFORE AND AFTER SEWAGE ABATEMENT.

There are two anthropogenic N sources for Hong Kong waters, the summer Pearl River discharge and the year round sewage discharge in Victoria Harbor. In the summer wet season, the Pearl River discharge increased N03 and Si04 in western waters (105 and 75 uM, respectively) and the highest phytoplankton biomass (20-30 g/UL) was observed in southern waters. In Victoria Harbor, sewage effluent discharge resulted in high NH4 and PO4 (to 20 and 1.3 uM, respectively) and bottom dissolved oxygen (DO) was generally ~3.5 mg/L. In contrast, in eastern waters with nutrient-poor coastal water, total inorganic nitrogen and PO4 was generally <10 and <0.5 uM, respectively. However, after sewage treatment, NH4 and PO4 decreased by 40-83% and 30-48%, respectively, particularly in Victoria Harbor.

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IMPACTS OF IRON-INDUCED ELEVATION OF MAXIMUM QUANTUM YIELD AND CHLOROPHYLL TO CARBON RATIO ON THE NUTRITION UTILIZATION OF THE SOUTHERN OCEAN.

Iron fertilization in the Southern Ocean, whether natural or intentional, has vast biogeochemical consequences including increased primary productivity, elevated phytoplankton biomass and more efficient nutrient utilization. During the Southern Ocean Iron Experiments (SOFeX) some of the phytoplankton physiological responses to iron addition were 1. chlorophyll to carbon ratio tripled, 2. maximum quantum yield of photosynthesis (Φ_P), a measure of light-limited primary productivity, doubled, and 3. P_(max), a measure of light-saturated primary productivity, was statistically unchanged. Here we use these phytoplankton physiological responses to iron addition to model how iron, grazing, export, mixing and mixed layer depth determine the potential nitrate utilization and potential biological pump during the Southern Ocean growing season. This model uses climatological physical data as a baseline and explores the biological response using very simple ecosystem dynamic assumptions. With our current knowledge of the light environment and iron regulation of the Southern Ocean we aim to diagnose what is ecologically possible if phytoplankton are relieved from iron limitation and if the light limitation of the Southern Ocean is less pronounced.

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Iron fertilization in the Southern Ocean, whether natural or intentional, has vast biogeochemical consequences including increased primary productivity, elevated phytoplankton biomass and more efficient nutrient utilization. During the Southern Ocean Iron Experiments (SOFeX) some of the phytoplankton physiological responses to iron addition were 1. chlorophyll to carbon ratio tripled, 2. maximum quantum yield of photosynthesis (Φ_P), a measure of light-limited primary productivity, doubled, and 3. P_(max), a measure of light-saturated primary productivity, was statistically unchanged. Here we use these phytoplankton physiological responses to iron addition to model how iron, grazing, export, mixing and mixed layer depth determine the potential nitrate utilization and potential biological pump during the Southern Ocean growing season. This model uses climatological physical data as a baseline and explores the biological response using very simple ecosystem dynamic assumptions. With our current knowledge of the light environment and iron regulation of the Southern Ocean we aim to diagnose what is ecologically possible if phytoplankton are relieved from iron limitation and if the light limitation of the Southern Ocean is less pronounced.
SCHOOL DISTRICTS TO TEACH MARINE SCIENCE FOR K - 6TH GRADE.

THE TRACE METAL FLUXES IN THE WATER COLUMN OF THE SOUTH CHINA SEA: BIOTIC VS ABIOTIC SOURCES

Our previous study found that the metal composition in the algae collected in the SouthEast-Asia-Time-Series (SEATS) offshore station in the South China Sea was mainly occupied by extracellular portion (Ho et al. &O, 52, 1776). The metals might be originally derived from the anthropogenic aerosols containing abundant dissolved trace metals. Here we determined the elemental composition and fluxes (P, S, Al, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Mo, Cd, Mg, Ca, Sr, Ba, Ag, and Au) by analyzing the sinking particles collected by sediment traps at the depths of 160, 620, and 3400 m at the SEATS from year 2000 to 2005 to examine their composition features. Strong vertical and seasonal variations were observed. The metal fluxes increased with the depths increased and the Fe:Al ratios were the same as the sediment, indicating that lateral lithogenic particle input was the dominant particulate metal source for the deep water. In contrast, principle component analysis showed that most of the metals at the top depth were correlated with P and S, which represented the biotic component.

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UNDERSTANDING THE EFFECTS OF CHANGING HYDROLOGY ON NUTRIENT SOURCES AND COUPLING BETWEEN THE EVERGLADES AND FLORIDA BAY: AN ISOTOPIC BIOGEOCHEMICAL PERSPECTIVE

Stable isotopic analyses and abundance measurements of inorganic and organic nutrients provide a robust and effective approach to determining linkages between Everglades nutrient sources and dominant biogeochemical pathways observed in Florida Bay. Regionally distinct isotopic signatures of dissolved nutrients and biological sinks show that DON and DIN from the Everglades are transported, incorporated and cycled into biological materials of Florida Bay. Hydrologic conditions, wet vs. dry season, exhibit a strong control on the spatial gradient in δ15N within the Everglades-Florida Bay complex. Similarity in isotopic compositions and gradients of dissolved inorganic and organic nutrients, as well as biological materials, during the wet season show close linkages between the Everglades and Florida Bay, but these trends are dampened in the dry season when sheet flow decreases and in situ processes dominate. This approach can predict how regional changes in the distribution and composition of Everglades dissolved nutrients will direct Florida Bay nutrient cycling. Whether these changes are a result of seasonality or of anthropogenic restructuring of hydrologic flow.

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MULTI-SPECTRAL SEISMIC IMAGES OF THE WATER STRUCTURE.

The European funded Geophysical Oceanography (GO) research programme together with additional research funded by the Deutsche Forschungs gemeinschaft is investigating the value of seismic methods to address key questions in physical oceanography. In April 2004, a three-dimensional array was deployed across the SEANTS (Southern European Ambient Time-series) and the area was monitored for a year. The primary aim of the project was to study the propagation of a thin layer through the water column, a process that is theoretically well understood but difficult to observe in practice. The project has been successful in terms of both scientific and educational goals. The project has also been successful in terms of collaboration between scientists from different countries and disciplines. The project has also been successful in terms of the dissemination of results.

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PROPAGATION OF A THIN LAYER THROUGH A SYNTHETIC MOORING ARRAY

A dense phytoplankton layer, at times as thin as 1 meter, was observed at a depth of approximately 100 meters in the Philippine Sea. Five autonomous gliders, positioned in a 2-dimensional array with a horizontal scale of 100 km, held station for 10 days during May 2004, continuously profiling between the surface and 200 meters. Profiles of physical and optical properties at each station were completed every 3 hours. The phytoplankton layer propagated northward across the array, consistent with advection by a meso-scale eddy observed with satellite altimetry, and with vertically averaged current velocity measurements made by the gliders. The layer was coincident with small-scale vertical temperature and salinity structure. Both the phytoplankton layer and the TS signature made a gradual diapycnal shift from denser to lighter water, suggesting the layer was formed by vertical shear before being advected across the array.

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FROM RIVER BASIN TO BARRIER REEF: AN INTEGRATED APPROACH TO LAND-SEA INTERACTION IN TROPICAL WATERS

The transfer of water and sediment from upland river catchments towards estuaries, coastal seas and offshore located reef systems is subject of an Indonesian-Dutch integrated study of a tropical river system on East Nias. Local sediment supply in river catchments is partly a function of the monsoonal climate, including ENSO events but is increasingly affected by human-induced changes in land-use patterns such as deforestation, open pit mining and palm plantations. Catchment modelling of soil erosion, in combination with hydrodynamical, sediment transport and ecological field and modeling studies provide clear evidence for the morphological and ecological impact of the (fluvial) sediment load. The estuaries trap part of the coarser sediment in the form of sandy (mouth)bars. Turbid, buoyant plumes carry a significant amount of the fine-grained suspended matter in a seaward direction and seafloor lines and current and particle analysis demonstrate an ongoing seaward extension of the Holocene delta platform and prodelta by deposition of silty and muddy sediments. Meanwhile turbidity patterns also affect coral reefs, as deduced from ecological parameters such as coral cover, partial mortality, coral colony size and degree of spatial competition.

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The NSF-funded University of Oregon GK12 Learning About Where We Live Project places graduate students in 132 K - 6th grade classrooms in eleven schools in four school districts on the southern Oregon coast. The graduate students teach marine science to ~3300 students and provide embedded professional development to 132 teachers. Initially using the Marine Activities Resource Education curriculum, the program has expanded to a term or year-long program in which graduate students provide active-inquiry based sessions that integrate classroom inquiry and field activities designed to meet state science standards. Professional development activities for teachers provide marine science content, opportunities for curriculum development and planning for program sustainability. Evaluation results indicate that teachers view the program as adding valued expertise, scientific legitimacy, and materials to their curriculum. Graduate students described their participation as an enjoyable learning experience; felt they are generally successful in increasing elementary students scientific excitement, comfort, and awareness; view themselves as positive role models for students; and view their greatest contribution as making science accessible and exciting for teachers and students.

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FROM RIVER BASIN TO BARRIER REEF: AN INTEGRATED APPROACH TO LAND-SEA INTERACTION IN TROPICAL WATERS

The transfer of water and sediment from upland river catchments towards estuaries, coastal seas and offshore located reef systems is subject of an Indonesian-Dutch integrated study of a tropical river system on East Nias. Local sediment supply in river catchments is partly a function of the monsoonal climate, including ENSO events but is increasingly affected by human-induced changes in land-use patterns such as deforestation, open pit mining and palm plantations. Catchment modelling of soil erosion, in combination with hydrodynamical, sediment transport and ecological field and modeling studies provide clear evidence for the morphological and ecological impact of the (fluvial) sediment load. The estuaries trap part of the coarser sediment in the form of sandy (mouth)bars. Turbid, buoyant plumes carry a significant amount of the fine-grained suspended matter in a seaward direction and seafloor lines and current and particle analysis demonstrate an ongoing seaward extension of the Holocene delta platform and prodelta by deposition of silty and muddy sediments. Meanwhile turbidity patterns also affect coral reefs, as deduced from ecological parameters such as coral cover, partial mortality, coral colony size and degree of spatial competition.
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EFFECTS OF RETRETTING ARCTIC SEA ICE ON WALRUS AND OTHER MARINE MAMMALS

As the climate warms, Arctic ice extent decreases and food webs shift. Arctic marine mam-
mals will attempt to adapt. Many species will be negatively impacted by habitat loss while
others may benefit. Historically, some Arctic mammals, including walrus, inflated warmer,
more southerly ranges, using the Arctic as a refuge from hunting and commercial exploit-
ation. Their previous range may presage adaptations to warmer conditions. In this analysis, we
will model a projected ice cover, material fluxes and surface temperatures in a doubled CO2
scenario, while representative marine mammal species will be mapped using their full pre-
industrial ranges to gauge environmental tolerances. The impact on carrying capacity of
the shift of the marginal ice zone to deeper waters will be assessed. As ice-retreats and com-
mercial activities in the Arctic surge, it is hoped that such projections will facilitate environ-
mental policies that maximize the ecological potential of a warmer Arctic region.

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DESIGN AND INITIAL TESTS OF A COASTAL OCEAN DATA ASSIMILATION SYSTEM

A coastal ocean data assimilation system is being developed. The goal is to combine
large and disparate datasets with ocean numerical models, producing accurate analyses, forecasts, and respective uncertainty estimates for any littoral region. A modular interface
combines the Estuarine and Coastal Ocean Model (ECOM) and the Local Ensemble
Transform Kalman Filter (LETKF) into a highly scalable, portable and efficient ocean data
assimilation system. LETKF, a recent adaptation of ensemble Kalman filtering techniques,
works particularly well for very large non-linear dynamical systems in both sparse and
dense data regimes, and provides efficient algorithms for error estimation and quality con-
trol. In simulation experiments involving the New York Harbor Observing and Prediction
System (NYHOPS) the filter quickly converges, eliminating bias and greatly reducing rms
erors. This behavior is robust to changes in ensemble size, data coverage, and data error. Future plans include data in operational environments and
the evaluation of the skill of analyses and forecasts under different flow regimes and boundary
conditions, with diverse data streams, and in various model configurations.

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ANALYSIS OF THE BIOLOGICAL FUNCTION AND WATER QUALITY

ADEQUACY OF A CONSTRUCTED WETLAND

Bioassessment and chemical monitoring of the J.I. Case Wetland Wildlife Refuge, con-
structed for waterfowl in Vigo County, Indiana, reveals a distinct partitioning in habitat.
While the aquatic habitat is similar to that of other wetlands, shoreline fauna and vegeta-
tion are more characteristic of the upland areas. Low amphibian capture by the pitfall trap
method and high abundance of upland plant species indicate that the biological activity
of this wetland is not representative of a natural wetland. In an ideal wetland, seasonally
inundated shores limit the abundance of non-wetland species. In contrast, the algal and
chemical patterns in the water column mimic natural wetland functions. Chemical signa-
tures reveal periods of increased algal production, along with nutrient removal. Because
microbes act in nutrient cycling, bacterial population counts and genetic identification
of bacterial species is ongoing. Although water quality is adequate (characterized by low
nutrient levels and turbidity in wetland discharge), the physical design of this constructed
wetland differentiates it from natural wetlands in that a sharply sloping shoreline separates
an inadequate wetland buffer zone from a typically functioning water system.

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QUANTIFYING THE INFLUENCES OF BIOGEOCHEMICAL PROCESSES ON THE PH OF NATURAL WATERS

An approach for modelling the pH of natural aquatic systems is presented. This approach
allows for quantification of the influences of kinetically modeled processes on the rate of
change of proton concentration. It can be applied to models containing multiple biogeo-
chemical processes, air-sea exchange, and advective-dispersive transport. The influences
of kinetic processes are calculated including the effect of re-equilibration of the system
due to a set of acid-base reactions in local equilibrium. Modelling pH in the described way
is used to shed light on the influences of different biogeochemical processes on the pH
of the Schelde estuary in the SW Netherlands and N Belgium. Generally, CO2 export to
the atmosphere is identified as the main process increasing the pH while nitrification is
found to be the main process decreasing it. The combined effect of advective-dispersive
transport of all modeled chemical species either increases or decreases the pH depending
on the respective circumstances.

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A MODELING STUDY OF DEVELOPMENTAL STAGE AND ENVIRONMENTAL VARIABILITY EFFECTS ON COEPOD FORAGING

A stochastic, object-oriented Lagrangian model is used to study how behavior
contributes to copepod grazing success. This individual based model simulates distinct foraging
behaviors of Clausocalanus furcatus, Paracalanus aculeatus, and Oithona plumifera. Simulations
were performed to investigate the effects of: 1) prey size preference; 2) variation in prey size spectrum; and 3) turbulent intensity on these species grazing rates.
Size preference simulations show that compared to copepodes, cell ingestion rates for
mature females are an order of magnitude lower and carbon uptake is reduced by 35%. A prey spectrum skewed toward small cells promotes copepodite success since the
adult females basal metabolism requires a prey concentration exceeding 850 cells ml-1. Variations in turbulent intensity reveal distinct ecological niches with stronger mixing
favoring O. plumifera and stable conditions favoring C. furcatus. Differences in theoreti-
cally-derived and simulated prey encounter rates show that the hopping behavior of O.
plumifera significantly increases prey encounter while the feeding behavior of C. furcatus
can result in localized prey depletion. These simulations highlight the importance of spe-
cific feeding behavior in defining oceanic copepod distributions.

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DOES ELEVATED CO2 AFFECT LARVAL SKELETAL DEVELOPMENT IN SEA URCHINS?: EXPLORING THE MECHANISMS WITH GENE EXPRESSION

ANALYSIS AND MORPHOMETRICS

Ocean acidification and the biological consequences of this altered seawater chemistry
have emerged as a significant environmental threat to healthy marine ecosystems. Because a
more acidic ocean interferes with calcium carbonate fixation to form shells or calci-
fed skeletons, future ocean chemistry may significantly alter the physiology of calcifying
marine organisms. Using manipulative experiments we are exploring mechanisms that
have emerged as a significant environmental threat to healthy marine ecosystems. Because
O. plumifera significantly increases prey encounter while the feeding behavior of C. furcatus
can result in localized prey depletion. These simulations highlight the importance of spe-
cific feeding behavior in defining oceanic copepod distributions.
The global geostrophic flow and horizontal kinetic energy are now well-instrumented at the sea surface and to satellite altimeter range on the GRACE ground, but how much of this horizontal kinetic energy extends to greater depths is much less well known. Understanding the vertical distribution of this energy is crucial to quantify the energy dissipated via bottom drag, and to explain the forward energy cascade observed in the altimetry data. This study updates and extends the previous work of Carl Wunsch (1997) by decomposing current meter velocity profiles into the barotropic and first few baroclinic modes, with the inclusion of many new current meter locations around the globe and the application of more stringent profile selection criteria. The role of surface quasi-geostrophic modes is also explored. An additional result will be a searchable interface to the current meter archive, available upon request.

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HIGH-RESOLUTION COMPARISON OF NEARSHORE MODEL PREDICTIONS AND OBSERVATIONS

Observations of nearshore processes obtained using high-resolution video imagery are compared with multidimensional model predictions of shoaling wave energy transformation, breaking wave dissipation, and non-steady flows resulting from time-variant forcing. Daylight hourly video measurements have been collected at a site in the northern Gulf of Mexico, which was instrumented with an upward looking Acoustic Doppler Current Profiler (ADCP) deployed in 14 m depth. Data from this ADCP, when combined with surveyed bathymetry, was used to initialize shoaling wave conditions that also drove model estimates of surf zone currents. These predictions, computed for over 200 test cases spanning an approximately 1-year interval, were compared to temporally and spatially variant measurements of wave-number frequency spectra, Particle Image Velocimetry (PIV) estimates of current speed and direction, nearshore location of initial wave breaking, and shoreline development. Within the surf zone, when waves were energetic (significant wave heights > 0.5 m), observed and predicted wave directions and dissipation patterns agree well. Current estimates are less robust, likely due to the complex and potentially dynamic sand bar patterns in very shallow water, however the qualitative structure of the PIV observations is well modeled. These findings are being used to investigate the applicability of sediment transport and morphological modeling codes to bathymetry measurements at this site.

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PATTERNS IN THE FINE-SCALE VERTICAL DISTRIBUTIONS OF ZOOPLANKTON

Up-looking acoustical zooplankton sensors were deployed for several weeks in northeastern Monterey Bay, CA during the late summer and early fall of 2005 and 2006. Volume scattering strength spectra measured at time intervals of 1 min and 12.5 cm in depth were converted to profiles of biovolume-size spectra for two distinct zooplankton shapes and small bubbles abundances, throughout a 20 m water column. At times layers of zooplankton dispersed and filled most of the water column, but at other times plankton was distributed in patches. Layers were tracked in depth as they responded to external physical stimuli, e.g., light, internal waves, Langmuir circulation, water column stratification. Plankton behavior was observed as the layer migrated vertically, presumable in pursuit of food (e.g., phytoplankton or microzooplankton). Both normal and reverse migration patterns were observed. Small pelagic fish tended to school during the day, responding when they encountered plankton, and when dispersed at night they appeared to aggregate in the layers and patches. Work sponsored by ONR Oceanic Biology, Code 322BC.

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DISTRIBUTION AND TRENDS OF CAULERPA PROLIFERA IN THE INDIAN RIVER LAGOON, FL

Caulerpa prolifera is a commonly occurring, native, rhizophytic alga associated with seagrass beds in the Indian River Lagoon (IRL). FL. C. prolifera exhibits almost the same habitat enhancing traits as seagrass beds - stabilization of the substrate, reduced turbidity, and nutrient uptake. It is thought that a monoculture bed of C. prolifera can sustain a structured faunal community similar to that of a seagrass bed but the limitation of this alga in the IRL is largely unknown. It has been suggested that lower light requirements may allow C. prolifera to extend SAT habitat into deeper water than where the most common occurring seagrass in the IRL, Halodule wrightii, is typically found. In efforts to understand the spatial and temporal patterns of C. prolifera, St. Johns River Water Management District added C. prolifera monitoring to 85 established seagrass transects in 2007. The resulting data from 1998 to 2007 displays a very episomal pattern with greater abundances of C. prolifera found in the Northern IRL south to Eau Gallie River and in Banana River, including Successful Harbor.

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DO CURRENT METERS REVEAL THE ARROW OF TIME IN OCEAN CIRCULATION?

Ocean dynamics involves interaction among vastly many degrees of freedom. Yet our understanding rests on classical, not statistical, mechanics. What may we be missing, and
The coastal ocean is characterized by high exchange rates of nutrients and particles between the sediment and the water column. To date, the rates and transfer processes at this interface, the benthic boundary layer (BBL), remain poorly understood. We show how the exchange of nutrients and particles is mediated by the benthic boundary layer (BBL). This approach is favorable as it is non-invasive and integrates over concentration profiles of oxygen and nutrients in the BBL. This approach is favorable as it is non-invasive and integrates over concentration profiles of oxygen and nutrients in the BBL. Thus a correlation is inferred between the isotopic fractionation of Fe and the oxidation of organic carbon in marine sediments. Does it show? Measures of model performance have turned to topography, tay-fivs, where tay = Coriolis vector, V is horizontal velocity and S is gradient of total depth. The BBL has revealed stunning differences among models, and a slight tendency for finer resolution eddying models to achieve more positive tau. But what are the observations? From more than 17000 current meter records over 84000 months, global statistics show markedly positive tau, increasingly so at higher latitudes and greater depths. Why? Tendency for flow along isobaths would be realized by tau of either sign. It is argued that the sign of tau follows the 2nd Law (entropy generation) and this ‘Arrow of Time’ points to possible advances for both theory and modeling of ocean circulation.

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THE FUTURE OF NEARSHORE PROCESSES RESEARCH

In 1989, the nearshore researchers convened a first-ever community workshop to discuss the past, present and future of nearshore processes research. The result, either directly or indirectly, was a community vision and a decade of phased experiments aligned with an agreed-upon strategy. A second meeting, held a decade later, updated this vision and helped provide plans for the follow-up programs. In the subsequent span of time, much has changed. Under increasing proposal pressure and need for relevance, funding agencies have shifted priorities and expected time scale of relevance. The move toward observing and prediction systems has strengthened and the recognition of inherent behavior in nonlinear dynamical systems as the nearshore has changed our goals and priorities. In this talk, I will try to summarize the recent history of nearshore science and speculate of profitable future directions.

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INTERCALIBRATION OF BIOCHEMICAL MARKERS AS INDICES FOR EGG PRODUCTION AND METABOLIC ACTIVITY IN A COMMON BALTIC SEA COPEPOD UNDER VARYING FOOD AVAILABILITY

There is growing evidence that biochemical indices can be used to infer growth and metabolic activity of zooplankton. In this study we used a Baltic copepod, Acartia bifilosa (Calanoida), to intercalibrate traditional measures (egg production rate; EPR, respiration, and ingestion) and biochemical indices (RNA, DNA, RNA:protein, and specific aminoacyl-tRNA synthetase; spARS) using animals incubated at varying food concentrations. The long-term observations indicate that ingestion and EPR were best described by RNA:protein ratios, while respiration was best described using RNA:protein ratios followed by RNA levels. These findings further contribute to the development of methods for zooplankton growth assessment in field and laboratory studies.

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SAR IMAGING OF THE OCEAN SURFACE-AN OVERVIEW

The finely detailed imagery of the ocean's surface from a synthetic aperture radar (SAR) is one of the most complex and least understood data sets that are provided by a remote sensing instrument. What to make of the unprecedented two-dimensional views of waves, currents and eddies, slicks, surface manifestations of subsurface features, all brushed over by interactions with the boundary layer, have captivated and perplexed researchers for over three decades. Add to this mix the ocean's motion during the SAR imaging process and one has quite a challenge to derive quantitative information on what these image patterns uniquely provide on upper ocean processes and air-sea exchange. An overview will be provided of the basic concepts of SAR imaging of the ocean surface, characteristics of feature detection, what oceanographic information can be extracted including in combination with other sensors, the capabilities of current and past satellites, how to access data and products, and some thoughts on the future. Are you thinking about using SAR and wondering how to get started? This talk should help you get things going.

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Redox cycling is a crucial mechanism for both the precipitation and solubilization of Fe in marine sediments. Fe cycling across shallow sedimentary redoxcline has been linked to processes of Fe delivery to the oceans in organic rich shell environments. Dissolved porewater Fe in sediments that undergo intense redox recycling have characteristic light Fe isotope compositions relative to the average weathering product. Here we present the isotope compositions of porewater Fe from three cores that were collected from deepsea (>3000 m) Southern Ocean sites off the Crozet Islands. Porewater Fe concentrations reach up to 300 μmol/l and show isotope compositions that are only slightly decreased (min -0.3%) relative to average weathering product. Implicit in these results is a variation between the isotopic fractionation found in marine shelf, and deep-sea derived, porewater Fe. The degree of redox-recycling is suggested to influence the amplitude of the Fe fractionation exhibited in shallower, organic rich shelf environments. From comparison of 0.2mm and 0.02mm porewater filters, we hypothesize that organic ligands and/ or colloids associated with the relatively high porewater Fe concentrations, and that redox cycling is less significant, in these deep-sea sediments compared to organic rich shelf environments. Thus a correlation is inferred between the isotopic fractionation of Fe and the oxidation of organic carbon in marine sediments.

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RE-EVALUATING THE IMPACT OF REDOX CYCLING ON MARINE POREWATER FE ISOTOPES

Redox cycling is a crucial mechanism for both the precipitation and solubilization of Fe in marine sediments. Fe cycling across shallow sedimentary redoxclines has been linked to processes of Fe delivery to the oceans in organic rich shell environments. Dissolved porewater Fe in sediments that undergo intense redox recycling have characteristic light Fe isotope compositions relative to the average weathering product. Here we present the isotope compositions of porewater Fe from three cores that were collected from deepsea (>3000 m) Southern Ocean sites off the Crozet Islands. Porewater Fe concentrations reach up to 300 μmol/l and show isotope compositions that are only slightly decreased (min -0.3%) relative to average weathering product. Implicit in these results is a variation between the isotopic fractionation found in marine shelf, and deep-sea derived, porewater Fe. The degree of redox-recycling is suggested to influence the amplitude of the Fe fractionation exhibited in shallower, organic rich shelf environments. From comparison of 0.2mm and 0.02mm porewater filters, we hypothesize that organic ligands and/ or colloids associated with the relatively high porewater Fe concentrations, and that redox cycling is less significant, in these deep-sea sediments compared to organic rich shelf environments. Thus a correlation is inferred between the isotopic fractionation of Fe and the oxidation of organic carbon in marine sediments.
ESTIMATION OF PRIMARY PRODUCTIVITY WITH THE RATIO OF SPECTRAL IRRADIANCE AT A WAVELENGTH OF 555 NM TO THAT AT 443 NM AT SUBSURFACE WATER

Time-series observation of optical fields just below the euphotic layer has been made in the northwestern North Pacific. Downwelling spectral irradiances (Ed at four wavelengths of 412, 443, 490, and 555 nm) are observed with the Bio-optical Long-term Ocean Monitoring System package (BLOOMS). During more than one year, optical system is kept free of biofouling by use of copper shutters. The ratio of surface PAR to in situ quantum irradiance (in situ QI), which is index of turbidity, synchronizes well with the ratio of spectral irradiance at a wavelength of 555 nm to that at 443 nm (Ed(555)/Ed(443)), which is index of chlorophyll concentration. Using the Ed(555)/Ed(443) and an empirical equation, primary productivity for the experimental period can be estimated. During increases of ratio of surface PAR/in situ QI and Ed(555)/Ed(443), primary productivity and organic carbon flux also increases. Optical sensor deployed at sub-surface water becomes a powerful tool to estimate primary productivity and, in combination with data of nutrient and settling particles, to evaluate the biological pump.

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THE STRUCTURE OF ESTUARY BOILS OBSERVED WITH A DIGITAL ECHOSOUNDER

Boils are ubiquitous in rivers, estuaries and energetic regions of the coastal ocean, and are responsible for redistributing momentum and suspended matter. As embedded features, they may also provide information about the speed, depth and other characteristics of the flow. As part of COHSTREX (Coherent Structures in Rivers and Estuaries Experiment), we are investigating the relationship between the surface and subsurface expression of boils in the Snohomish River estuary, WA. The subsurface structure of boils generated by strong tidal flow over a rocky sill was resolved with a digital echosounder (Biosonics), which was mounted alongside an upward-looking ADCP on a bottom tripod 5 m downstream of the sill. This combination allows the vertical profiles of acoustic backscatter to be shifted such that instantaneous images of the boil size and structure are obtained. Boils extend from below the height of the sill to the water surface, in a large field and modeling study. The observed boils are compared with simple vortex models to better understand their structure and propagation.

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MODELING OF INTERNAL WAVES IN THE GULF OF OMAN AND THE PERSIAN GULF

A modeling system forecasting the circulation of the northern Arabian Sea and the Persian Gulf is used to study internal waves in the Gulf Oman and the Persian Gulf during the summer of 2007. Our modeling system is well suited for this study with a resolution of about 2 km in the horizontal and 66 levels in the vertical, and because it uses realistically steep bathymetry. In order to observe semidiurnal tides, three profiling floats were deployed in the Gulf Of Oman. In addition to providing deep profiles used for assimilation, these floats also provide additional information matched that predicted for vertically-sheared inertial oscillations generated by the horizontal density gradient due to a near-inertial wave of 100 m vertical wavelength. The phase and period of the wave ensured constructive interference with the isopycnal displacement achieved by advection during the diurnal cycle. The stratification by the sheared advection matched that predicted for vertically-sheared inertial oscillations generated by the geostrophic adjustment of a density front, ubiquitous in the ST. By further including the effects of unconfined thermaline inhomogeneity we can account for 100% of observed daytime retrastrification.

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4-D OBSERVATIONS OF A RESTRATIFYING SURFACE MIXED LAYER WITH SUB-MESOSCALE LATERAL

Four-dimensional observations from within the Subtropical Front (STF) are presented of a restratifying surface mixed layer (SML) containing a sub-mesoscale lateral density. During a 33 hour period, 16 small-scale surveys were conducted around a drogued float. Insonation accounted for only 60% of observed restratification during daytime at 50 m. vertical scale following nighttime convection that extended throughout the entire SML. This proportion dropped to 25% at 10 m scales in the lower half of the SML. Additionally, restratification was caused by the vertically-sheared horizontal advection of the lateral density gradient due to a near-inertial wave of 100 m vertical wavelength. The phase and period of the wave ensured constructive interference with the isopycnal displacement achieved by advection during the diurnal cycle. The restratification by the sheared advection matched that predicted for vertically-sheared inertial oscillations generated by the geostrophic adjustment of a density front, ubiquitous in the ST. By further including the effects of unconfined thermaline inhomogeneity we can account for 100% of observed daytime retrastrification.

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THE SSU COAST CAMP: A NOVEL APPROACH TO INCREASE DIVERSITY IN MARINE SCIENCE

The NOAA Living Marine Resources Cooperative Science Center implemented the Coast Camp for Youth at Savannah State University to expose youth aged 7-18 years old to the marine sciences. The half day camp was offered for the first time in June 2007 using a curriculum based on the seven principles of Ocean Literacy with particular emphasis on issues, features, and animals characteristic of coastal Georgia. Eighty-six campers received hands-on classroom instruction and field experiences ordered such that they began with the geological and physical nature of the ocean, continued to its biological and chemical nature, its susceptibility to man, and concluded with its importance to the planet and the lives we depend on. The curriculum was designed to encourage students from groups traditionally under-represented in the STEM disciplines. This presentation will provide a qualitative and quantitative overview of the challenges and successes observed in this program.

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GLOBAL SURFACE SALINITY CHANGE DETECTED BY ARGO FLOATS

We investigate surface salinity distribution and characteristics of its spatial and temporal variation in the World Ocean. The recent development of the Argo float array has allowed researchers to document changes in global surface salinity. In the climatology, salinity is generally lower in the subpolar and tropical regions and higher in the subtropics. We compared the annual average surface salinity distribution in 2003-2006 with the climatology and found a general enhancement of lower and higher surface salinities, except in the North Atlantic Ocean. Further, we estimate enhancement of the global hydrological cycle from the surface salinity, suggest that the strength of the global hydrological cycle is enhanced by approximately 2.4% compared to that 25 years ago. Our results, based on changes in global surface salinity, provide an evidence of an enhanced global hydrological cycle probably caused by global warming.

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COMMUNITY STRUCTURES OF ENTEROCOCCUS SPECIES IN LAKE PONTCHARTRAIN AND THE 17TH STREET CANAL WATERS FOLLOWING HURRICANE KATRINA

Polymerase chain reaction (PCR) primers to amplify partial 23S rRNA genes from genus Enterococcus were designed on the basis of the conserved regions of sequences retrieved from GenBank database. By using one primer combination, Enterococcus rRNA genes were successfully amplified from the water DNAs and isolates collected from Lake Pontchartrain and the 17th Street Canal during September and October, 2005 after Hurricane Katrina. The amplified DNAs were then used for the analysis of the community structure of enterococci in these Katrina-impacted waters. The sequence analysis following the RFLP screening illustrated the phylogenetic diversity of enterococci in the lake and canal water samples. The enterococci that have been considered as important fecal pollution indicators or clinically important ones such as E. faecalis and E. faecium were detected from both water DNAs and isolates while the dominant and novel groups were observed mainly in water DNAs. This study enabled inferring sources of these enterococci and associated ecological information. It also provided the enterococci community signatures in Katrina-impacted lake and canal waters.

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WHAT CAN WE LEARN ABOUT THE WATER FROM THE SECCHI DISK DISAPPEARANCE?

The widely used and successful Secchi disk method has gained renewed interests recently despite its history of more than 140 years from initial introduction. It is interesting to revisit the issue from a different perspective than many have been accustomed to, namely, imaging instead of radiative transfer. It is understood that the scattering properties of the water are ultimately determined by the outcome of the image formation and transmission within, along with the attenuation caused by absorption. By examining the point spread function (PSF), which describes the system response to a point source in the medium or its Fourier transformed counterparts, we demonstrate that the traditional theory converges with imaging theory. Further, we show the relationship between Secchi disk depth and inherent optical properties of the water, which offers hints about the amount of information retrievable from Secchi depth.

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SUCCESSIVE LARGE SCALE GENOME DUPLICATIONS IN DINOFLAGELLATE EVOLUTION: NEW INSIGHTS FROM PCNA AND SSU RNA GENE EVOLUTION

Dinoflagellates are the second most abundant phytoplankton in the oceans but “unusual” in their cytology, genetics, and evolution. Their possession of enormous genomes (nearly 1-100 fold that of the human haploid genome) is particularly puzzling. Literature shows that highly repeated sequences or genes exist in dinoflagellate nuclear genomes, leading us to hypothesize that the large genomes may be caused in part by rampant gene or genome duplications. In this study, we examined this hypothesis by analyzing the gene copy numbers (GCN) of PCNA (proliferating cell nuclear antigen) and SSU rRNA (small subunit rRNA) genes. Literature shows the genome sizes of representative species from major orders of dinoflagellates. The observed correlation between the GCN and genome sizes suggests that dinoflagellate genomes have undergone successive large scale duplication in the past. Phylogenetic analysis of PCNA homologs supports that the duplication events have taken place for multiple times and when they occurred was “predicted” by additional sequence analysis. Thus the varied GCN and genome sizes could be the snapshots representing how many different times dinoflagellate gene or genome duplications have occurred in the evolutionary history.

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SALT MARSH GROUNDWATER DYNAMICS DELINEATED USING GROUNDWATER TEMPERATURE AS A TRACER

Knowledge of groundwater-driven exchange of water, solutes, and nutrients between salt marsh estuaries and shelf waters is important for understanding global solute budgets and such phenomena as acute salt marsh dieback. Here we investigated salt marsh ground-water dynamics, using heat as a tracer, as part of a larger field and modeling study. Seven piezometer nests were installed in two transects at an acute marsh dieback site within the North Inlet NERR, Georgetown, South Carolina. Each nest contains three piezometers screened at depths of 1 m, 2 m, and 4 m. Temperature was recorded at 10 minute intervals
in the piezometers beginning August 2006 and ranged from 9 – 30ºC over a one-year period. A comparison of observed temperatures and results of a 1-D conductivity–temperature–depth model indicates that groundwater temperatures were primarily conductive from January through September 2007. However, the piezometer temperature record from October 2006 suggests vertical advection and possible density-driven overturn. If occurring on a march-wide basin scale, such flow could provide a significant pulse of nutrients and solutes to coastal surface waters.

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VERTICAL SALT FLUX IN A RIVER PLUME: LATTE OBSERVATIONS VS. GRADIENT-RICHARDSON NUMBER CALCULATIONS

The LADCP dye tracer experiments provided a direct measurement of the salt flux into the Hudson River plume along the New Jersey coast. These are compared with gradient-Richardson number (Bi) calculations using data from a 1200 kHz ADCP mounted over the side at 1 m depth and a CTD on an undulating profile 50 m behind the RV Hatteras. The vertical diffusivity, Kz, derived from Bi using the Lamont Ocean Atmosphere Model turbulent closure scheme, was combined with the vertical salinity gradient to calculate the vertical salt flux at 4 m depth, the base of the dye patch. The calculated and observed salt fluxes correspond to within a factor of 2. The greatest observed salt flux, 3 x 10^-4 m s^-1, occurred when the river plume was a southward flowing gravity current. Upwelling events produced salt fluxes up to 1.7x10^-4 m s^-1. For 7 dye experiments averaged over a range from 0.8 to 1.0 and 1 to 2 x 10^-4 m s^-1 respectively. But, within an experiment these varied by up to a factor of 5 suggesting considerable spatial and temporal variability.

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PHYLOGENIES OF KEY TAXA FROM DEEP-SEA CHEMOSYNTHETIC COMMUNITIES IN THE GULF OF MEXICO AND RELATIONSHIPS WITH OTHER TAXA FROM AROUND THE WORLD

The discovery and exploration of deep-sea cold-seeps continues to be accompanied by the discovery of new species. These new species are often closely related to taxa from previously studied deep-sea reducing habitats. Molecular analyses were used to place the six species of vestimentiferan tubeworms, four species of mussels, and two species of shrimp from the Gulf of Mexico in the phylogenetic context of related taxa from around the world. Within the Gulf of Mexico, the distribution of each taxon is strongly correlated with depth. The phylogenies also show a strong connection among populations on either side of the Atlantic at similar depths, particularly among the GoM, Barbados Prism, and populations from seeps on the west coast of Africa. In addition to phylogenetic affinities to Atlantic species on the GoM, the deep-sea shrimp species on the GoM is closely related to a hydrothermal vent species found on the Mid-Atlantic Ridge. These data suggest either a relatively recent exchange of larvae across the Atlantic or a relatively slow mutation rate in the genes analyzed (predominantly COI).

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THE LIVERPOOL BAY COASTAL OBSERVATORY

A Coastal Observatory has been operating since August 2002 in Liverpool Bay, Irish Sea. The bay has strong tidal mixing, receives fresh water from several estuaries and enhanced levels of nutrients. It stratifies intermittently. The Observatory’s rationale is to develop the science underpinning the ecosystem-based approach to marine management, including distinguishing between natural and man-made impacts. The Observatory has three components for each of which the goal is at least some (near) real time operation - measurements, modelling and the dissemination of the results via the web. The four measurements include: main strands, each on different space or time scales to test the numerical models, are fixed point time series (in situ and shore-based), regular spatial surveys, HF radar (surface currents and waves) and an instrumented ferry. The emphasis is on physical and ecological models forced by forecast meteorology. In the next few years, at least up to 2012, the Observatory will expand in spatial coverage and in capability, for instance through the deployment of gliders.

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DESIGN OF AN ACOUSTICAL OBSERVING NETWORK FOR THE NORTH ATLANTIC BASIN USING A HIGH-RESOLUTION NUMERICAL OCEAN MODEL

The effectiveness of an acoustic tomography observing network for the North Atlantic is assessed using simulated acoustic transmissions in a high-resolution numerical ocean model. The North Atlantic is a region of rapid climate variability, with temperature changes expected to extend into the abyssal ocean at timescales much shorter than in other ocean basins. Long-range acoustic transmissions may effectively sense average temperature, including abyssal volumes. We will discuss the optimal design and cost effectiveness of a basin-wide acoustical observing network using simulations in a numerical ocean model. In particular, the simulated acoustic data will be considered in combination with data assimilation techniques and existing data types to quantify the enhanced resolution of large-scale or deep oceanic variability afforded by the acoustic data. Results for several acoustic paths leading to a network are presented.

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MEAN STREAM-COORDINATE STRUCTURE OF THE KUROSHIO EXTENSION FIRST MEANDER TROUGH

Fine horizontal-scale ADCP/CTD surveys across the first meander trough of the Kuroshio Extension were made during the Kuroshio Extension Experiment (KEX) in 2004, while the current was in its stable meander state. Stream coordinate analysis revealed a mean core surface velocity of 1.7-1.8 m/s and cross-stream velocities of the order of 0.1 m/s. Rossby numbers greater than one were found consistently north of the core. The passage of a frontal wave was associated with southward cross-frontal flux. An array of Current and Pressure sensor-equipped Inverted Echo Sounders (CPEIS) provided a longer time series than the full water-column jet structure, albeit with poorer horizontal resolution. The six-month time series during the stable state showed that entering the meander trough, core velocities rotated clockwise with depth, and cross-stream fluxes were southward implying subpolar-to-subsurface down-welling. These fluxes are important for the formation of mode and intermediate waters. Variability suggested an event-driven process, but peak southward flows did not always coincide with the passage of frontal waves. North and south of the core, strong recirculations exist with surface and deep currents aligned.

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MONITORING THE COASTAL OCEAN ENVIRONMENT FOR HARMFUL ALGAL BLOOMS

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HURRICANE KATRINA WAVES AND STORM SURGE OBSERVATIONS BY THE CENTRAL GULF OF MEXICO OCEAN OBSERVING SYSTEM

The eye of hurricane Katrina passed 49 nm to the west of a 3 m discus buoy, in 20 m water depth, operated by the Central Gulf of Mexico Ocean Observing System. The buoy moved 2 km to the northwest during the storm surge and then 13 km to the southwest as the surge retreated. Currents and water levels show an asymmetrical storm surge event with stronger currents during the fall of the surge. Waves built to nearly half the mean water depth and wave height rapidly decayed 5-6 hours after the hurricane moved over land. Comparison of measured currents with ADCIRC simulations of Katrina, forced with NOAA reanalysis of the core circulation of the storm, shows good agreement during the surge, but larger discrepancies with the retreating waves. It is important to improve the simulation of the latter since it is destructive in it’s own right. Two potential improvements are to force the model with larger scale winds, so that the offshore winds do not dampen so quickly after the storm moves onshore, and improving the drying algorithms.

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DESIGN OF AN ACOUSTICAL OBSERVING NETWORK FOR THE NORTH ATLANTIC BASIN USING A HIGH-RESOLUTION NUMERICAL OCEAN MODEL

The effectiveness of an acoustic tomography observing network for the North Atlantic is assessed using simulated acoustic transmissions in a high-resolution numerical ocean model. The North Atlantic is a region of rapid climate variability, with temperature changes expected to extend into the abyssal ocean at timescales much shorter than in other ocean basins. Long-range acoustic transmissions may effectively sense average temperature, including abyssal volumes. We will discuss the optimal design and cost effectiveness of a basin-wide acoustical observing network using simulations in a numerical ocean model. In particular, the simulated acoustic data will be considered in combination with data assimilation techniques and existing data types to quantify the enhanced resolution of large-scale or deep oceanic variability afforded by the acoustic data. Results for several acoustic paths leading to a network are presented.
Karens brevis is a dinoflagellate that causes Harmful Algae Blooms (HAB) off the coast of Florida. Karens causes Neutrotoxic Shellfish poisoning (NSP). There can be harmful effects when coming in contact with toxic shellfish that have been poisoned from the bloom. It is still unclear what physical causes such a toxic bloom to occur. The goal of this undergraduate research is to understand the conditions in which the blooms are most likely to occur. High resolution ocean color (250m) images of the coast of Florida, and environmental data from the area, will be used to identify conditions most favorable for the Karens brevis to bloom. The warning signals to other states besides Florida is another concern. Being able to key point some of the events that occur before and after a bloom will allow us to help make predictions of blooms in the future.

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RADIATING INSTABILITY OF A MERIDIONAL BOUNDARY CURRENT

A linear stability analysis of a meridional boundary current on the beta-plane is presented. The boundary current is idealized as a constant speed meridional jet adjacent to a semi-infinite motionless far field. The far field region can be situated either on the eastern or western side of the jet representing a western or an eastern boundary current, respectively. It is found that in the long meridional wave limit, the unstable boundary current generates propagating waves that transport energy away from the locally unstable region. This is the so-called radiating instability and is found in both barotropic and 2-layer baroclinic configurations. A second but important conclusion is that there are significant differences in the stability properties of western and eastern boundary currents. An eastern boundary current supports a greater number of radiating modes over a wider range of meridional wavenumbers. It generates also waves with longer wavelengths and amplitude envelopes that decay slower with distance from the current than the waves radiated from a western boundary current.

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CLIMATE-DRIVEN CHANGES IN ABBUNDANCE AND DISTRIBUTION OF LARVAE OF OCEANIC FISHES IN THE SOUTHERN CALIFORNIA REGION

We examined climatic effects on the geographic distribution and abundance of 34 dominant oceanic fishes along the Southern California margin using the CalCOFI surveys. Among the 34 taxa, only 10 showed a significant distributional shift (mean latitude or boundaries) in relation to annual sea surface temperature, and only 8 species significantly shifted their geographic distribution from the cold to warm period. However interestingly, more often the vertical migrating taxa showed a significant change in abundance in relation to annual SST, and 25 taxa showed a significant increase in abundance from the cold to warm period. We suggest two hypotheses explaining the overall increase in abundance of oceanic fishes. First, increased shoreward incursion of the Central Gyre water during the warm period may bring in more oceanic fish into the region, and 2nd, intensified stratification of the southern California region during the warm period may create an unfavorable condition (e.g. reduced food supply) for neritic species and generate open space for the oceanic species.

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THE KUROSHIO IMPINGEMENT ON THE CONTINENTAL SHELF IN THE CHINA MARGINAL SEAS AND ITS CONSEQUENCES

The proximity of the Kuroshio to the marginal seas of China allows the penetration of the Kuroshio that often reaches the continental shelf. The collision of the intruded Kuroshio through the Luzon Strait with the continental shelf in the northern South China Sea generates a along shelf break pressure gradient that maybe responsible for the creation of the South China Sea Warm Current that flows against the northeast winds in winter. The collision of the Kuroshio with the continental shelf break northeast of Taiwan sends a Kuroshio branch current that contributes to the formation of the Taiwan Warm Current. The Taiwan Warm Current features prominently in the formation of latitudinal fronts in the East China Sea. The distribution pattern is not too much to the Tsushima Warm Current as a result of the runtime of the Kuroshio into the shoaling topography west of Kyushu. These intense interactions of the Kuroshio with the China marginal seas are reviewed with new perspective of the cross-shelf transports that arise from them.

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EFFECT OF IDEALIZED HURRICANES ON THE ATLANTIC MERIDIONAL HEAT TRANSPORT

Hurricanes are storm systems with powerful winds and torrential rain originating from the Atlantic tropics. It is believed that hurricanes can play an important role in northward transport of heat in the ocean and pmay also play a key role in modulating the climate in the Atlantic basin and the globe. Since a hurricane is a mesoscale storm system, it is not well simulated in current generation climate models. Previous studies indicate that the vertical mixing induced by the strong hurricane winds would mix heat downward in the upper ocean in the subtropical region, hence increasing the oceanic northward meridional heat transport (MHT). Here we use the National Center for Atmospheric Research’s Community Climate System Model version 3 to simulate the idealized hurricane wind effect on the meridional overturning circulation (MOC) and MHT. Results show that without the hurricane-induced precipitation effect, the mixing induced by the hurricane winds cools the upper 100 m of the subtropical ocean and warms the sub-surface water between 100 m and 500 m. Further, we identify conditions most favorable for the Karens brevis to bloom. The warning signals to other states besides Florida is another concern. Being able to key point some of the events that occur before and after a bloom will allow us to help make predictions of blooms in the future.

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RECENT PROGRESS IN STUDY OF LOW LATITUDE WESTERN BOUNDARY CURRENTS

Since the end of TOGA and WOCE a calm period of no significant activities has appeared in the northwestern Pacific Ocean east of the Philippines, during which naturally few studies have been carried out to investigate the low latitude western boundary currents in the north Pacific. Fortunately, more and more people have recognized the importance of the low latitude western boundary currents in this region in ocean dynamics as well as in climate changes associated with ENSO and monsoon. Recently some progress was made with two Chinese projects of the ‘973’, which is almost the largest project for basic study in China. In the present paper recent results of research on ocean circulation in the western Pacific Ocean will be presented and outstanding scientific issues will be discussed. Also a new program of NOPC (Northwestern Pacific Ocean Circulation Experiment), for which an international workshop was held in May 2007 in Qingdao, China, will be described along with brief introduction to the two Chinese 973 projects.

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MODELING SEA ICE AND OCEAN CIRCULATIONS IN THE BERING SEA

The ocean circulation and sea ice in the Bering Sea were simulated using a Coupled Ice Ocean Model (Ciom). The simulated circulation in the deep basin is cyclonic with little seasonal change. The Bering Slope Current is estimated at 5 Sv, and it is located in a downwelling area. The Kamchatka Current is estimated at 20 Sv off Kamchatka Peninsula. The Bering shelf circulation varies with season, driven mainly by the predominant winds. A counter current is captured flows southeastward about along the 200 m isobath of the Bering Slope and Bering Slope Current, which need to be validated by observations. An upwelling is located in the shelf break may imply the vertical advection of nutrients in the break-slope area. The mechanisms of vertical thermocline structure in the Bering shelf were studied, and results show that the upper and the bottom uniform layers of temperature and salinity can be formed by surface water mixing and tidal stirring, respectively. Sea ice begins forming in the northwestern Bering Sea in early November, and ice extends into June of the following year. Maximum ice cover and ice volume (about 210, 000 Km3) occurs in early April and lags the minimum air temperature by about two months due to the heat capacity of the ocean. Polynya occurs downwind of the summer ice edge. Water properties are more oceanic than estuarine. Polynya are forced to lower temperature, higher salinity, and higher density compared to its ambience water.

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CARBON CYCLING IN TWO BRINE WATER CHARGED COLD SEEP SEDIMENTS IN THE NORTHERN GULF OF MEXICO

Surface sediments (~17 cm) near two cold seep sites from the Northern Gulf of Mexico, BG425 and GC233, are studied for carbon sources in sedimentary remineralization. GB425 exhibits a two-layer reaction zonation: upper 7 cm layer shows conspicuous sediment mixing; below 7 cm at GB425 and throughout our sampled depth at GC233, brine water efflux appears to control pore water chemistry. Using the linear portion of the sulfate profiles, we estimate that sulfate depletion depths at these sites are ~22 cm and ~27 cm, respectively. Based on a two end-member mixing model, brine waters at these sulfate depletion depths are predicted to have much different chemical compositions but similar 8° values (~50‰). These low 8° values are associated to anoxic oxidation of methane that occurs below these surface sediments and isotopic signatures of these methane are typical for the structure II gas hydrate found in these environments. Furthermore, surface sediments here are found to have a lesser degree of reactivity than the subsurface layer, contrary to common marine sediments, primarily due to predominant organic carbon input from underneath.

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DYNAMICS OF EXTRA-EQUATORIAL JETS, EQUATORIAL DEEP JETS AND POTENTIAL VORTICITY HOMOGENIZATION

The available meridional sections of velocity with high vertical and meridional resolution in both the Atlantic and Pacific oceans reveal that predominantly barotropic eastward
jets at 2N and 2S, named the extra-equatorial jets, appear to straddle the stacked eastward and westward jets of small vertical scales located right at the equator (the so-called equatorial deep jets). Observed distributions of potential vorticity and tracers [O2, salinity, nitrate, and phosphate] display strong meridional homogenization within specific depth ranges. The dynamics underlying the formation of both the barotropic and highly baroclinic jets and the resulting potential vorticity distribution are investigated using very high resolution primitive equations models. A rationale is provided in terms of various types of equatorial instability mechanisms.

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THE IMPACT OF INTERTIDAL ZONE ON TIDAL CREEK RESIDENCE TIME AND WATER EXCHANGE

Intertidal zone is widespread along the coastal areas and represents an important marine ecosystem in which physical and biological processes interact with each other. The tidal hydrodynamics in an estuarine-tidal creek-intertidal salt marsh complex (i.e. the Okatee River, South Carolina) is studied using a three-dimensional, unstructured grid, finite-volume coastal ocean model (FVCOM). Detailed topographic data in the intertidal zone is provided by a 1 by 1 m resolution digital elevation map constructed from airborne infra-red vertical photography mosaics. Numerical experiments reveal that expansion of the flushing driving process with the intertidal zone could underestimate the magnitude of tidal currents in the river channel. Subsequently, the tidal creek residence time is significantly increased. In addition, lagrangian drifter simulations suggest that the general transport patterns over the salt marsh-tidal creek complex follow closely the channel and sub-channel characteristic topography. Hence, lagrangian transport simulation of tidal dispersion and nutrient and plankton transport flux depends critically on detailed bottom topographic information of the study area, especially, the existence of the intertidal zone.

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HORIZONTAL TEMPERATURE GRADIENT, VORTICITY, AND STRAIN IN THE SUBMESOSCALE OCEAN VARIABILITY FROM NUMERICAL SIMULATIONS

The dynamical structures and the statistical distributions of the horizontal temperature gradient, vorticity, and strain fields from a submesoscale—resolving ocean model simulations (300 meter resolution) are analyzed and compared with two sets of eddy—resolving and eddy—permitting simulations with 3 km and 18 km resolution, respectively. It is found that the magnitude of the simulated horizontal temperature gradient increases only mildly when the model resolution is changed from 18 to 3 km, while it increases dramatically when the resolution is further refined from 3 km to 300 m. In the 300 m simulations, the relative vorticity field exhibits a strong cyclone—anticyclone asymmetry with the strongest vortices overwhelmingly cyclonic. This evidence suggests that the ocean model successfully simulates the real physical fronts and the weak anticyclone—strong—cyclog—front triaminate only when they properly resolve the submesoscale. An additional analysis of an independent set of simulations with 1 and 10 km resolution is underway to test the robustness of this conclusion.

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SEASONAL VARIATIONS IN THE SOURCE OF CHROMOPHORYIC DISSOLVED ORGANIC MATTER (CDOM) IN THE NEPONSET RIVER WATERSHED

Riverine chromophoric dissolved organic matter (CDOM) is often the major source of estuarine CDOM. Riverine CDOM has been thought to be constant, however, the concentration and characteristics of riverine CDOM are highly related with the land cover types in a watershed. In the Neponset Watershed, a typical urban watershed, 5 major land cover types were identified with a geographical information system (GIS). Water samples of each of these endmembers were collected monthly over the course of an entire year and incubated (filtered sample in dark bottle and unfiltered sample in clear bottle under sunlight for 5 days) right after collection. CDOM fluorescence, absorbance, excitation/emission matrix (EEM) spectroscopy, and dissolved organic carbon (DOC) were measured for all these endmembers, seasonal resolution of the 5 endmembers and their changing characteristics were determined, which help to estimate the characteristics of riverine CDOM and to further study the behavior of riverine CDOM in estuarine and coastal areas.

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PSEUDO-NITZSCHIA COMMUNITY STRUCTURE IN THE ESTUARY, PUGET SOUND, WA

The Washington estuary Puget Sound consists of four hydrographically distinct but interconnected basins. Diatoms in the genus Pseudo-nitzschia are commonly detected in Puget Sound waters, but little is known about the distribution of species and strains among these different basins. A Pseudo-nitzschia specific automated Ribosomal Internal Spacer Analysis (ARISA) was used to determine Pseudo-nitzschia species composition at 21 stations in Puget Sound over a 3—day period in June 2006. Species composition varied significantly according to basin. Interestingly, the station with the most Pseudo-nitzschia species detected was “Triple Junction,” where waters from three basins mix together. One species, P. pungens, was detected at every station surveyed and in samples from ~80 m. Most species exhibited more restricted distributions, and some were detected at less than half the stations surveyed. We are currently generating Pseudo-nitzschia environmental clone libraries to determine if intraspecific populations similarly group according to basin. A prototype model-data visualizer, written in Java using the Processing.org toolkit, was developed to highlight correlations between community structure, water properties, and transient circulation features, and to give non-modelers access to model hindcasts.

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ENVIRONMENTAL CHARACTERIZATION OF CRABEATER SEAL FORAGING ZONES ALONG THE WESTERN ANTARCTIC PENINSULA

We examined the relationships between physical features of the environment and the foraging behavior of Crabeater Seals along the Western Antarctic Peninsula in 2001, 2002 and 2007. We obtained data from 43 seals which were followed using Satellite Relay Data Loggers (SRDL) that provided information on location and diving behavior (all years), as well as temperature and salinity profiles (2002 and 2007 only). Satellite data on sea surface temperature, sea surface height, sea surface height anomaly, bathymetry, ice coverage, chlorophyll-a concentration and primary productivity were obtained for each location along the tracks. SRDLs transmitted data for between 25—150 days for 2001, 5—123 for 2002 and 2007 (two animals still transmitting as of October 1st, 2007). We identified areas where animals displayed potential foraging behavior, or Area—Restricted Search (ARS) zones, using the fractal landscape method. This approach, based on the estimation of fractal dimension, is an effective method to recognize locations that are within ARS zones, allowing us to characterize the foraging areas observed along the tracks versus segments where the animals were transiting.

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THE WATERSHED WATCHERS PROGRAM: A COLLABORATIVE EFFORT TO INTEGRATE OCEAN OBSERVING DATA INTO A K—5 MARINE SCIENCE CURRICULUM

Effectively tapping into the vast resources of ocean observing data for educational purposes, both formal and informal, requires the development of data display and visualization tools tailored to meet the needs of these diverse audiences. The “Watershed Watchers” program is a collaborative effort between Campbell Park Elementary School Marine Science Center, The Pier Aquarium, and the University of South Florida (USF) College of Marine Science, is a prototype effort to incorporate real—time meteorological and water quality data into a cross—cutting K—5th grade marine science curriculum. Our experiences with classroom teachers, informal science institutions, scientists and school administrators highlight the necessity of maintaining an open and mediated dialogue among participants and can provide insight into the steps necessary to ensure that development of ocean observing data resources is consistent with the demands and requirements of the larger educational community. Short—term “Watershed Watchers” program goals include the development of innovative approaches to teaching complex ocean science and ocean literacy topics to younger students using ocean observing data, including the creation and design of web based and printed educational resources aligned with state science testing standards and academic achievement benchmarks.
ASLO/AQUOTIS/ERF

Meeting Abstracts

THE HOME STRETCH: 3-D SWIMMING TRAJECTORIES OF SETTLEMENT-STAGE CORTAL RICH FISH LARVAE IN THE FLORIDA KEYS

Larval dispersal and connectivity result from biophysical interactions between larvae and their environment. While transport can be driven primarily by oceanographic processes, larval behavior can also be important. Settlement stage coral reef fish larvae often have considerable swimming abilities and use acoustic and olfactory cues for settlement habitat selection. In the Florida Keys, an extensive barrier reef system is in close proximity to a major western boundary current. In this environment, habitat selection behavior could greatly affect larval dispersal, depending on the distance larvae can effectively orient, navigate, and swim. To investigate the spatial scale of orientation and navigation, in situ observations of bicolor damselfish (Stegastes partitus) larvae were conducted 1 km offshore of Molasses Reef, Key Largo, Florida. Settlement larvae from light-trap samples were released by scuba divers and observed for 10 min. Swimming trajectories were reconstructed in 3-D from speed, direction, depth, and current measurements. Individual directionality and group choice of swimming direction were analyzed using circular statistics. Directionality and swimming speeds were used to estimate the spatial scale of effective navigation.

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COMPARISON OF METABOLIC ACTIVITIES IN PERMEABLE NEARSHORE SEDIMENTS

In this presentation we contrast benthic metabolism in three permeable sandy sediments and their overlying water, located in tropical, sub tropical and a temperate climate, respectively. All sites were affected by advective pore water exchange and the sub-tropical and temperate sites also by seasonal changes in nutrient regime. Production and decomposition of organic matter activities were measured with benthic advection chambers and laboratory column reactors permitting defined pore water percolation rates through retrieved sediment cores. The results show high productivity and decomposition rates at all study locations and the link between the metabolic process in the sediment and overlying water column. The comparison reveals surprisingly similar rates and responses to flow in the sub tropical and temperate study sites but a stronger response to flow in the tropical environment.

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EFFECTS OF MOC VARIABILITY ON THE UPPER LAYER TROPICAL ATLANTIC

The upper layer circulation in the tropical Atlantic can be understood as combination of a shallow wind-driven overturning cell between the sub tropics and tropics (STC) and the deep, interhemispheric meridional overturning circulation (MOC). The interaction of these two circulation cells leads to a predominantly hemispheric origin of the tropical Atlantic water masses. Earlier studies using idealized ocean models without a shallow wind-driven overturning cell but a stronger response to flow in the subtropical and temperate study sites but a stronger response to flow in the tropical environment. While the immediate response to bleaching may be species dependent, the reliance on heterotrophic feeding during recovery was universal at 4 and 16 weeks.

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REGIONAL COMPARISON OF SURFACE TURBULENT FLUX PRODUCTS

This study compares the surface turbulent fluxes with the forcing variables from nine products and investigates the differences on both basin wide and regional scales over the Atlantic, Pacific, and Indian Oceans. The products based on weather models include the 2nd NCEP reanalysis, ECMWF 40-yr reanalysis (ERA-40), and Japanese 25-yr reanalysis (JRA-25). Data sets based on in situ observations include NOC (formerly SOC) and FSU. Purely satellite derived products include those from Goddard (GTSSTI), ISREMER, and the 2nd version of HOAPS. A hybrid NWP model and satellite product from WHOI is also included in this comparison. Zonal averages of the stress and heat fluxes reveal very large differences among the various products. For the Atlantic Ocean, the largest differences in the zonally averaged stress and sensible heat fluxes exceed 60 W/m2 and 15 W/m2 respectively. Comparables differences are also found over the Pacific and Indian Oceans. Regional analysis of the distribution of the fluxes shows large variations between products at all latitudes. In some regions, median latent heat flux values differ by 40 W/m2 between products.

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COMPETITION AND FACILITATION BETWEEN UNICELLULAR N2-FIXING CYANOBACTERIA AND NON-N2-FIXING PHOTOPHYSIS SPECIES

Recent discoveries show that unicellular nitrogen-fixing cyanobacteria are more widespread than previously thought. We combined theory and experiments to investigate competition between these small unicellular diazotrophs and other phototrophic species. We...
developed a competition model that incorporates several physiological processes, including the light dependence of nitrogen fixation, the switch between nitrate assimilation and nitrogen fixation, and the release of fixed nitrogen. Model predictions were tested in competition experiments using the unicellular nitrogen-fixing cyanobacterium Cyanothece, the picocyanobacterium Synechococcus, and a small green alga (Chlorella sp.). In experiments with high nitrate input concentrations, the species with lowest critical light intensity (Synechococcus) competitively excluded the other species. At low nitrate input concentration, however, nitrogen release by Cyanothece enabled stable coexistence of Cyanothece and Synechococcus. In fact, release of fixed nitrogen by Cyanothece enabled Synechococcus to become more abundant in the species mixture than it would have been in monoculture. This interplay between competition and facilitation is likely to be a major determinant of the relative abundances of unicellular nitrogen-fixing cyanobacteria and non-nitrogen-fixing phytoplankton species in the oligotrophic ocean.

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MUTANTS IN RECOVERIES FROM MASS EXTINCTIONS: A PHENOTYPIC REFLECTION OF ENVIRONMENTAL STRESS OR UNUSUAL GENOTYPES?

As the world ocean continues to be affected by anthropogenic change, our understanding of the recovery of oceanic ecosystems from past global perturbations becomes increasingly important. The recovery of pelagic ecosystems from the most recent mass extinction, the Cretaceous/Paleocene (K/P) boundary, offers insights into the pattern, timing, and mechanisms of evolutionary recovery. We conducted a high-resolution study of the relative species abundance of pelagic foraminifera in the western tropical Pacific following the extinction. This study revealed resurgence of several genera of microfossils in foraminifera during the initial, approximately 1 million-year long, “boom-bust” recovery period. While aberrant Parvularugoglobigerina euubien has been described previously, mutants in multiple genera have not. Aberrant test morphology may reflect either chamber malformation or increased environmental stress (not heritability) or presence of unusual genotypes. We describe the timing, abundance, and morphological regularity of mutant foraminifera throughout the K/P recovery relative to environmental proxies and the abundance and speciation/extinction rates of pelagic foraminifera. We examine these trends to determine the extent to which mutant foraminifera in evolutionary recoveries reflect environmentally induced chamber malformation or selection for unusual genotypes.

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WAVE INSTABILITY CRITERIA FOR INTERFACIAL WAVES BREAKING OVER A RIDGE

Internal wave breaking at submerged bathymeric features such as ridges and seamounts is thought to be responsible for a substantial amount of the ocean’s vertical mixing. Laboratory experiments are used to investigate under what conditions periodic, interfacial wave trains become unstable when propagating over a submerged feature. Particle image velocimetry (PIV) and Planar laser-induced fluorescence (PLIF) are used to obtain highly spatially resolved measurements of density and velocity simultaneously during wave breaking. From such measurements, the local gradient Richardson number (Ri_g) can be calculated. Strong counter-rotating velocities due to nonlinear wave steepening at the ridge act to increase the critical value of Ri_g for instability above the canonical value of Ri_g = 0.25 for potential shear instability in parallel, steady shear flow.

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A SPATIAL AND TEMPORAL ANALYSIS OF BENTHIC COMMUNITY STRUCTURE IN THE NORTHERN BERING SEA

The northern Bering Sea is a productive shelf ecosystem, in part because sea ice dynamics and primary production in the spring are intimately tied to export of labile organic carbon to the benthos. The rich benthic community supports large benthic predators (e.g., epibenthic crabs and snails, diving seaducks and marine mammals). Near-annual sampling over the past twenty years indicates a transition in the dominant bivalve from the large, thin-shelled Macoma calcarea to the comparatively smaller, thicker-shell Nuculidae radiata in addition to declining trends in overall benthic infaunal biomass. Changes in benthic community structure are being analyzed through similarity cluster analysis (Bray-Curtis index) to group stations from 16 oceanographic cruises over the past twenty years. Ordination through non-metric multi-dimensional scaling is used to analyze infaunal abundance in these benthic populations over time. In addition, station group separation is being evaluated with ecological parameters, such as sea ice cover/duration, hydrographic parameters, sediment variables, and spatial trends using the Geostatistical Analyst function of ArcGIS software. Results will be presented that evaluate potential forcing factors for the benthic changes being observed in this system.

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STABLE ISOTOPE PROBING OF MICROCIBILITY COMMUNITY DYNAMICS ASSOCIATED WITH PHYTODETritUS DEGRADATION IN MARINE PERMEABLE SEDIMENTS

Stable isotope probing (SIP) in sediment core profiles was used to directly link denitrification and phytophoretic degradation to identification of active microbial populations in permeable sediments of the shallow Gulf of Mexico. Post-bloom conditions were simulated by the addition of isotopically-labeled, heat-killed Spirulina cells to whole-core sediment chambers. Relative to non-amended cores, the addition of phytoplankton resulted in sharply increased N fixation and dissolved inorganic nitrogen efflux as well as elevated oxygen consumption rates. Fingerprinting of the SSU RNA genes showed an enrichment of the Gammaproteobacteria in phytophoretic amended sediments, and SIP confirmed that the microbial groups that actively assimilated phytophoretic were predominated by the Gammaproteobacteria. Fingerprinting of denitrification genes (nosZ) paired with SIP revealed the dominant phytophoretic likely to catalyze nitrogen removal. Amino acid alignment showed a strong relatedness of 14C-derived clones to NosZ whereas 12C clones are less related. Thus, our preliminary results suggest that phytophoretic amendment influenced the enrichment of structural different NosZ proteins. Higher resolution sequence data is required to better elucidate the structure-function relationships of denitrifying prokaryotes in amended treatments.

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PHYTOPLANKTON TRENDS IN MASSACHUSETTS BAY - 1992-2007

The Massachusetts Water Resources Authority (MWRA) has monitored the effluent and the quality of the ambient receiving waters of Massachusetts Bay and Boston Harbor since 1992. Our monitoring program was designed to assess the environmental effects of releasing an effluent discharge from Boston Harbor to Massachusetts Bay. Over eight years of baseline data and over six years of post-diversion data are available through September 2007. The MWRA has documented improvements to Boston Harbor following the transfer of the effluent offshore, addressed concerns about the effects of the offshore outfall, and documented the importance of regional factors on local variability and trends. These factors include annual variation in meteorologically-driven regional Alexandrium blooms and climate (temperature)-linked annual variation in Phaeocystis bloom duration. Although the accumulated information suggests that the outfall is generally benign, ongoing outfall monitoring provides surveillance for unusual events and contributes to understanding of regional factors affecting plankton blooms. Late summer ctenophore blooms may affect zooplankton and in turn planktonplankton (recent phenomena), and variable fall diatom bloom dynamics across the data set. This paper will explore the interplay between the regional/hemispheric factors and phytoplankton chlorophyll biomass of 15 plus years of measurements.

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TEMPORAL TRENDS IN SEABIRDS NEAR THE PribILOF ISLANDS

We examined trends in the abundance of 12 species of marine birds around the Pribilof Islands in southeastern Bering Sea during the 1970s-2004. These species, which include Pacific loons, short-tailed shearwaters, forster's terns, red phalaropes) were scarce in the 1970s, were abundant in the 1980s, and declined in abundance in the 1990s and in 1999-2004. Planktivorous alcids that breed at the Pribilof Islands showed a remarkable 4x increase from the 1970s to the 1980s, and a rapid decline after the 1980s. In contrast, the abundance of piscivores (kittiwakes and murres) was high in the 1970s and declined thereafter. In 1999 and 2004, the total number of all seabirds at sea around the Pribilof Islands was well below the numbers seen in any other survey period. We hypothesize that these changes in the abundances and types of seabirds present through time reflect changes in the structure of the marine ecosystem of the eastern Bering Sea shelf. We suggest that changes in pathways of energy flow may be responsible for these shifts, although a decline in primary production cannot be ruled out.

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SUB-TIDAL VARIABILITY IN THE HUDSON RIVER PLUME AS A RESULT OF HIGH-FREQUENCY FORCING

During the course of Lagrangian Transport and Transformation Experiment (LaTTE) in 2004 and 2005, the structure of the Hudson River plume was highly variable. Although forcing due to variations in discharge, low-frequency winds, and ambient shelf circulation are important, high-frequency forcing and sub-tidal response of the plume is apparent in the observations. Tidal mixing in the estuary manifests as fortnightly variability in plume stratification in the 2005 and 2006 mooring records. Diurnal wind variability related to the sea-land breeze system (SLBS), while episodic, accounts for up to 50% of the energy in surface currents in the New York Bight Apex at times. Regional Ocean Modeling
The applicability of a two-layer theory for abyssal current steering of upper ocean current pathways is investigated using HYCOM simulations with high vertical resolution (15-32 layers). This theory has the advantage that it is relatively easy to apply in simulations by comparing model results with oceanographic data from stratified basins. However, it is not as easy to apply to observations in the real ocean. This is because the two-layer theory is based on the assumption that the ocean is stratified, which is not always the case. Additionally, the two-layer theory does not take into account the effects of wind stress and tides, which are important factors in the ocean circulation. To address these limitations, we have developed a new model that incorporates a more realistic representation of the ocean circulation.

We demonstrate how our model can be used to predict the effects of wind stress and tides on the ocean circulation. Our results show that these factors can have a significant impact on the ocean circulation, and that our model is able to accurately predict these effects. This is important because it allows us to better understand the ocean circulation and its role in the Earth's climate system.

Vertical migrations are recognized as a critical component to the development of realistic models of larval dispersion. Unfortunately, our understanding of these behaviors lags well behind our ability to construct 3-dimensional flow-field models. We demonstrate how laboratory experiments can be used to resolve this problem. We examined the effect of ontogeny and temperature on vertical responses of larval Pacific cod to changes in light levels, but larvae at 4°C were more surface oriented than larvae at 8°C. The behavior of smaller larvae (<10 mm SL) showed no response to varying light levels, but larvae at 4°C were more surface oriented than larvae at 8°C. The behavior of larger larvae was consistent with a diel vertical migration and independent of temperature.

We also apply eight years of discreet-depth sampling in the Gulf of Alaska to validate and scale laboratory observations to the field. Field data for small larvae (c.1 mm) failed to show indications of vertical migration, a finding that was consistent with the laboratory results. However, field data were insufficient to determine patterns of vertical migration in larger larvae. These comparisons demonstrate the utility of independent laboratory observations in developing dispersal projections.

**Meeting Abstracts**

**ASLO/AGU/TOS/ERF**

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**ABYSSAL CURRENT STEERING OF UPPER OCEAN CURRENT PATHWAYS IN AN OCEAN MODEL WITH HIGH VERTICAL RESOLUTION**

The applicability of a two-layer theory for abyssal current steering of upper ocean current pathways is investigated using HYCOM simulations with high vertical resolution (15-32 layers). This theory has the advantage that it is relatively easy to apply in simulations by comparing model results with oceanographic data from stratified basins. However, it is not as easy to apply to observations in the real ocean. This is because the two-layer theory is based on the assumption that the ocean is stratified, which is not always the case. Additionally, the two-layer theory does not take into account the effects of wind stress and tides, which are important factors in the ocean circulation. To address these limitations, we have developed a new model that incorporates a more realistic representation of the ocean circulation.

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**APPROPRIATELY DETAILED SURVEYS FOR EFFECTIVE SEAFLOOR SENSOR INSTALLATIONS**

Appropriate surveys of the seafloor where ocean observatories will be installed are critical to the success of these projects. The sensors must be located in an environment matched to their scientific objectives, and then installed and potentially serviced in a way that will not disrupt the provide energy for the upward transport of organic carbon. This is required for the deployment, there should be no interaction. The systems are generally designed to work in this pristine environment for on the order of 25 years. Initial design of any observatory requires swath bathymetry surveys and full seafloor characterization of a regional basin. In deep water, regional surveys from surface vessels might be followed by high-resolution deep-towed surveys. In most cases ultra-precise mapping using an AUV will then be needed for the waters near the sensors. The greatly increased cost of acquiring high-resolution data mandates that survey programs be designed well in advance of final observatory design and installation. This paper illustrates the resolution, and costs, of various survey techniques that need to be applied to the various stages of observatory implementation.

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**VARIABILITY IN THE LIPID CLASS AND ISOTOPIC COMPOSITIONS OF THE HAWAIIAN CORAL, PORITES COMPRESSA, AND ITS SYMBIOTIC ZOOXANTHELLAE**

Lipid class and stable carbon and nitrogen isotopic variations of coral host tissue and zooxanthellae were examined at a range of spatial scales and two depths in order to understand the basic biogeochemistry of the Hawaiian coral Porites compressa in Kaneohe Bay, HI. Host and zooxanthellae tissues have significantly different lipid class compositions, which wax esters dominate host tissues and triglycerides dominate zooxanthellae tissues. Polar lipids, fatty acids, alcohols, and sterols are less abundant in both tissues. Host lipid concentrations were relatively homogeneous over all spatial scales (cm to km) where as zooxanthellae lipids exhibit heterogeneity. Host and symbiont 13C signatures correlate at reef crest suggesting zooxanthellae and host carbon cycles are tightly coupled. At 4m, however, depleted 13C values in host tissues suggest corals must supplement their carbon supply via heterotrophy. At the largest spatial scales (between reefs) significant variation in 13SN indicates regional variations in nitrogen input. Thus, both the variability within a system as well as the dynamics of the coral-zooxanthellae relationship must be considered when defining biogeochemical and trophic dynamics within the coral ecosystem.

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**COMBINING LABORATORY AND FIELD OBSERVATIONS TO MODEL VERTICAL MOVEMENTS OF LARVAL PACIFIC COD: EFFECTS OF ONGENETY, TEMPERATURE, AND LIGHT**

Vertical migrations are recognized as a critical component to the development of realistic models of larval dispersion. Unfortunately, our understanding of these behaviors lags well behind our ability to construct 3-dimensional flow-field models. We demonstrate how laboratory experiments can be used to resolve this problem. We examined the effect of ontogeny and temperature on vertical responses of larval Pacific cod to changes in light conditions in vertical columns. Smaller larvae (<10 mm SL) showed no response to varying light levels, but larvae at 4°C were more surface oriented than larvae at 8°C. The behavior of larger larvae was consistent with a diel vertical migration and independent of temperature.

We also apply eight years of discreet-depth sampling in the Gulf of Alaska to validate and scale laboratory observations to the field. Field data for small larvae (c.1 mm) failed to show indications of vertical migration, a finding that was consistent with the laboratory results. However, field data were insufficient to determine patterns of vertical migration in larger larvae. These comparisons demonstrate the utility of independent laboratory observations in developing dispersal projections.

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**RADICarbon Evidence for lateral supply of organic CARRON to the DEEP CANADA Basin**

Understanding the processes driving the carbon cycle in the Arctic Ocean is of fundamental importance for assessing the impacts of the predicted rapid and amplified anthropogenically-driven climate change in this critical region. However, our knowledge of these processes, especially in the permanently or seasonally ice-covered deep Arctic basins, is severely hampered by the paucity of information on fluxes and fate of biogenic materials exported from surface waters to the interior basins. We analyzed sinking particle samples intercepted by a time-series sediment trap deployed in the abyssal Canada Basin (3067m) in order to examine carbon export to the deep Arctic Ocean. Old radiocarbon ages (mean ~ 1900 14C years) of organic carbon, abundant lithogenic material (~80%), and mass flux variations temporally decoupled from the cycle of primary productivity in surface waters suggest that, unlike other ocean basins; the majority of the organic carbon on export in the deep Canada Basin is laterally advected from the surrounding margins. Whether this carbon derives from the continents or reflects marine productivity over the shelves and marginal seas remains unclear. Nevertheless, predicted changes in physical forcing on the Arctic Ocean suggest that this situation may change dramatically in the near future with uncertain biogeochemical and ecological consequences.
VORTEX-VORTEX MERGER AND INTERACTIONS BETWEEN THE LOOP CURRENT EDDIES

We describe vortex-vortex merger and interactions observed between the Loop Current Eddies (LCE) in the Gulf of Mexico (GoM) using satellite altimetry and HYCOM. GoM altimetry exhibits that two LCEs located in the western and central GoM ('west' and 'east' vortices) frequently collide and merge into a giant LCE, however, occasionally they remain/move apart without merger. Isolated vortex-vortex interaction models (two LCE-types, not embedded at different initial positions) reveal that vortex-vortex merger occurs when (1) the east vortex is bigger/stronger than the west vortex, (2) the west vortex strongly reflects offshore due to vortex-topography collapse and 3) the west vortex is strongly distorted and core-strained out by vortex-topography interactions. Vortex distortion/erosion due to vortex-topography collapse play a significant role in the merger. During the merger, the east vortex generally attracts and absorbs the west vortex, inducing vigorous momentum and mass transports. On the other hand, two approaching vortices occasionally remain apart or 'repose' to the opposite direction when the west vortex has strong swirl currents without distortion, which repels the east vortex south or north. During the vortex-vortex interaction, filaments detached from the west vortex often attach to the east vortex, producing a northward drift of the east vortex. We present examples of vortex-vortex merger and 'repose' from a realistic GoM model.

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GEOCHEMICAL DATA AND SOURCE OF ORGANIC MATTER FROM THE SURFACE SEDIMENT OF THE TWO BAYS OF KOREA

Surface sediments of the two bays (Gwangyang and Masan) of Korea were conducted to estimate the sedimentary environments and to determine the source of organic matter (OM), the portion of terrestrial OM. Total 75 surface sediments from Gwangyang and Masan bay were analyzed and compared with C/N ratio of OM and other inorganic geochemical data. Analytical values of the carbon isotope of OM in Gwangyang bay ranges from -25.83% to -20.26%, and in Masan bay sediment it ranges from -20.76 to 19.92%. The terrigenous portion of OM was calculated by using 13C content as -28% in 13C CN. The terrigenous OM content is -27% in 13C CN. It ranges from 20.01 to 19.7% in Gwangyang bay (ave: 21.75%), and from 54.69 to 13.17 in Masan bay (ave: 25.18). Therefore, relatively large portion of terrigenous OM was supplied into the bay sediments. Especially, terrigenous OM mainly contributes to total organic carbon content near the river mouth area. The ratio of the OM also exceeds 10 in several samples indicating clear contribution of terrigenous organic matter input. However, both C/N ratio and carbon isotope of organic matter do not matched well in terms of terrigenous signals. This may be due to the sedimentary environments. In both bays, anoxic environment has been prevailed due to the sluggish ventilation and shallow water depth. The concentration redox-sensitive elements and other geochemical data support severe anoxic sedimentary environment.

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COMPARING KELP COMMUNITIES ON THE INNER AND OUTER COASTS OF SOUTHEAST ALASKA

Variation in physical and biological processes in coastal ecosystems determines kelp productivity and influences community structure. Identifying regional patterns of community structure is necessary to interpret coastal ecosystem response to climate change. We compared kelp communities on the inside coast of southeast Alaska near Juneau, and the outer coast near Skitka. Greater seawater exchange and reduced freshwater runoff at the outer coast may result in greater kelp biomass, density, and diversity; however kelp communities have not been comparatively studied between subregions of southeast Alaska. Kelp communities were surveyed at nine sites in each location using SCUBA transects at 6 m and 12 m depths to characterize physical habitats, and quantity kelps. Water quality parameters were measured using a CTD. Kelp abundance was greater at 6 m in both locations, but there was no significant difference in kelp abundance or density between locations. Species richness and diversity were greater on the outer coast, although community evenness was similar between locations. Patterns of kelp community structure are evident within and between these coastal subregions of southeast Alaska.

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NITROGEN FIXATION IN THE MEDITERRANEAN SEA

The Mediterranean Sea is an oligotrophic basin characterized by low nutrient levels and unusually high NO3/PO4 molar ratios in the deeper layers, that reach the maximum (N/P ≈ 28) in the Eastern Mediterranean. An external nitrogen source needs to be claimed in order to explain the nitrogen excess. Pantoja et al. (2002) found that the 15N/14N natural abundance in particulate and dissolved inorganic nitrogen display low values, suggesting an external source of “light” nitrogen source. Two hypotheses can be formulated to explain the west vortices: (i) nitrogen fixation from atmospheric deposition and/or (ii) atmospheric molecular nitrogen throughout nitrogen fixation. During TRANSMED oceanographic cruise carried out in

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Coral reefs are an essential element of the economies, cultures and ecology of the Pacific Islands of Micronesia. While traditional stewardship practices have served to protect coral reefs and their related resources for generations, recent development activities and outside influences have threatened the sustainability of reef fisheries and have led to the regional decline of coral reef health and resilience. Poor land use practices within inland watersheds have led to the degradation of coastal reefs, with an accompanying cost to present populations of islanders and are threatening the legacy to be left to future generations. There is a need for modern science to help guide the management of human activities responsible for coral reef decline, and scientific data need to be presented to stakeholders and leaders in a form and format that can be used to develop and implement sound conservation policies. The integration of modern scientific techniques with traditional management activities has proven to be effective in several villages in Micronesia, and this experience serves a model for broader conservation efforts regionally and internationally.

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**MODELING THE DYNAMICS AND TRANSPORT OF SOUTHERN CALIFORNIA STORMWATER PLUMES**

In the highly urbanized region of Southern California stormwater plumes carry considerable amounts of known and unknown pollutants, and have significant effects on coastal water quality. Understanding the dynamics and transport of these stormwater plumes is essential to proper management of coastal resources. The Regional Ocean Modeling System (ROMS) is used to investigate statistically the temporal and spatial variability of typical coastal plumes in response to the ever-changing ocean environment. Plume persistence and characteristic directions of transport are identified. Plume dispersion and dilution rates are used to compute the cumulative impact of stormwater pollutants, such as nutrients. The results of this investigation are compared with field measurements and satellite imagery of stormwater plumes.

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**COCCOLITHOPHORE CALCIFICATION UNDER HIGH CO2**

From the mid-Mesozoic, marine calcifying phytoplankton, the coccolithophores, have been major calcium carbonate producers in the world's oceans. It has been suggested that the increasing anthropogenic CO2 absorbed by the oceans will cause ‘ocean acidification’ and that this will decrease calcification in coccolithophores. Recent results show that, in a scenario where the CO2 partial pressure in the world's oceans is twice that of pre-industrial concentrations compared to current levels, calcifying phytoplankton will double the rate at which they calcify and photosynthesize. Consequently, calcium carbonate to particulate organic carbon ratios are comparable across CO2 partial pressures ranging from pre-industrial to end of the century projections. These trends are consistent with those seen in the geological record of the calcified phytoplankton community in past periods of CO2 increase.

Our findings have significant implications for biogeochemical modeling of future oceans, and highlight acclimation and evolutionary versatility of a major calcareous group to past and future ocean acidification.

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**PERFORMANCE OF THE 2ND ORDER TURBULENCE CLOSURES IN THE RED SEA OVERFLOW**

Mixing between overflows and ambient water masses is a critical problem of deep-water formation in the downwelling branch of the meridional overturning circulation of the ocean. Modeling approaches that have been tested so far rely either on algebraic parameterizations in hydrostatic ocean circulation models, or on large eddy simulations that resolve most of the mixing using nonhydrostatic models. In this study, performance of different closure models (k-ε, k-ω, KPP; and Mellor-Yamada) are evaluated by conducting numerical simulations of the Red Sea overflow and comparing the results to those observed in the Red Sea Outflow Experiment. We also use a new k-ε turbulence model without any closure assumptions to model the Red Sea Outflow. The results of this investigation are compared with field measurements of velocity and temperature at the outflow. It is found that most of the two-equation turbulence models capture the basic structure of the overflow, consisting of a well-mixed bottom layer (BL) and entraining intermediate layer (IL). KPP model leads to less mixing and thin IL; however Mellor-Yamada leads to high mixing and BL signal becomes weak. The other models including the new k-ε give reasonable result in error analysis with respect to the observations.

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**A TOOL FOR EARLY DETECTION OF GLOBAL-SCALE CHANGES IN MARINE CALCIFICATION**

Ocean acidification is likely to impact calcification rates in many pelagic organisms, which may cause significant changes in marine ecosystem structure. We examine changes in marine CaCO3 production using the global biogeochemical ocean model HAMOCC in combination with observational data. Calcification in different organisms shows a wide range of sensitivities to saturation state. Therefore, we test different future calcification scenarios running the model until the year 2300 forced with anthropogenic CO2 emissions. Two assimilation systems based on a suboptimal extended Kalman filter have been developed to simultaneously assimilate physical and biochemical data into a complex ecosystem model of the Eastern Mediterranean. The three-dimensionnal ecosystem model is composed of two on-line coupled sub-models: the Princeton Ocean Model (POM) and the European Regional Seas Ecosystem Model (ERSEM). The filter is a variant of the extended Kalman filter which operates with low-rank error covariance matrices to reduce computational burden. Two different approaches have been considered: the “joint approach” for the “dueling filter”. In the first approach, one filter is used in which the state vector of the filter is composed of all prognostic variables of POM and ERSEM models. Basically, the numerical models are integrated forward in time to produce the (physical and biochemical) forecasts. The observations are then assimilated jointly to correct all forecast variables using the cross-correlations between all physical and biochemical forecast errors, which simultaneously provides the analyses for the physics and for the ecology. The dual approach consists of two filters, operating separately on the physics and on the ecology. We describe the two assimilation systems and discuss results of assimilation experiments with a coupled POM/ERFM model of the Mediterranean Sea ecosystem.

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**LAGRANGIAN DATA ASSIMILATION: METHOD, APPLICATION AND STRATEGY**

The Lagrangian data assimilation (LaDA) is a method for the assimilation of Lagrangian observations directly into the model. By augmenting the model state vector with the coordinates of the Lagrangian instruments and computing their trajectories based on the model velocity, the LaDA removes the need for any commonly used approximations to transform the Lagrangian observations into the Eulerian velocity observations. We demonstrate the LaDAs efficacy using the ocean applications. By considering a volume of influence, we examine how and to what extent the LaDA propagates the information horizontally and vertically. When the drifter deployment locations are judiciously chosen, the LaDA is strikingly effective in both estimating the large-scale ocean circulation and tracking the ocean eddies. Using Lagrangian analysis based on dynamical systems theory, we present a strategy for observing system design that maximizes the impact of Lagrangian observations.

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**COMBINING MODERN SCIENCE AND TRADITIONAL KNOWLEDGE FOR CORAL REEF PROTECTION IN MICRONESIA**

Coral reefs are an essential element of the economies, cultures and ecology of the Pacific Islands of Micronesia. While traditional stewardship practices have served to protect coral reefs and their related resources for generations, recent development activities and outside influences have threatened the sustainability of reef fisheries and have led to the regional decline of coral reef health and resilience. Poor land use practices within inland watersheds have led to the degradation of coastal reefs, with an accompanying cost to present populations of islanders and are threatening the legacy to be left to future generations. There is a need for modern science to help guide the management of human activities responsible for coral reef decline, and scientific data need to be presented to stakeholders and leaders in a form and format that can be used to develop and implement sound conservation policies. The integration of modern scientific techniques with traditional management activities has proven to be effective in several villages in Micronesia, and this experience serves a model for broader conservation efforts regionally and internationally.
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LAYERED ISOPYCNAL INTRUSIONS FROM A SLOPING BOUNDARY
Motivated to understand better the fate of baroclinic waves impinging on sloping boundary areas, fluorescent dye was released at a point ~15m above the critical sloping boundary of a Scottish fjord (maximum depth=150m) and tracked for four days with CTD/fluorometer casts at an average speed of 5m/s across the basin. Shear micro-stratification measurements were made, and a thermometer mooring deployed. The dye spread symmetrically in the vertical (Kz=1.5–10-4 m/s2) until the lower edge of the patch became influenced by the bottom boundary layer (BBL). The shallower portion of the BBL-influenced dye spread rapidly upslope (~1 km/day) in a 3 metre thick layer influenced by non-isopycnal distortions. The deeper portion of the BBL-influenced dye detached from the boundary and intrusted into the interior at a slower rate (~0.5 km/day) in three distinct layers along isopycnal surfaces. At the depth of the intrusions (50 to 70m) the baroclinic wave field was characterised by a clear M2 signal. It is argued that the layered intrusions result from the gravitational collapse of mixing patches created by the trapping of baroclinic energy on the critically sloping boundary.

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ACCURATE TIDE MODELING AND SEMIDIURNAL SEICHS IN SOUTHEASTERN ALASKA
Oceanic tides in the foidic system of Southeastern Alaska are realistically simulated by a barotropic model. The simulated tides strongly depend on the seafloor bathymetric data sets. In the case of the GINA bathymetric data (Lindquist et al., 2004), the major M2 component tides are simulated with errors less than ten percents of the observational tides. Sea level in the vicinity of the Chatham Strait resonates with semidiurnal tides. The simulation with the ETOP02 bathymetric data (Smith and Sandwell, 1997) gives unrealistically amplified sea level response to the semidiurnal tides in the strait, since depths based on ETOP02 are shallower than those based on the GINA data sets by several tens meters in large areas of the Inner Passage. Especially in the head of the Chatham Strait, the M2 tide is amplified by several tens centimeters (i.e. a few tens percents of the observational M2 amplitude).

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FISH EMBRYOS AS SENTINELS FOR UNEXPECTED HUMAN HEALTH THREATS
Developmental biology and genetics have revealed the high degree of evolutionary conservation among vertebrates. Thus the embryos of a fish (Danio rerio, zebrafish) have become a powerful tool for studying the molecular basis of human disease. As humans are difficult to study in lab, so are many native fish species. Zebrafish thus provide a powerful tool for the study of fish health as it relates to conservation biology and coastal resource management. Polycyclic aromatic hydrocarbons (PAHs) derived from fossil fuels are among the most abundant pollutants on the planet. To gain insight into how PAHs affect fish health, as demonstrated by the impacts of the Exxon Valdez oil spill on species such as pink salmon (Oncorhynchus gorbuscha), we are analyzing the effects of PAHs on zebrafish embryos. These studies identified the heart as a major target for tricyclic PAHs such as phenanthrene, which are very abundant in both water and air. Because the candidate molecular targets are conserved between fish and human hearts, tricyclic PAHs are a likely contributor to diseases, which are very abundant in both water and air. Air and concentration of DOM was applied to seawater samples from Effingham Inlet, British Columbia. To trace chemical transformations within the water column, DOM samples were characterized with total carbon and phosphorus magnetic resonance (NMR). The molar ratio of carbon to phosphorus in the one DOM sample analyzed to date is 235:1. This ratio is essentially identical to the average carbon to phosphorus ratio of 211:1 seen in open ocean DOM. Although DOM elemental ratios are similar in estuarine and open ocean samples, NMR analyses reveal large differences in the relative abundance of compound classes. Effingham Inlet samples contained phosphate esters (85-86%), phosphonates (3-5%) and, notably, polyphosphates, which accounted for 10-11% of the total dissolved phosphorus pool. In comparison, open ocean DOM samples are comprised of approximately 75% phosphate esters, 25% phosphonates, and have little or no polyphosphates present. Carbon, NMR spectra of Effingham Inlet samples indicate enrichment in alkyglycerol carbon and depletion in carboxydrate carbon relative to open ocean DOM samples.

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INCREASING IMPACT AND REDUCING CHALLENGES OF AQUATIC SCIENCE EDUCATION AT THE UNDERGRADUATE LEVEL
A multiple-year assessment on a local constructed wetland has provided the framework to advance three important goals in aquatic sciences education at the undergraduate level: 1) expand interdisciplinary thinking in students and faculty, 2) promote females in science, and 3) foster ownership of learning by taking the research to the classroom, and the classroom to research. A three-way collaboration between chemistry, civil engineering, and applied biology faculty has led to students being trained more deeply in their own areas of expertise and broadly among the three disciplines. Framing the project in terms of human and environmental benefit has attracted many female students, far overrepresenting females relative to the student body. Techniques, tools, and skills resulting from the procedures developed by the undergraduate research collaborators have been incorporated into general classroom use, and classroom projects have been designed to model research. Although several challenges have been encountered, students have proven to be remarkably resilient, with most participants maintaining a long term commitment to the project and intending to pursue careers in the environmental sciences.

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ON THE EFFECT OF A SILL ON DENSE WATER FORMATION IN A MARGINAL SEA
Dense and intermediate water formation in the North Atlantic, in the Nordic and Labrador Seas, respectively, contribute to the global ocean’s overturning circulation and poleward heat transport. One major difference between these two basins is the due to the Greenland-Scotland Ridge which isolates the deep waters of the Nordic Seas from those of the North Atlantic. In this study, we investigate the role of the sill in setting the properties of the water mass transformed by comparing convection in an idealized, semi-enclosed basin, subject to surface cooling, with and without a sill that separates it from the open-ocean. This study utilizes both numerical and theoretical tools to extend previous studies that addressed this problem in a sill-less basin. We find that denser (colder) waters are formed in and exported from a marginal sea with a sill compared to an identical basin with no sill. Dynamically, the sill impacts the convective process within the marginal sea both locally, by limiting the advection of heat into the basin (from the open-ocean), and non-locally by affecting the width and depth of the boundary current, which alters the stability of the boundary current as it flows around the marginal sea. While idealized, we believe these experiments capture the basic features of convection in the Nordic Seas and, furthermore, support the distinction between the dense waters formed in the interior of the basin and those exported by the outflows.

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CONSEQUENCES OF INCREASED MOBILITY AND QUICKER DEVELOPMENT IN POND PLANTS, S. C. L., Georgia Institute of Technology, Atlanta, USA, ingel@seas.gatech.edu; Jackson, C. L., Georgia Institute of Technology, Atlanta, USA, dstl@seas.gatech.edu

COMPOSITION AND TRANSFORMATION OF ESTUARINE DISSOLVED ORGANIC MATTER FROM SAMPLES RECOVERED USING COMBINED ELECTROLYDIALYSIS AND REVERSE OSMOSIS
A new high yield technique combining electrolydialysis and reverse osmosis for the recovery and concentration of DOM was applied to seawater samples from Effingham Inlet, British Columbia. To trace chemical transformations within the water column, DOM samples were characterized with total carbon and phosphorus magnetic resonance (NMR). The molar ratio of carbon to phosphorus in the one DOM sample analyzed to date is 235:1. This ratio is essentially identical to the average carbon to phosphorus ratio of 211:1 seen in open ocean DOM. Although DOM elemental ratios are similar in estuarine and open ocean samples, NMR analyses reveal large differences in the relative abundance of compound classes. Effingham Inlet samples contained phosphate esters (85-86%), phosphonates (3-5%) and, notably, polyphosphates, which accounted for 10-11% of the total dissolved phosphorus pool. In comparison, open ocean DOM samples are comprised of approximately 75% phosphate esters, 25% phosphonates, and have little or no polyphosphates present. Carbon, NMR spectra of Effingham Inlet samples indicate enrichment in alkyglycerol carbon and depletion in carboxydrate carbon relative to open ocean DOM samples.
such as reduced water viscosity), these changes will enhance the mobility of fish larvae. A model of the pelagic phase of fish, which represents larval behavior explicitly, is used to simulate individual trajectories in a typical coastal environment. Rather than implementing the very few things we know about larval behavior, an optimization method allows to compute the best behavioral rules given a goal (i.e. recruitment) and realistic constraints (e.g. swimming speeds, larval duration, etc.). This model is used to examine the influence of enhanced swimming abilities and shorter larval durations on the ability of larvae to self-recruit. The optimization method as well as the consequences on population connectivity of predicted changes in recruitment dynamics are discussed.

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VARIATIONS IN THE RESERVOIR AGE OF THE NE PACIFIC OVER 6000 YEARS

SUGGESTS CHANGES IN OCEAN CIRCULATION – LINKED TO CLIMATE?

Variations observed in the reservoir age of the ocean from a single site over time may indicate differences in ocean circulation, possibly reflecting changes in climate. Long-term data from single or closely associated sites in the NE Pacific are rare. We add to that meager body through data obtained from Mink Island, an archeological site in Katmai National Park & Preserve, located in the Shelikof Strait in the northern Gulf of Alaska. We compare 13C dates of paired marine and terrestrial material selected from different climate periods over the last 60,000 years. The dated terrestrial material is chosen from human occupation surfaces, while the marine dates are from midden shells of the bivalve, Saxidomus giganteus, surveyed to be at the same excavation level. A rigorous examination of the archeological context is being used to validate the pairings. The differences between the marine and terrestrial changes over time indicate that there is not a constant reservoir age for this NE Pacific location. These differences suggest that ocean circulation has changed over the last 60,000 years, possibly in response to climate.

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SATELLITE DETECTION OF SEASONAL AND SECULAR CHANGE OF GLOBAL OCEAN BIOME DISTRIBUTIONS

Historically, the ecological concept of biome has been applied to static global ocean climatologies with the purpose of describing the basic biogeography of marine systems. However, because these biogeographical maps are not time-resolved, the seasonal and secular changes in ocean biome distribution have been missed. In this work, we use a biome classification scheme that is based on time-resolved satellite imagery. This method allows us to see seasonal and secular changes in global ocean biome distributions. This technique has been independently validated with in situ data. We find strong seasonal signals in biome distributions in all areas of the global ocean and find secular trends in the area of certain ocean biomes. For example, our analysis suggests that the most oligotrophic biomes in the global ocean may be increasing in size. Understanding the long-term secular trends in ocean biomes has implications for the future of global ocean primary production. In addition, we analyze the tempo-spatial variability of biomes to identify the most variable regions of the global ocean.

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DIFFERENT DISCHARGE MECHANISMS OF WARM WATER BETWEEN NORTHERN AND SOUTHERN PACIFIC OCEANS DURING EL NINO

The discharge of warm water volume (WWV) in the tropical Pacific related with El Niño/Southern Oscillation (ENSO) is a key to understand the termination of ENSO. We have investigated interannual variation of the WWV transport above the 20°C isotherm by diagnosing the observed data and results from a numerical experiment. The results indicate that WWV transports in the western region play different roles in the northern and southern hemispheres. The transport across 8°S in the western region counterbalances the interior transport, and both are approximately explained in terms of the Sverdrup theory. In contrast, the boundary transport across 20°F does not balance because of remote effect by Rossby waves. Negative wind stress curl anomaly generated in the northern off-equatorial region after the mature state of ENSO deepens the 20°C isotherm depth that generates anomalous northward transport. Hence imbalance of the WWV transport between the western boundary and interior in the northern hemisphere has more impact on the variability of WWV in the tropical Pacific.

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RECENT TRENDS OF THE VERTICAL DISTRIBUTION AND THE SIZE COMPOSITION OF CHLOROPHYLL- A IN THE WESTERN NORTH PACIFIC REGION

From the last several decadal data of the vertical distribution and the size composition of chlorophyll-a (Chl-a) in the western North Pacific, significant trends of three relating indices with Chl-a at summer season were found. (1) the proportion of Chl-a in the surface layer to that of the whole water column was linearly decreased by 0.4 % in the subtropical area along 137°E (STA137) and by 2.3 % year^-1 in the Kuroshio Extension area along 175°E (KEA175), respectively, (2) the depth of subsurface Chl-a maximum increased by 0.4 m year^-1 in STA137 and 2.6 m year^-1 in KEA175, and (3) larger-sized Chl-a (larger than 3 µm) decreased at the ratio of 2.5 % year^-1 in KEA175. We also found that the ratio of bio-genic opal/ biogenic CaCO3 in the sinking flux decreased -0.015 year^-1 in the subtropical region from 1997 to 2005. These trends indicate the possibility that larger phytoplankton, such as diatoms, has been decreasing during the past decade in the western North Pacific at least in the summer.

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TREND OF DIC INCREASE IN THE WESTERN NORTH PACIFIC ALONG P9 AND P13

Trend of DIC increase in the WP core cruises along the same lines conducted by JMA and that of the WEST-COSMOS project, we have analyzed the decadal trend of total dissolved inorganic carbon (DIC) on various isopycnic surfaces in the northern limb of the subtropical gyre. The preformed NDIC (=DIC - 117 –170AOU/45) at layers ≤ 26.7 at 165˚S and 0 ≤ 26.1 at 137˚E are increasing at a rate of +0.7 to +1.2 µmol kg^-1 year^-1 that are in near equilibrium with the atmospheric CO2 increase. The rate of increase of preformed NTICO reduced moderately to +0.4 to +0.6 µmol kg^-1 year^-1 at 26.2 ≤ 26.5 at 137˚E, and it abruptly decreased in deeper layers and no significant increase was detected below 27.0 in both sections.

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THE COLD-WATER BELT OFF THE SOYA WARM CURRENT IN THE NORTHEAST COAST OF HOARKAIDO

The cold-water belt (CWB) is frequently appeared off the Soya Warm Current in summer. The formation mechanism of the CWB has two formation mechanism (Ishizu et al., 2017). One is the upwelling of the so called “Sakhalin current” by topographic effect, the other is the upwelling in the northeast coast of Hokkaido, which is formed by the convergence due to the bottom Ekman transport of strong wind/wave forcing during storms. Net horizontal transport during supercell events is approximately downwind and associated cross-shelf transport is dependent on the angle between storm wind direction and shelf orientation. Net cross-shelf transport will be mediated by seasonal variability of storm frequency and directionality. With spring storm winds typically from the NE off much of the US east coast, supercell events often directed onshore transport across the inner shelf, acting as vectors for springtime movement of bioactive material towards the coast. Year-class success of fish stocks that spawn near the shelf break but rear in coastal

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IMPACT OF INDIAN OCEAN DIPOLE ON INTRASEASONAL ZONAL CURRENT IN THE EASTERN EQUATORIAL INDIAN OCEAN

Impact of the Indian Ocean Dipole (IOD) on intraseasonal zonal currents in the eastern equatorial Indian Ocean is evaluated in an eddy-resolving OGCM. A neural network pattern recognition approach, so called self-organizing map (SOM), is applied to fourteen-year output fields from 1990 through 2003, which capture weak positive IOD event in 1991, strong positive IOD event in 1994, strong positive IOD event co-occurred with El Niño in 1997/98, and two negative IOD in 1996 and 1998-1999. The analysis identified change in dominant mode of variability associated with the IOD events. During positive IOD events, the intraseasonal zonal currents are mostly dominated by higher modes, while the first two modes become more dominant during negative IOD events. One potential contribution factor to these interannual variations is an apparent shoaling of psy-
OCEAN CARBON PUMPS AND AIR-INSECT DISSOLVING OF CO2. Dissolved Inorganic Carbon in surface waters can be significantly out of equilibrium due to the finite timescale of air-sea CO2 exchange. Surface dissolubility is carried into the thermocline and deep ocean through water mass formation and ventilation processes. This “dissolution carbon pump” can significantly impact the global ocean carbon storage. We formulate a highly idealized model to illustrate how it modulates solubility and biological carbon pumps and impacts on atmospheric CO2. The magnitudes of surface dissolution are controlled by the balance between entrainment, surface residence time, air-sea heat and gas exchange, and export production. The theory predicts that the dissolution pump amplifies the effect of soft-tissue carbon pump by up to a factor of 2. For example, if the sea ice cover can reduce the effect of soft tissue pump by increase air-sea dissolution. The theoretical predictions are supported by a suite of sensitivity experiments using a global ocean circulation and biogeochemistry model. These results highlight the importance of air-sea CO2 equilibration in the regions of water mass formation and its impacts on the oceanic carbon inventory.

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SUBMEOSESCALE/MESOSCALE SYNTHESIS BASED ON DATA-DATA AND DATA-MODEL FUSION INVOLVING NON-PROBABILISTIC A PRIORI INFORMATION Novel approach for synthesis of a coastal ocean state through data-data and data-model fusion is presented. The fusion process is formulated as a global optimization problem for which direct search for the optimal solution (corresponding to enhanced estimate of environment) is performed under control of non-probabilistic a priori information coming from the historical data, different sensors, model simulations and expert opinions. Methods, based on control analysis, apply to sensor fusion, aggregation of expert opinions as well as merging databases. The approach represents the non-probabilistic a priori information and uncertainty associated with it through the so-called fuzzy sets. That results in convenient and fast numerical algorithms for searching the global extremum of the objective functions through high-performance parallel computing, allows using non-traditional information, such as synthetic aperture radar images and expert opinions, and combining pieces of information, which contradict one to another. The approach is targeted to synthesis of submesoscale/mesoscale fronts, jets, eddies and islands waters through fusing high-resolution satellite data and lower resolution in-situ data, as well as satellite data and numerical simulation results for Central and Southern California.

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PROPAGATION OF SEASONAL SIGNAL IN THE ATLANTIC WATER LAYER IN THE ARCTIC OCEAN Warm and salty water of Atlantic origin (AW) enters the Arctic Ocean through the Fram Strait. In Fram Strait and north of Svalbard AW experiences strong seasonal variations due to the large volume of meltwater entering the Arctic Ocean in the North Atlantic Deep Water formation and the cold Arctic water from the Norwegian Sea. The seasonal cycle of AW is determined by the Svalbard Current, which flows southward on the eastern side of the Svalbard Archipelago. The Svalbard Current interacts with the Arctic Current, which transports cold and fresh water from the North Atlantic to the Arctic Ocean. This interaction results in a strong seasonal cycle of AW in the Arctic Ocean, with warm and salty water entering the Arctic Ocean in the summer and cold and fresh water entering in the winter. The seasonal cycle of AW is influenced by the Arctic Oscillation, which is a major mode of variability in the Arctic climate system. The Arctic Oscillation is characterized by a positive anomaly of atmospheric pressure in the Arctic, which results in increased inflow of Atlantic water to the Arctic Ocean and a negative anomaly of atmospheric pressure in the North Pacific, which results in decreased inflow of Atlantic water to the North Pacific. The Arctic Oscillation is a major driver of climate variability in the Arctic, and its variability is linked to global climate patterns such as the North Atlantic Oscillation and the El Niño-Southern Oscillation.

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KUROSHIO-INDUCED COLD EDDY STREETS IN THE LEES OF ISOLATED ISLANDS A time series of SAR images acquired during summer of 2006 revealed island wakes in the lees of oceanic islands in the north of Japan. The wakes were formed not only of vortices, but also of eddy streets with diameters in the order of the islands. The Kuroshio flowed in the vicinity of these islands in summer of 2006, which indicates that the island wakes were induced by a Kuroshio-island interaction. Satellite sea surface temperature (SST) and Chlorophyll-a (Chl-a) images observed in summer of 2006 showed low SST and high Chl-a wakes, some of which included low SST eddy streets. A numerical simulation was performed to investigate their formation mechanism. The simulation qualitatively reproduced the cold eddy pattern, with eddy-driven mixing developing a mixed layer down to 100m, causing the low-SST island wakes. The shedding frequency and distance of the model-produced eddies were close to those of the Karman vortex theory, suggesting that Karman-type cold eddy streets are commonly formed behind the islands when the Kuroshio passed.

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PROPOSITION OF SEASONAL SIGNAL IN THE ATLANTIC WATER LAYER IN THE ARCTIC OCEAN The accurate representation of the formation of North Atlantic Deep Water (NADW) is challenging for the current generation of climate models. Their resolution is insufficient to depict the entire range of scales associated with the important water mass formation processes. Some of the widely argued reasons for these model deficiencies are the poor representation of overflows, freshwater fluxes, and overestimated ice extent. In the current work we analyze the biases and their origins in NADW formation in terms of location, pathways, and formation rates, in a suite of IPCC model simulations. The fidelity of the models will be assessed with diagnostic metrics such as mixed layer depth, volumetric latitude, and volume fluxes through crucial inter-basin sections. The results will be compared to similar quantities from observational data sets and a finer resolution, coupled ocean-ice simulation, forced with realistic NCEP/NCAR atmospheric fluxes. Special focus will be given to the estimation of the water mass transport over the Nordic Seas, and its sensitivity to changes in the surface heat and freshwater fluxes. Finally, to further understand the inter-annual variability of NADW water mass formation related to the North Atlantic Oscillation we will examine the different ocean states during its opposite phases. Their connection to changes in the atmospheric and sea ice conditions will be investigated.

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NUMERICAL STUDY OF THE BOTTOM-CONFINED INTENSE MIXING USING AN EIKONAL APPROACH Diapycnal mixing is thought to play an important role in global overturning circulation. Previous observations showed that background diapycnal diffusivity was O(10^5 m^2 s^(-1)), an order of magnitude less than required to maintain global overturning circulation (e.g. Gregg, 1987). Recently, enhanced mixing above rough bathymetry is thought to be a strong candidate for the missing mixing that might make up for the lack of diapycnal diffusivity in the thermocline. In such areas, diapycnal diffusivity rapidly increases exceeding 10^4 m^2 s^(-1) as the rough ocean bottom is approached (Polzin et al., 1997). In this study, as a first step to clarify the physical mechanism of bottom enhanced mixing, we carry out a series of numerical experiments using an “Eikonal Approach” (Hessey et al., 1986). It is clearly shown that vertical scales of bottom-confined mixing hotspots are strongly dependent on horizontal wavenumbers of internal tides emanating from the ocean bottom, local density stratification, and latitudes.

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VARIABILITY OF THE CARBON BUDGET AND CONSEQUENTIAL FLUXES AT THE BATS SITE For decades, scientists have been trying to understand the carbon cycle of the ocean by exploring the various processes that regulate carbon within the upper ocean. Typically, the net exchange of CO2 between the atmosphere and upper-ocean is dominated by surface fluxes. Measurements made over the last eleven years from the BATS project have shown some interesting results. Within the DIC pool, long-term changes are evident and represent a significant component of the total carbon pool of the water column. On the other hand, monthly variations in the total carbon budget (0-300m) are large (~1.5 to 3.5 moles C m(-2)) as compared to the assumed total mixed waters (summarized sediment trap fluxes, gas flux and active transport by zooplankton typically < 0.2 to 0.5 moles C m(-2) year(-1)). It appears much of this residual imbalance in carbon change is associated with the physical processes such as mesoscale eddies or horizontal advection rather than biological (i.e. Redfield). We investigate the extent of these physical processes and devise a simple box model approach to investigate the flux variability of the total and individual pools of carbon.
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THE PACIFIC OCEAN SHELF TRACKING PROJECT, PROVIDING A WINDOW ON THE MOVEMENT OF SALMON AND OTHER SPECIES

The Pacific Ocean Shelf Tracking (POST) array is an expanding telemetry array for tracking fish in coastal and freshwater regions of the Pacific Northwest. The array is one of two Census of Marine Life projects focusing on movement of marine organisms using electronic tagging technology. POST’s marine array currently spans over 2,200 km from Willapa Bay, WA, in the north to San Diego, CA, and almost 900 km up the Colombia-Snake River. The acoustic technology used allows the seamless tracking of fish in both freshwater and marine environments. POST has successfully measured the migration paths, swimming speed and estimated survival of migrating salmon smolts from numerous species and stocks in the Pacific Northwest. Adult salmon have been tagged at sea and tracked back to their natal rivers and young salmon have been tagged with ‘sleeping tags’ that turned back on prior to their return spawning migration. The array has revealed remarkable long distance migration of other species such as green sturgeon. POST can help answer questions critical to conservation, fisheries management and the role of fitness in salmon smolt survival.

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REAL-TIME TURBULENT ODD PLUME QUANTIFICATION: II. CORRELATION TO SPECIALIZED BEHAVIORS IN BLUE CRABS

Previous behavioral studies suggest that blue crabs (Callinectes sapidus) utilize chemical signals arriving at their antennules in combination with perception of flow direction (odor-gated rheotaxis) to move towards sources of attractive odors. Experimental evidence also suggests that bilateral comparison of spatially-separated chemosensory must occur simultane-ously with odor-gated rheotaxis for C. sapidus to successfully navigate chemical plumes and locate attractive sources, such as food and mates. To further test these hypotheses, we use three-dimensional laser-induced fluorescence (3DLIF) data to evaluate correlations linking chemical signal properties at the antennules to simultaneous upstream motion and correlations connecting the signal contrast across transversely-separated leg chemosensors to simultaneous side-to-side position adjustments. Preliminary data indicate that the intensity of concentration maxima at the antennules significantly correlates with the duration of upstream motion surges in tracking C. sapidus. Further, the intensity of concentration maxima at the antennules directly correlates with the magnitude of the resulting change in upstream crab walking speed. Additional data evaluating relationships between behavior and signals arriving at the antennules or the leg chemosensors will also be presented.

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SEDIMENTARY SIGNATURES OF PALEOTUSSUNI DEPOSITS IN SRI LANKA

The subsurface of Sri Lankan coastal lagoon sediments include at least two deposits analogous to the 2004 tsunami deposit. Sediment cores collected during two field campaigns to Karagan Lagoon, southeastern Sri Lanka, were sampled along transects parallel and perpendicular to the coastline. The 2004 tsunami layer is characterized by inversely graded coarse quartz sand intermixed with some silt and shell fragments. Based on similar trends in sorting, grain size, and their deposits are 10 cm thick and are composed of inversely graded coarse quartz sand intermixed with some silt and shell fragments.  Based on similar trends in sorting, grain size, and their ages (3690 to 4570 radiocarbon years), these deposits are interpreted to represent paleotsuna layers. These deeper deposits are taken as evidence for tsunamis that occurred during periods of increased sea level. The 2004 tsunami deposit in Karagan Lagoon thus provides a modern analog by which we can interpret the deeper sand layers. Our study provides evidence that there were at least two paleotsunamis that affected Karagan Lagoon during the Holocene.

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TIDAL EFFECTS ON THE MEDITERRANEAN OVERFLOW

We investigate the influence of a barotropic tide on the mixing through the Strait of Gibraltar, and hence on the Mediterranean overflow. A barotropic tide could have several effects on the water flowing through the strait: firstly it could enable dense water to move over the strait, leading to a denser overflow; secondly, the greater kinetic energy could generate more mixing through turbulent bottom stresses, leading to a less dense overflow; and thirdly, the barotropic tide could generate more shear through interactions with topography leading to greater mixing and a less dense overflow. Our initial results suggest that the properties of the outflow are relatively insensitive to the amount and source of mixing in the strait, since there are negative feedbacks in the steep slope region downstream of the strait.

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A TRACER RELEASE EXPERIMENT ON THE EAST PACIFIC RISE (9°N TO 10°N): IMPLICATIONS FOR LARVAL DISPERSION

Tracer release experiments can provide estimates of dispersion of passive particles including some larvae. To investigate dispersion of hydrothermal vent larvae, sulfur hexafluoride was released in a 1.2 km long streak in the axial summit trough (AST) of the East Pacific Rise at 9°N. A survey approximately 40 days after the injection revealed complex horizontal and vertical distributions of the tracer. Only a small percentage of the tracer (about 3%) remained on the ridge crest and this patch was spread along an 80 km section of the ridge with the main concentration near 9°59°N, an Integrated Study Site of the Ridge 2000 program. These observations provide direct evidence of connectivity between vent communities on the ridge. The tracer distribution was heavily influenced by the topography and hydrothermal vent plumes in the area. Analysis of the vertical distribution of the tracer suggests as much as 16% of the tracer was exported in hydrothermal plumes. Comparison of the tracer distribution with a three-dimensional hydrodynamic model prediction is encouraging and gives further insight into the evolution of the tracer patch.

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SEAFLOOR SALINITY AND TRANSPORT: VARIABILITY TO SURFACE FORCING CHANGES

In nature and coupled models, ocean-atmosphere feedbacks of freshwater are mutually compensated by evaporation and precipitation. However, in stand-alone ocean circulation model (OGCM) studies, precipitation is prescribed from forcing datasets and evaporation is computed using a variety surface boundary conditions. In this paper, the sea surface temperature, salinity variability and the associated transports are investigated for many existing forcing datasets and varying boundary conditions using a global primitive equation model. Results show a significant variability in the surface transport with a very different ocean state for the forcing datasets. While a systematic surface salinity and temperature increase is found, the near-dynamic equilibrium solution converges to a fresher state compared to climatology. An additional source of variability in the numerical simulations is the parameterization of ocean mixing. In general, differences due to mixing are large in the near-equatorial band between 30°S and 30°N latitudes. The overall goal of this work is to understand and quantify the role of fluxes in the surface salinity distribution in the ocean in relevance to the upcoming Aquarius SSS mission to be launched in 2009.

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OPERATIONAL OCEAN ENVIRONMENT PREDICTION BASED ON SATELLITE OBSERVATIONS

Satellite observations are a critically necessary piece of information required to forecast the ocean environment for operational uses. Broadly, the ocean processes can be categorized into 1) predictable processes such as tides for which forcing is accurately known and predictions made, 2) deterministic processes such as inundation that given accurate forcing predictions may be constructed, and 3) nondeterministic processes such as mesoscale instabilities for which continual observations are required as small errors grow in time. Within each of these categories, satellites provide necessary data that makes operational prediction possible. For all these, satellite observations are very limited to the ocean surface and are often sparsely distributed through space and time. A coordinated effort must be made to join satellite observations with additional knowledge of the ocean in order to extend the observation influence. This additional knowledge takes the form of understanding the dynamics and representation in numerical model systems, information based on historical data that shows relations between surface and subsurface ocean state and in situ sensors that provide direct surface to subsurface observations. All these components must come together on a daily basis to provide predictions that are used by many government agencies and people for applications from recreation to fishing to search and rescue.

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COMPARISON OF DIFFERENT SUBMESOSCALE LATERAL MIXING SCENARIOS: A NUMERICAL STUDY

Our understanding of lateral dispersion at the submesoscales is largely limited by our incomplete knowledge of the dynamical mechanisms that act at these scales. We compare the characteristics of the lateral mixing produced by a variety of numerically simulated submesoscale flows, including fields of vortices created by the adjustment of mixed-fluid patches, rotating-stratified turbulence and near-inertial waves.
We present here an inversion for surface fluxes of carbon dioxide using the global carbon cycle inversion framework. The inversion is conducted on a semi-enclosed bay in northern Norway. The bay is characterized by a high biological productivity and a complex circulation regime. The inversion is based on a 6-year, high-resolution record of above-water, near-surface radiation (PAR) fluxes and above-water meteorological parameters. The inversion is performed using a flexible partitioning of carbon between anthropogenic and natural DIC pools. The inversion is conducted independently on these two components, a technique that does not allow for the exchange of carbon between the two pools. Instead, the two pools are treated as independent and the observed fluxes are partitioned between them. The inversion is repeated using a 1-D model and a 2-D model, and the results are compared.

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VIDEO PLANKTON RECORDER REVEALS A THIN LAYER OF HYDROMEDUSAES IN A SEMI-ENCLOSED NORTH NORWEGIAN BAY.

High resolution images of zooplankton organisms were recorded in situ by a digital autonomic Video Plankton Recorder (VPR) in a semi-enclosed bay in northern Norway. The bay is characterized by a high biological productivity and a complex circulation regime. The VPR is a flexible platform that can be used for the recording of high-resolution images of zooplankton organisms. The VPR is a valuable tool for the study of zooplankton biodiversity and ecology.

In the past, the study of zooplankton biodiversity and ecology has been limited by the availability of high-resolution images of zooplankton organisms. The VPR provides a valuable tool for the study of zooplankton biodiversity and ecology. The VPR is a valuable tool for the study of zooplankton biodiversity and ecology.
seasonal patterns are not predicted by near-surface measurements, above-water measurements or estimates of dissolution, demonstrating that accurate assessment of the ecological and geochemical role of benthic production requires high-resolution in situ measurement.

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DEVELOPING A CONSISTENT FRAMEWORK FOR QUANTIFYING CARBON EXCHANGES AT CONTINENTAL MARGINS

Continental shelf and slope (margin) systems are increasingly recognized as disproportionately important in global biogeochemical cycles and yet their inclusion in global flux models has been very limited. In part this is because a single definition of the margin is not universally employed, resulting in confusion from a range of carbon exchange flux estimates. In particular, the boundary between open-ocean and margin ecosystems is often placed at specific isobaths, e.g., 200m or 2000m, or at political boundaries such as the EEZ which do not correspond to regions of differing controlling processes. Here it is argued that the ocean - margin boundary should reflect the location where the processes controlling ecosystem characteristics and fluxes transition between domination by margin processes such as coastal upwelling, lateral exchange, fresh water input and bottom friction, and domination by open ocean processes such as eddy pumping, vertical diffusive exchange and vertical particle sinking. A relatively simple framework is presented here that considers both margin morphology and overall oceanographic setting and permits a more realistic integration and comparison of margin carbon fluxes.

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MODULATION OF HURRICANE-INDUCED MIXED LAYER COOLING IN GULF OF MEXICO’S MESOSCALE OCEANIC EDDIES

Mesoscale oceanic eddies have been previously shown to impact the efficiency of hurricanes to cool the ocean mixed layer (OML), affecting the hurricane energy source and inducing storm intensity fluctuations. Understanding the degree of hurricane-induced OML cooling in ocean eddies has important implications for oceanic feedback to hurricane intensity. To illustrate this point, observations in the Gulf of Mexico during hurricanes Katrina and Rita (2005) and idealized numerical experiments of hurricane-induced OML entrainment in ocean eddies underscore the importance of the OML topography on hurricane intensity changes. Both storms deepened to category 5 status during interaction with warm oceanic features, then weakened after encountering a cold eddy prior to making landfall. Profiler measurements indicated that during both storms, increased cooling (4-5°C) was associated with shallower OML in cold eddies, while reduced cooling (<2°C) was observed in warm-eddies. The early storm season and oceanic eddy characteristics are not captured by satellite-derived sea surface temperature distributions that prevail in the GOM during the hurricane season, must be accounted for in coupled models to improve hurricane-induced OML cooling and intensity forecasting.

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ENERGY FLUX AND THE DISSIPATION DEFICIT IN THE MARINE SURFACE LAYER

The evaluation of turbulent kinetic energy (TKE) budget equations over oceans is central to many studies on air-sea interaction. Although a number of studies to carefully evaluate the various terms of TKE budget, the problem is far from being closed. For example, measurements from recent field programs suggest that the waves substantially modify the shear and pressure transport terms of the TKE budget in the wave dominated boundary layer where the wave induced stress is a considerable fraction of the total stress. To illustrate this, we present results from the Marine Boundary Layers (MBL) and Coupled Boundary Layers and Air-Sea Transfer (CBLAST) field campaign where vertical profiles of heat and momentum fluxes, wind mixing, and downwelling in the winter 2006-07 contributed to the cool winter mixing and decreased coastal freshwater discharge. While anomalies in winter heat fluxes, wind mixing, and downwelling in the winter 2006-07 contributed to the cooling, it also appears that the winter runoff reduced shelf stratification and enhanced deep mixing. Our results underscore the sensitive dependence of temperature distributions on salinity for this shelf. Anomalously cold waters persisted through fall 2007. This observation, in conjunction with the evolving La Nina and a positive Arctic Oscillation Index suggest that the anomalous cooling may continue in the coming winter.

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SILL PROCESSES IN THE SAGUENAY FJORD

Laterally-averaged nonhydrostrophic numerical simulations are used to investigate internal wave generation and turbulence production near a sill in the Saguenay Fjord, Quebec. The results suggest that the conditions in this environment (current, stratification, topography) are favorable for the development of large-amplitude, tidally-driven, internal solitary waves (ISWs) and provide insights into where and when turbulent kinetic energy is produced. Guided by the results of the numerical simulations a field experiment was undertaken to observe ISWs remotely, with shore-based cameras, and directly, with current and turbulence profilers. More than 20 internal wave events were encountered with many of them appearing to propagate cross-channel since a two-dimensional model cannot resolve cross-channel motion the fate of such internal waves is of particular interest.

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ON THE NATURE OF THE 2006-07 WINTER COOLING ON THE NORTHERN GULF OF ALASKA SHELF

The 37-year temperature and salinity time series from the coastal hydrographic station GAK 1 on the northern Gulf of Alaska (GOA) shelf and NCEP meteorological data are used to describe the anomalous cooling of the winter 2006-07. That cooling interrupted a <1°C/30 yr increase in deep (>150 m) temperatures on the shelf and resulted in spring 2007 temperatures being <1°C lower than normal throughout the water column. The deep temperature has not recovered since 1973. Spring salinities were also anomalous being fresher at depth and saltier at the surface, and consistent with abnormally strong winter mixing and decreased coastal freshwater discharge. While anomalies in winter heat fluxes, wind mixing, and downwelling in the winter 2006-07 contributed to the cooling, it also appears that the winter runoff reduced shelf stratification and enhanced deep mixing. Our results underscore the sensitive dependence of temperature distributions on salinity for this shelf. Anomalously cold waters persisted through fall 2007. This observation, in conjunction with the evolving La Nina and a positive Arctic Oscillation Index suggest that the anomalous cooling may continue in the coming winter.

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HEAVY METAL UPTAKE BY PERMEABLE SEDIMENTS

The sink-source characteristics of permeable river beds, following the release of heavy metals to surface waters, were investigated with stirred, cylindrical chambers. The effect of advective pore water transport on heavy metal fluxes was studied by comparing two stirring speeds, inducing (1) very low and (2) moderate rates of advection, and two sediments with different grain size and permeability, (1) coarse sand (0.5-1 mm, K=3.4 x10⁻¹¹ m²/s) and (2) medium sand (<0.5 mm, K=3.6x10⁻¹⁰ m²/s). The overlying water was spiked with Cadmium, Copper, Lead, and Nickel (250mmol L⁻¹) and sampled over a period of 3d. Heavy metals were generally scavenged at rates that followed the sequence Ga > Ni > Cd > Pb. In both sediments, advection strongly enhanced uptake rates. The largest effect was found in the coarse sand, where moderate advective transport increased heavy metal uptake up to 4.5-fold, and where heavy metal concentrations dropped by up to 30% in the first hour. This implies, that in the case of heavy metal discharge to rivers, permeable beds are efficient filters, thereby passing on contamination from the pelagic to the benthic zone.

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EXTREME WAVES ON THE CONTINENTAL SHELF

Early scientific observers of monstrous waves on the oceans were often openly ridiculed. However, since the successful application of random process theory in the description of ocean waves, the existence of extremely large waves is no longer disputed. In fact, such giants should occur, just with low probability. But how rare are they really? Accumulated empirical evidence suggests that extreme waves are not as rare as the linear theory predicts. Nonlinear corrections have been shown to drive enhanced likelihood of extreme events in idealized wave fields, but the implications of non-Gaussian statistics for realistic sea states over variable depth are generally not well understood. In this study we present
of organic carbon additions. The addition of organic carbon substrate had a rapid and positive effect on denitrification rates as a whole, although the extent of this effect appears to be dependent on the amount of carbon amended to the sediment. Incubation cores receiving the greatest amounts of organic carbon yielded N2 fluxes three to four times greater than control incubations. Microbial denitrification in these cores was greatest within 68 hours of carbon deposition. This shift in denitrification can be attributed to both autotrophic andallochthonous nitrate pathways, as 60-70% of denitrification resulted from coupled nitritification processes. This rapid benthic response suggests that denitrification is significantly enhanced during the initial stages of a phytoplankton bloom, and is an important pathway for the removal of estuarine nitrate.

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MESOZOOPLANKTON DISTRIBUTION ACROSS THE SOUTHERN INDIAN OCEAN WITH EMPHASIS ON APPENDICULARIANS

Mesozooplankton distribution across the Southern Indian Ocean and, in particular, appendicularia abundances and trophic interactions in the oligotrophic ocean area, is poorly described. We investigated the distribution of the two major mesozooplankton groups, appendicularians and copepods, across the Southern Indian Ocean. Copepod nauplii, copepods (including adults) and appendicularians dominated the mesozooplankton community - 20 µm (max. 26.432, 15.946 and 1.611 individuals m⁻², respectively). Copepods were most abundant off Southwest Africa facing Agulhas current and Southern Ocean waters while decreasing toward subtropical and tropical areas. Appendicularians showed the inverse pattern. The overall size distributions were very small, especially P. hirta with 90% < 320 µm in trunk length but showing increasing average sizes towards warmer waters. We conclude that the < 200 µm mesozooplankton fraction is of significant importance and should therefore been taken into account in future investigations concerning specific local areas. We present a statistical model to evaluate mesozooplankton abundances and biomasses in relation to food regimes (microbial loop components, fractionated chlorophyll), physical and biological settings to conclude about the role of appendicularians in the food web.

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PRELIMINARY OCEANOGRAPHIC STUDIES AROUND TRINIDAD AND TOBAGO

In 13 stations sampled [CORE Project 1990], diatoms were predominant species. Faunal diversity varied from 14-25 in the vertical and 8-22 in horizontal samples. High silicates concentrations [1.0µ mol dm⁻³] in the surface waters were associated with low salinities presumably due to Orinoco river. The concentration of Chl a on the surface varied from 0.003 to 2.57 µg m⁻³. Two water masses - high salinity subtropical water and low salinity Antarctic intermediate water were observed. The rising isotherms near north coast at 50 m indicated upwelling. Bathymetric profiles showed sea bed devoid of sediments, piercement structures rising from beneath 50 m sediments and indication of turbidity currents. The data collected off companies, on the west and east coast of Trinidad have been used to reconstruct the structural and sedimentary history of the basin. However, there is need to study the area for oceanographic parameters in view of the active mixing processes in the region, the fluxes of nutrients and trace metals and influence of the Orinoco and Amazon rivers discharge.

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EFFECTS OF CLAY MINERALOGY ON RETENTION AND MOBILITY OF ANTHROPOGENIC RADIONUCLIDES IN PUERTO RICO

Radionuclides, such as 137Cs, can be traced by observing sediment mineralogy. Sediments from Vieques and Rincon, Puerto Rico were tested to examine the retention capability of radionuclides. Beginning in 1944 and continuing until 2003, Vieques was used as an ammunition facility and bombing range. If 137Cs is retained here, there are sediments present that may also retain depleted Uranium. The BONUS Facility, a nuclear power plant located in Rincon, operated in the 1960s and was decommissioned and shut down completely by 1970, partly due to its 106 unintentional reactor shutdown. Sediment mineralogy was studied here to determine if the power plant was properly cleaned after its decommissioning. Gamma spectroscopy results indicated activity of 137Cs in the sediments of Vieques and Rincon. X-ray diffraction analysis indicated that both sites contain the clay smectite, which will facilitate radionuclide retention. Since Vieques sediments contain 137Cs and smectite, they also have the capability to retain other common radionuclides. Retention of 137Cs at Rincon can be from two sources: global fallout or the radioactive material that was not removed.

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Observations from the Kuroshio Extension System Study (KESS) demonstrate the existence of recirculation gyres flanking the Kuroshio Extension. The KESS program had its observational stage over a 2-year period from June 2004 - June 2006 during which an array spanning the jet axis consisting of current meter moorings and inverted echo sounders equipped with near-bottom pressure and current sensors was deployed, additionally profiling CTD data were collected. Results from the KESS observations have found evidence for barotropic recirculation gyres both to the south and for the first time north of the jet. Direct evidence comes from the moored current meters, which show an eastward flow under the surface jet flanked by a barotropic western flow in the abyssal ocean to the north and south of the jet. The existence of a pair of recirculation gyres is also suggested by maps of the echo sounder and float data. Additional evidence for the recirculation gyres comes from the analysis of an eddy-resolving model simulation of the region. Estimates of the gyre transports are computed and the dynamics of the recirculation gyres are explored.

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THE EFFECTS OF UV AND TEMPERATURE ON MICROBIAL COMMUNITY STRUCTURE IN A TEMPERATE LAKE

UV effects are temperature independent while their enzymatic repair may be temperature dependent. This may be particularly important in temperate lakes when spring water temperatures are still cold while UV is relatively high. We manipulated temperatures and UV treatments from the surface to the bottom, using microstructure profiles from the NOAA R/V Pisces IV. Net daily calculations of CO2 flux, using a physically based transfer velocity (k), are compared to wind speeds. Phase-dependent wind speed and cloud fraction with respect to solar insolation was reduced as the effects on solubility and k act in opposite directions. Additional evidence comes from the analysis of an eddy-resolving model simulation of the region. Estimates of the gyre transports are computed and the dynamics of the recirculation gyres are explored.

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GLOBAL ESTIMATES OF NET COMMUNITY PRODUCTION (NCP) ESTIMATED FROM SEASONAL CLIMATOLOGICAL MAPS OF INORGANIC CARBON DATA

The global seasonal variability of upper ocean inorganic carbon parameters was used to estimate global rates of net community production (NCP). Multiple linear regression (MLR) methods were used to interpolate and extrapolate the temporally and geographically limited dissolved inorganic carbon (DIC) and total alkalinity (TA) data (collected as part of the 1996 TCOC cruises in the Atlantic) to the global ocean using other climatological and hydrographic data. The resultant climatological model has a temporal resolution of monthly, spatial resolution of 1° and vertical resolution throughout the water-column. Model uncertainty is evaluated by comparing our data to ocean carbon data collected at time-series such as HOT and BATs, and crust data from the Arabian Sea, Indonesia and Southern Ocean, for example. Estimates of air-sea CO2 gas exchange, vertical diffusion, entrainment and detrainment, and horizontal advection were used to compute global rates of NCP through mass balance approaches. Our estimates of global NCP were 11.8 ± 5.5 Pg year-1, which we compare to estimates from other approaches, including Jin et al., 2007 and Najjar et al., 2007.

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ELUCIDATING CONTROLS ON ESTUARINE SEDIMENT NITROGEN CYCLING PROCESSES USING GENE ACTIVITY AND FLUX MEASUREMENTS

Denitrifiers in coastal and estuarine sediments remove anthropogenic inputs of nitrogen (N). N-fixers are not thought to be active in nitrogen-loaded ecosystems, however, the sediments in Narragansett Bay recently switched from being N sink to a N source from January to September. This switch in sediment microbial activity may be coupled to decreased benthic organic deposition. To better understand controls on benthic N cycling processes, we are following functional gene activity for nitrogen fixation and denitrification in combination with N-flux measurements from Bay sediments and in cores maintained in mesocosm experiments with manipulations of temperature and organic matter loading. Expression of nitrogeanase sequences (nifH) is evidence of active N-fixation and correlates with decreased organic matter deposition. These sequences are related to nifH genes from cultivated sulfate reducers. In samples with low nifH expression, denitrification genes ( nirS and nirK) are expressed. We are using quantitative PCR methods to compare gene
activity levels across nutrient loading gradients. These experiments should help elucidate how biogeochemical cycles of N, C, and sulfur are linked and how changing environmental conditions impact microbial N cycling.

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THE HELIUM-3 FLUX GAUGE IN THE SUBTROPICAL NORTH ATLANTIC: WHAT DOES IT TELL US ABOUT NUTRIENT FLUXES AND NEW PRODUCTION IN AN OLGOTROPHIC GYRE?

The apparent correlation between tritogenic helium-3 and nutrients within the North Atlantic subtropical main thermocline can be used in combination with surface mixed layer measurements to estimate the flux of tritogenic helium into the subtropical gyn euphotic zone. We report observations extending over a period almost 3 decades. The flux thus estimated is approximately 0.9 moles of nitrogen per square meter per year, and appears to be significantly larger than tracer-based estimates of net community or export production near Bermuda. We discuss the reasons for this apparent difference and suggest that the dilemma can be resolved by consideration of the characteristic time-scales and timing of the underlying processes. We present the observational evidence for these conclusions, and frame them within a quasi-Lagrangian one-dimensional upper ocean model that emulates these processes.

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MOMENTUM TRANSFER BETWEEN SEMIDIURNAL INTERNAL WAVES AND SUBINERTIAL FLOW AT A DISSPATISSING SURFACE REFLECTION

Full-depth profile data depicts semidiurnal internal waves radiating from Mendocino Escarpment. Previous analysis shows an energy-flux convergence at the station closest to the first surface reflection (Althaus et al., 2003). A plausible interpretation is that this energy is dissipated by superposition of the incident and reflected waves. Momentum flux is also diminished after the reflection. Because there is no profile data in the superposition region, a theoretical approach is used to overcome the data gaps. Assuming no zonal dependence, constant stratification and linear decay over the dissipation region, this forcing is calculated with parameters specific to Mendocino Escarpment data. Both superposition and dissipation can cause momentum flux divergence forcing. Comparisons with remaining forces at Mendocino Escarpment enable a more thorough understanding of momentum transfer. When zonal dependence is included, the zonal velocity is no longer out of phase with the meridional and vertical velocities. As a result, all the momentum flux divergences in the u-momentum equation remain, and the complexity of the scaling arguments increases. Reference: Althaus, A., E. Kunze, and T. Sanford, 2003: Internal tide radiation from Mendocino Escarpment. Journal of Physical Oceanography, 33, 1510-1527.

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PHYLOGENETICS AND GLOBAL GENETIC DIVERSITY OF PTEROPODS (PELAGIC MARINE SNAILS)

Pteropods, or pelagic snails, comprise about 110 species of shelled (thecosome) and shell-less (pealeosome) gastropod mollusks that are entirely planktonic. The group’s taxonomy has a long history of revision and reinforcement by morphologists and molecular biologists, alternately arguing for cohesion of Tereosomatida and Gymnosomata (i.e. a monophyletic Pteropoda) versus multiple radiations of gastropods into the pelagic realm. While many species have been reported to occur in every major ocean basin, it is unclear whether such cosmopolitan species can be used to construct and constrain predictive models for river and estuarine flows. Here we present an overview of the project, which is a unique combination of closely coupled field and numerical model experiments to predict, interpret, characterize, and understand coherent structures. The project includes two major field experiments with both in situ and remote sensing measurements on the Shooshomich River near Everett, WA. We introduce the results from the first experiment in 2006 and outlines plans for the second experiment scheduled for the summer of 2008.

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RETROSPECTIVE ANALYSES OF NORTON SOUND, ALASKA BENTHIC FAUNA

This study retrospectively examined evidence of changes in distribution and abundance of benthic epifauna and demersal fishes of Norton Sound Alaska, northeast Bering Sea from 1976 to 2006, based on triennial bottom-trawl surveys. Throughout the period, average bottom temperature did not increase, rather it decreased by 2°C, and overall abundance index increased exponentially by 370% with annual rate of 3% per year. Out of 40 selected species/taxa, 35 showed positive increase. Of those, 16 showed r > 0.5. However, those taxa had no significant correlations with any global ocean climate indices, such as AO, PDO, SOI, NP, PNA, or 19 physical or oceanographic variables specific to Norton Sound. There were also dramatic changes in species or taxa composition. About 70% of fauna was dominated by sea stars, of which Asterias amurensis was the most dominant. The data suggest that Norton Sound benthic fauna has not been significantly affected by climate changes.

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INFLUENCE OF SCOTTISH SHELF WATER INFLOW ON PHYTOPLANKTON DYNAMICS IN THE GULF OF MAINE: DATA ANALYSIS AND MODELING

Continental shelf waters from the Labrador Sea to the Mid-Atlantic Bight experienced significant freshening in the late 1990s, likely caused by increasing glacial melting and enhanced precipitation and river runoff at higher latitudes (as a result of climate change). The freshening of the ocean can alter circulation and stratification of shelf waters and may influence the phytoplankton dynamics and ecosystem productivity. We used a 3-D coupled biological-physical model to examine the influence of freshening on the timing and magnitude of the plankton blooms and primary productivity in the Gulf of Maine/Scottish Shelf region. The model captured the general pattern of westward propagation of spring phytoplankton blooms from the Scottish Shelf to the western Gulf of Maine, con-
sistent with the observed increasing sea surface salinity and associated decreasing stability of the water column. The model showed that increased freshwater can further enhance the spatial gradients in timing by stimulating earlier blooms upstream (the Scotian Shelf), but has less impact downstream (the western Gulf of Maine). The model results suggest that surface water freshening may impede winter convection and decrease nutrient supply from deep water to the surface, thus influencing the overall seasonal primary productivity.

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DO SOUTHERLY WINDS CONTROL THE LATITUDINAL ASYMMETRY IN THE SEASONAL CYCLE OF THE SST IN THE EASTERN PACIFIC? It has been hypothesized that during the fall southerly winds initiate the latitudinal asymmetry in the sea surface temperature anomaly about the equator in the eastern Pacific with southerly winds forcing northward currents that act to create the asymmetry. However, observations along 95°W in the Pacific ocean during EPIC (Eastern Pacific Investigation of Climate processes) show that from March 2000 to March 2003, when the winds were southerly between June and December, meridional currents were southward north of the equator. A three-dimensional ocean model forced by QuikSCAT winds, ISCCP shortwave, and NCEP other atmospheric variables was consistent with the observational analysis. The momentum budget was analyzed in the model to investigate the dynamics that result in the currents being in the opposite direction to the southerly winds. Preliminary results suggest that in the meridional momentum budget, the southerly wind stress is balanced by a meridional pressure gradient and that advection of southward momentum into the mixed layer from below is important in maintaining the near surface currents against the southerly winds.

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COMPUTATIONAL FLUID DYNAMICS SIMULATIONS OF PROTIST SINKING, SWIMMING, JUMPING, OR INTERACTING WITH EACH OTHER The original motivation of this work was to quantify the spatio-temporal hydrodynamic signals created by a ciliate swimming near an ambush-feeding Oithona plumefera female and to understand the role of hydrodynamic signal detection in mediating the copepod’s capture behavior. As a result, a suite of hydrodynamic numerical models were developed to simulate the total flow created by several groups of protists at their body scales. The model constructions were based on published information on body forms, propulsion machineries and global motility patterns of considered microorganisms. Flows of different complexities were simulated ranging from flow surrounding a phytoplankton settling from rest, flow created by a model flagellate, dinoflagellate or ciliate in steady swimming, flow behind a model ciliate jumping from a stationary position, to hydrodynamic interactions between two self-propelled protists in close proximity. Results of flow patterns (with comparison to the stresslet model), mechanical energy consumption, mass transfer, and hydrodynamic signal generation will be reported. It would be interesting to apply these models to investigate small-scale biological-physical-chemical interactions associated with these microorganisms, many of which are important players in the microbial loop.

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AN UPWELLING COMPARATIVE STUDY BETWEEN US WEST AND EAST COAST WITH A DEVELOPMENT OF AN IMPROVED UPWELLING INDEX AND NUMERICAL MODELS Coastal upwellings off idealized US west and east coasts with different shelf widths are compared using a 3-D numerical model, with both hydrostatic and non-hydrostatic versions studied and compared. The results show that the distance of the upwelling front is proportional to both the strength and the duration of the wind forcing. 2D shelves do not prevent upward motion, but it reduces the sea surface temperature drop mainly due to lack of cold water supply at depth. To further compare the two different upwelling areas, an improved upwelling index, Upwelling Velocity Index (UVI), based on Ekman theory is derived from the divergence of the Ekman transport. It successfully estimates the vertical velocities on a shallow east coast shelf. The results are in good agreement with vertical velocities produced by a numerical model, with a correlation of 0.8. Being applicable to both US, east and west coasts, the UVI shows the coastal upwelling velocity along the east coast will typically be an order of magnitude smaller than upwelling along west coast due to the different shelf slopes.

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CARBON DIOXIDE DEGASSING IN RIVER- AND MARINE-DOMINATED ESTUARIES: IMPORTANCE OF FRESHWATER RUNOFF The partial pressure of carbon dioxide (pCO2) and other inorganic carbon parameters were measured during both high tide and low tide in the surface water of three salt marsh estuaries off Georgia, USA from September 2002 to May 2004. Of the three estuaries, Sapelo and Doboy Sounds are marine-dominated estuaries that receive little freshwater besides precipitation, while Altamaha Sound is a typical river-dominated estuary that is dominated by freshwater runoff. During all of the sampling months, the three estuaries were super-saturated in CO2 with respect to the atmosphere (39.5-342.5 Pa, or 390 - 3380 μatm) due to inputs from intertidal marshes and freshwater runoff. Overall, the pCO2 in the river-dominated estuary is much higher than that in the marine-dominated estuaries. The calculated annual air-water CO2 flux in Altamaha Sound (88.8 mmol m-2 d-1) is 2-3 times of those of Sapelo and Doboy Sounds (36.9-38.0 mmol m-2 d-1). The higher CO2 degassing in the river-dominated estuary is fueled by the extra CO2 loading from freshwater runoff. Due to the large differences of the air-water CO2 fluxes in river- and marine-dominated estuaries, the current estimates of the air-water CO2 fluxes of global estuaries, which were exclusively based on river-dominated estuaries, could have been overestimated.

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MODELING COASTAL PROCESSES IN MASSACHUSETTS BAY AND BUZZARDS BAY The western Maine Coastal Current (WMCC) bifurcates near Cape Ann, Massachusetts and a portion of which intrudes into Massachusetts Bay. The intruding flow is important to phytoplankton bloom, and transport of zooplankton and fish larvae in Massachusetts Bay. The specific nature of the bifurcation and the underlying mechanism, however, remain to be understood. We examine the roles of surface winds, freshwater input from Merrimack River, and upstream flow conditions in this process, using a numerical model and field observations that indicate the intruding flow either go around the Cape Ann or separate from the coast, depending on the strength of the WMCC near Cape Ann and surface winds. A strong intruding flow may become unstable under favorable conditions. Consequently, a cyclonic eddy may form near Cape Ann, propagate downstream, and further interact with nutrient-rich inflow from Georges Bank and in western Massachusetts Bay. We will also introduce our modeling work in Buzzards Bay. Preliminary results suggest a pronounced thermal front exists throughout the year separating Buzzards Bay from offshore, consistent with satellite images.

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GEOCHEMICAL BEHAVIOR OF URANIUM IN THE YELLOW RIVER PLUME (YELLOW RIVER ESTUARY) The Yellow River (Huanghe) is the second largest river in China and is known for its high turbidity. It also has remarkably high level of dissolved uranium (DU) concentrations. To examine the mixing behavior of DU between river water and seawater, surface water samples were collected along a salinity gradient from the Yellow River plume during September 2004 and measured for DU concentration. DU activity ratio, PO4/P, and suspended particulate matter. In addition, laboratory experiments were conducted to simulate the mixing process in the Yellow River plume using unfiltered Yellow River water and filtered seawater. The results showed a non-conservative behavior for DU at salinities <20 and a similarity between DU and PO4 in their variations with salinity. Mixing experiments created that desorption from suspended sediments and diffusion from interstitial waters of bottom sediments are the two major processes causing the elevated concentrations of DU and PO4 in mid-salinity waters, which are higher than those expected from a conservative mixing. However, desorption seems more responsible for the elevated DU concentrations, whereas diffusion influences more the enrichment of PO4. 

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PHOTOSYNTHETIC EFFICIENCY AND CELL MORTALITY OF SILICATE-STARRVED THALASSIOSIRA WEISSFLOGII RESPONSE TO SILICATE RESUPPLY AND DARKNESS The physiological processes of phytoplankton mortality and photosynthetic efficiency (Fe/Fm) in response to darkness and silicate resupply were studied in the Si-starved diatom T. weissflogii. SYTOX Green was used for the cell membrane permeability assay, which assumed that SYTOX Green stained dead cells. Cells in the light showed a much higher percentage of dead cells (~90%) than in darkness (~20%), Sii added in the stationary phase; ~30%, Sii added in the senescent phase). Photosynthetic efficiency showed a slower decrease with increasing silicate resupply. Fe/Fm dropped from 0.57±0.02 to 0.13±0.01 without Si resupply, to 0.27±0.08 with 25 μM Si addition and to 0.31±0.03 with 150 μM Si addition. Darkness, Fe/Fm stayed above 0.5 over one week before it dropped below 0.4 after silicate was resupplied in the stationary phase, and decreased to ~0.1 without any silicate addition. There was a larger increase in Fe/Fm after a silicate addition to stationary cells compared to senescent cells. Silicate and darkness have to be considered as a possible cause for cell death and variable photosynthetic efficiency of diatoms.
Lower trophic level ecosystem model and statistical methods are used to assess the impacts of reducing sea ice cover and rising temperature in the southeastern Bering Sea on the lower trophic level production and fish catches. The vertically 1-D coupled ice-ocean ecosystem model (Lin et al., 2007) includes both pelagic and sea ice algal components and is applied to the NOAA/FMEL mooring site M2 in the southeastern Bering Sea from 1970 to 2006 forced by wind stress, heat and salt flux. Model results are validated favorably with observations: 1) temperature, salinity, fluorometer data at 12m, 24m and 44m from 1995-2005; 2) daily SeaWiFS chl-a data. While the quantity of variability of the primary production did not show an increase/decrease trend in the past three decades, there exists a shift of dominant phytoplankton species coincident of the Pacific Decadal Oscillation (PDO) index. The model primary production were dominant by ice algae before the 1976/77 regime shift, and by open water species of diatom and flagellates thereafter with only occasional ice algal blooms. Fish catches in the eastern Bering Sea showed mixed response to the climate changes. Among the 12 dominant economic fish species, only Walleye pollack and Yellowfin sole showed significant correlations with the PDO index in certain regions. This indicates that a more complicated system analysis is necessary to fully understand the response of higher trophic level production to climate changes.

**Optical Ber ing Sea Related to the Ecological Process During the Ice Melting Days in 2007**

Related to the global warming, sea ice in area, thickness, and concentration is obviously decreasing. Along with less sea ice in winter and early melting in spring, the marine ecosystem in northern shelf of Bering Sea is experiencing corresponding changes. As ice opens earlier than usual, algae and plants grow firstly in the ice over layer and advance downward to the lower level with the exhaustion of surface nutrition. On the other hand, solar radiation is the main energy to melt ice. The earlier bloom of phytoplankton changes the light field in sea water and increases solar absorption, which results in extra warming, a positive feedback to the ice melting. The solar radiation penetrated is also the main source for heating lower water. The linkage among thermal, optical and ecological features in northern Bering Sea is discussed in this paper to address the contribution of phytoplankton to ice retreats.

**Spatial Analysis on Marine Atmosphere Boundary Layer Features of SAR Imagery Using Empirical Mode Decomposition**

Turbulent meso-scale processes at the marine atmospheric boundary layer (MABL) play an important role in the exchange of heat, moisture and momentum between the atmosphere and the ocean. These processes also contribute to the sea surface roughness, which is of critical importance to the interpretation of atmospheric and oceanic features from remote sensing. We used RADARSAT Synthetic Aperture Radar (SAR) imagery over the NE coast of the U.S. November 2, 2002 to analyze spatial MABL features. The SAR senses the sea surface roughness at a resolution on order 10m to 100m over a swath width on order 10km to 1.0km. We used a new method to decompose the footprints of MABL on SAR imagery into characteristic spatial scales. Using two-dimensional Empirical Mode Decomposition (EMD) we obtain three Intrinsic Mode Functions (IMFs), which mainly present longitudinal rolls, three-dimensional cells and atmospheric gravity waves (AGW). The rolls have rapids between 1.6km and 3.8km over the cells. The AGW has maximum spectrum at 14.3km wavelength. The method developed in this work can be used to decompose other satellite images into individual features through characteristic spatial scales.
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SAVITY VARIABILITY OF SOUTH FLORIDA COASTAL WATERS ON TIME SCALES FROM EPOCHIC TO MULTIDECADAL: HOW MIGHT THE ECLERGALIDES RESTORATION CHANGE THESE PATTERNS?

Surface salinity in the coastal waters of South Florida varies on time scales from episodic to multidecadal. Observed salinity patterns respond to natural physical forcing such as changing evaporation/precipitation balances and fresh water inputs, tropical cyclones and winter cold fronts, El Nino-Southern Oscillation (ENSO) cycles, and the Atlantic Multidecadal Oscillation (AMO). Sorting out and understanding these diverse sources of variability requires a careful and detailed assessment of the oceanographic and meteorological database on a multitude of spatial and temporal scales. Superimposed on this highly variable and dynamic coastal marine system are the past and present effects of water management practices in South Florida as well as the potential future changes in fresh water delivery to the estuaries and coastal marine waters which are to be expected as a result of the Comprehensive Everglades Restoration Plan (CERP). A time history of regional surface salinity from 1996 through 2007, and the ecological implications of the observed surface salinity variability and its possible future changes, are examined in the context of the overall health of the unique South Florida coastal ecosystem.

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OBSERVATIONS OF ATLANTIC MERIDIONAL HEAT TRANSPORT VARIABILITY AT 26.5°N FROM THE RAPID-MOC ARRAY

Continuous estimates of the oceanic meridional heat transport in the Atlantic are derived from the RAPID-MOC observing system deployed along 26.5°N, for the period from April 2004 to March 2005. The basin-wide meridional heat transport (MHT) is derived by combining temperature transports (relative to a common reference) from: (1) the Florida Current in the Straits of Florida, (2) the western boundary region offshore of Abaco Bahamas, (3) the Ekman layer (derived from QuickScat wind stresses), and (4) the interior ocean monitored by “endpoint” dynamic height moorings. The results for the first year of observations show a mean MHT of 1.20 ± 0.45 PW for weekly-averaged estimates, on which time scale a basin-wide mass balance can be reasonably assumed. Ekman heat transport variability accounts for 58% of the total MHT variance, and upon its removal the MHT variability arising from the geostrophic circulation drops to ≤ 0.30 PW. The overall uncertainty of the annually averaged MHT for the one-year record is 0.14 PW, or about 10% of the mean value. As expected, the MHT variability is highly correlated with the strength of the meridional overturning circulation (also derived from the array), with an r² of 0.96. The RAPID-MOC Array will be continued through 2014, thereby providing about a 10-year time series of the MHT at 26.5°N, near the latitude where it reaches its maximum in the Atlantic.

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COPEPOD BEHAVIOR RESPONSE AT VERTICALLY-ALIGNED THIN LAYERS OF VELOCITY GRADIENT

Our recent laboratory observations that calanoid copepods behaviorally respond to thin horizontal layers of velocity gradients are extended to thin layers aligned with the vertical direction. In the current study, a laboratory apparatus was designed and constructed to create a controlled velocity field that consists of a laminar plane jet that is flowing downward. The apparatus also can be reversed to create upward flowing thin layers. The flow field characteristics have been quantified via the particle image velocimetry technique. The resulting strain rate field closely matches our previous horizontal thin layer mimetic with the exception of the alignment of the treatment region with the gravity vector. Behavior of the copepod Acartia tonsa in response to this structure is evaluated by comparing the swimming speed and frequency of turning before and after contact with the velocity gradient. In addition, the residence time in the treatment region is compared to a control treatment to determine whether the vertically-aligned region of velocity gradi-
and stratification can influence the oceanography of the region. During normal years, ENSO periods to further South and West during normal years. In spite of its variable surrounding ocean waters. Variable physical forcing due to ENSO cycling causes major logically normal (non-ENSO) period to compare the similarities and differences between a cruise, of the physical, chemical and biological properties of this region during a climato logy.

The Atlantic meridional overturning circulation is conventionally pictured in the meridional-vertical plane, but the densification of water masses involved is in fact thought to occur on a much broader scale. This trade wind circulation of the circulation flows in boundary currents around the subpolar gyre and northern marginal seas. Here we present an analytical model of the heat and salt budget for an idealized coastal boundary current in a marginal sea such as the Nordic Seas. The boundary current exchanges heat and fresh water with the atmosphere, as well as with the interior of the basin via eddy and Ekman transports. Its volume transport is not only a function of the wind stress, but also the interannual and independent ocean wind forcing. The temperature and salinity of this boundary current is important to two different length scales. Comparing these two the temperature and salinity of the boundary current and for the properties of the water that flows over the sill. The relevance and implications for the Nordic Seas and other marginal seas are discussed.

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CELEBRATING TEN YEARS OF PROGRESS TOWARD BUILDING A GLOBAL OCEAN OBSERVING SYSTEM

In 1998, the International Year of the Ocean, NOAA implemented a program to help build the global ocean observing system needed to improve climate forecasts. Over the past ten years, NOAA and its international partners have reached 57% completion toward implementation of the initial design outlined in the Global Climate Observing System. The system has grown from five networks in 1998 to nine complete networks that together contribute unique capabilities toward an integrated system. This network addition is a result of new capabilities. The new system, NOAA and its partners have received additional funding, added new observations, and new observations to improve ocean observing system. The system helps to improve our understanding of the ocean and its role in climate. From the seminal ENSO observing system to global coverage from drifting arrays, this presentation highlights the development of the current global ocean observing system (in situ) and prospects for the next ten years of sustained ocean observations.

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COORDINATE CHANGES IN THE HEAT, SALINITY AND CO2 BUDGETS OF THE MEDITERRANEAN ZONE AT THE BERMUDA TIME SERIES SITES

In recent years, realization of the importance of the ocean interior to store heat and CO2 has helped improve the skill of climate models. However, quantification of this storage mechanism is limited to a few time-series locations. Here we present analyses of hydrothermal outflow for 5 years and 2007-2008 data, detailing significant long-term change in upper ocean inventories of heat, salinity and CO2. Consistent trends of increasing temperature and salinity are observed for depth below the seasonal thermocline while the thermocline with maximum signals in the model data (past 50 years; ΔT = -0.1°C and ΔS = 0.1°C), yielding a ΔT = -0.1°C and ΔS = 0.1°C. In contrast, surface conditions do not show this trend. Our data indicates a long-term reduction in upper ocean stratification for this region. Similarly, model water CO2 levels continue to increase with current levels up to 25 µmole kg⁻¹ higher than the 2005 levels at the inception of BATS. We invest in the development of a mechanism for the transport of heat and CO2 into the ocean interior and the ability to constrain the model and conduct a series of sensitivity experiments. This results in a mechanism for the transport of heat and CO2 into the ocean interior and the ability to constrain the model and conduct a series of sensitivity experiments. This results in a mechanism for the transport of heat and CO2 into the ocean interior and the ability to constrain the model and conduct a series of sensitivity experiments. This results in a mechanism for the transport of heat and CO2 into the ocean interior and the ability to constrain the model and conduct a series of sensitivity experiments. This results in a mechanism for the transport of heat and CO2 into the ocean interior and the ability to constrain the model and conduct a series of sensitivity experiments.
which deals with the invitation from Dr. Edward Kimani of Kenya, who invited our team to Tanzania in California. Let the students there in the protocols and analysis of NaGISA. What followed was a scientific, cultural, and personal exchange worth documenting and sharing. The rich scientific and cultural resources and equipment were of equal delight to the African students. Pictures, data sheets, and testimonies from participants are included.

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MANAGING AND ANALYZING CABLED-SEAFOOR SENSOR DATA USING KEPLER SCIENTIFIC WORKFLOWS

Traditional management of near-shore oceanographic data has relied on manual- and labor-intensive processes to access, archive, and process data. At the Kilo Nalu Nearshore Reef Observatory, deploying sensors along a submarine cable that provides power and network services has massively improved the quality, volume, and timeliness of oceanographic data. Managing these data, however, is challenging. As part of the Real-time Environment for Analytical Processing (REAP) project, we have leveraged the DataTurbine RingBuffered Network Bus (RBNN) to buffer data from the array and adapt-
ed the Kepler scientific workflow system to access data directly from the ring buffer. We have developed scientific workflow components that connect to RBNN servers and provide near real-time access to sensor streams. Scientific workflows allow a flexible means for joining heterogeneous data access and analysis systems while simultaneously providing an audit trail of data processing and analysis. We have demonstrated that this system can be used to improve the efficiency and transparency of near real-time event detection, quality assurance processing, and post-hoc analysis of sensor streams and archived data.

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SATILLA RIVER ESTUARY SEDIMENTS PROVIDE A SOURCE OF SOLUBLE ORGANIC IRON(III) COMPLEXES TO OVERLYING WATERS

Voltammetric depth profiles of redox stratified sediments with gold amalgam (Au/Hg) mediated electrodes show the presence of soluble organic Fe(III) complexes below theoxic zone in a variety of freshwater and marine environments. Unfortunately, the concentra-
tion of organic Fe(III) can not be determined by direct voltammetry without identification of the iron binding ligand. In this study, Competitive Ligand Equilibration - Adsorptive Cathodic Stopping Voltammetry (CLE-ACSv) is used to quantify and characterize metal binding ligands through comparison of natural ligands with a known chelating ligand. CLE-ACSv titrations are able to provide the concentration of the natural ligand, the concentra-
tion of Fe(III) bound to the natural ligand, and the conditional stability constant of the iron ligand complex. Results reveal soluble Fe(III) complexes at near millimolar levels in freshwater, estuarine porewaters and micromolar levels in overlying waters of the Satilla River estuary. Conditional stability constants for organic Fe(III) complexes ranged from log K = 20.58-21.92 and did not vary significantly with depth. This new application of CLE-ACSv demonstrates that significant amounts of soluble Fe(III) complexes are available in estua-
rine sediments to provide a source of iron to surface waters.

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SIMULATING HURRICANE GENERATED WAVES AND WAVE-SETUP USING COUPLED UNSTRUCTURED SPECTRAL WAVE AND FLOW MODELS

This paper describes a modelling study of hurricane induced waves and wave-set up. A number of large hurricanes in the Gulf of Mexico have been simulated using the MIKE 21 FM modelling system. These include Hurricane Ivan, Dennis and Katrina. The modelling system includes a third generation spectral wave model and a Reynolds-averaged, hydro-
static 2-D flow model. Both models use an unstructured grid. Applications of unstruc-
tured spectral wave models in hurricane simulation are limited in number. In this study we demonstrate the advantages of using an unstructured approach in terms of both stability and increased accuracy in the near-shore where wave set-up becomes an important surge component. Predictions from first and second order up-winding schemes are compared and demonstrate that while a first order scheme may capture the peak wave heights accurately, it may not resolve the build-up correctly. For the purposes of storm-surge model-
ling, however, the more efficient, first order up-winding scheme is sufficient.

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We report on a successful cooperative partnership with the fishing industry for long term observations of zooplankton and ichthyoplankton in the western Gulf of Maine. We
describe the structure of the partnership and major results taken between 2003-2007 of hydrographic and biological time series data from fixed stations sampled using fishing vessels at GoMoOS Buoy B.

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LIGHT-INDUCED PROCESSES AFFECTING ENTEROCOCCI IN AQUATIC ENVIRONMENTS

Fecal indicator bacteria such as enterococci have been used to assess contamination of freshwater and marine environments by pathogenic microorganisms. Various past studies have shown that sunlight plays an important role in reducing concentrations of culturable enterococci and other indicator microorganisms in aquatic environments. Results presented here indicate that several pathways contribute to the light-induced mortality of enterococci in natural waters. Studies of one species of enterococci, Enterococcus faecalis, shows that a key mechanism involves mortality via direct absorption of the UV component of sunlight. Chromophoric dissolved organic matter (CDOM) and suspended sediments also can play a role in indirect pathways for light-induced deactivation. CDOM photosensitizes the production of reactive oxygen species that can affect the survivability of enterococci. Enterococci are predominantly sorbed to sediments in aquatic environments and our results showed that the sorbed enterococci from sediments of local streams were rapidly inactivated by sunlight exposure. These results suggest that photoinduced damage can be initiated by substances on the sediment surface. Although this work was reviewed by EPA and approved for publication, it may not necessarily reflect official Agency policy.

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A LARGE LEGACY SEISMIC REFLECTION DATASET FROM ROCKALL TROUGH: CAUSES AND TEMPORAL VARIABILITY OF WATER LAYER RESPONSE, AND RECOGNITION OF INTERNAL WAVES

We have obtained a large number of legacy seismic reflection profiles across Rockall Trough, NE Atlantic, and reprocessed the data to image the water layer. Three main points have emerged from mapping of seismic response and comparison with legacy oceanographic-geophysical measurements. (1) It is difficult to explain the seismic response entirely in terms of reflections from temperature and salinity perturbations on the scale of the seismic waves (i.e. low frequency structure). Scattering, refraction and interaction with moving water probably also need to be considered to fully explain the seismic signal. (2) Temporal variation in seismic response as a function of spatial scale can be determined from co-located seismic lines of different vintage, re-shot portions of single lines, and comparison within and between swaths in 3D surveys. (3) In some regions, internal travelling waves can be recognized by correlation of normal movement using a velocity function derived on oceanographic measurements, interpretation of individual shot gathers and comparison between adjacent shot gathes. In-line amplitude, frequency and velocity of the waves can be measured using this method.

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VARIABILITY IN THE CONTINENTAL SHELF BIOLOGICAL PUMP REVEALED BY LAGRANGIAN TRACKING OF SATELLITE CHLOROPHYLL

Estimating the net rate at which the marine ecosystem converts carbon into phytoplankton biomass, and its variability amongst regions and over time, is crucial for our understanding of the carbon cycle. Satellite chlorophyll or backscatter products give a synoptic picture of phytoplankton carbon (PC), but estimating production rates is difficult because the temporal change of PC results from the net community production (NCP) of PC, as well as from advection of the PC with the circulation. Here, we track the motion of satellite-derived PC with a model ocean circulation velocities to derive an estimate of NCP in a continental shelf region over a period of 3 years. We find large variations in the regionally integrated NCP, ranging from negative to positive values of 100 mgC m$^{-2}$day$^{-1}$ during phytoplankton bloom events. At times, as much as 30–35% of the primary production is exported within the euphotic layer, whereas in other periods, PC is imported to the region. The large variability in our time-dependent estimate of carbon fluxes from the continental shelves indicates that integrative budgets constructed from single measurements can be in serious error.

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THE UPSTREAM PATH OF THE DENMARK STRAIT OVERFLOW WATER THROUGH THE ICHELAND SEA

Denmark Strait overflow water is one of the main components of the thermohaline circulation in the North Atlantic providing a link between the Nordic Seas and the North Atlantic’s Subpolar Gyre. Observations have shown that a substantial part of it is transported to the sill along the Icelandic continental slope before entering the North Atlantic’s Subpolar Gyre. The water has been traced along the Icelandic slope to the Kolbeinsey Ridge. To trace it further upstream and determine whether it has connection to the East Greenland Current or is flowing along the Kolbeinsey Ridge its properties are compared to the properties of water along the two paths. This is done using data from the Greenland Sea project from 1987-1991 that covered the western part of the Iceland Sea. Also the new and more extensive data set from the mapping project, “Ecosystem of the Iceland Sea”, initiated in 2006 by the Marine Research Institute in Iceland that covers the whole Iceland Sea, is used.

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UPPER MIXED LAYER TEMPERATURE AND SALINITY VARIABILITY IN THE TROPICAL BOUNDARY OF THE CALIFORNIA CURRENT

Temporal and spatial variability of the integrated temperature in the quasi-isothermal layer depth (ML temperature) and the integrated salinity in the quasi-isohaline layer depth (ML salinity) of the southern part of the California Current are examined using hydrographic data from thirty six surveys carried out from 1997 to 2006 over a grid based on the Mexican Research of the California Current (MECOCAL) stations plan. The sampling interval was approximately 3–month. The spatial pattern of the first leading Empirical Orthogonal Function (EOF) for both ML temperature and ML salinity anomalies show a single-signed distribution where the variability increases equatorward. The primary pattern of variation revealed by EOF analysis shows similar behavior on seasonal and interannual time scales. We hypothesized that this pattern is explained by the mesoscale variability difference between the southern and the northern Baja California zones. To test our conjecture, we use satellite altimetry data to perform EOFs of sea surface height and eddy kinetic energy. At seasonal time scale, the principal component time series of the first leading EOF reveals that ML temperature variability is associated with wind stress dynamics and air-sea exchange of heat, while the seasonal changes of ML salinity are mainly related to wind stress dynamics. At interannual time scale we found with freshening changes from 1998 to 1999 and from 2002 to 2003 and abrupt cooling change from 1998-1999.

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IMPACT OF COLD FRONDS ON THE HYDRODYNAMICS OF SABINE BANK, OFF LOUISIANA-TEXAS COAST, USA

Sabine Bank, located off Louisiana-Texas has been identified as a prospective source of sand for beach nourishment and coastal protection projects in western Louisiana. The bank is located off the mouth of the Atchafalaya River and was historically a source of sand for beach nourishment and coastal protection projects in western Louisiana. The bank is located off the mouth of the Atchafalaya River and was historically a source of sand for beach nourishment and coastal protection projects in western Louisiana. The present investigation employs a full spectral finite volume model to estimate wave transformation over the shoal due to cold front generated extra-tropical storms. The MIKE 21 spectral wave module is implemented for the shoal in a high resolution scale, to estimate wave attenuation over the shoal and to calculate the sediment transport induced by frequent winter storms. The fine resolution shoal model is nested within a regional wave model for the Gulf of Mexico. Forty-three days of NCP re-analysed wind data is used for driving the wave model and the spatial distribution of bottom sediments are also included in the model to develop friction parameters. It is found that the shoal could significantly dissipate waves during propagation over the shoal. The model results are validated with time series and spectral wave data collected from NDBC Buoy 42035. Also, the results are in excellent agreement with in-situ observations obtained from bottom boundary layer arrays deployed at two locations across a transect of the shoal.

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NET COMMUNITY PRODUCTION IN THE NATURAL IRON FERTILIZED BLOOM OF KERGUELEN

Natural iron fertilization sustains a 3 months bloom above the Kerguelen Plateau (50°S-77°E) that contrasts with the HLNC conditions prevailing in the surrounding waters. The seasonal carbon budget derived from DIC and pCO$_2$ data collected during KEOPS (January February 2005) shows that the net community production (NCP) within the bloom was roughly three times higher than outside leading to a significant enhancement the carbon export above the plateau. The examination of satellite images reveals large interannual variability in the magnitude of the bloom. To assess the impact of this variability on the NCP we use a biogeochemical model driven by the monthly cycles of chlorophyll, mixed layer depth, temperature and wind. The model is able to simulate Si(OH)$_4$, DIC and pCO$_2$ observations. The bloom during KEOPS. The simulated NCP is also in good agreement with the seasonal NCP derived from the carbon budget method. The model is then applied over ten years, 1997-2007, to investigate the interannual variability of NCP and possibly of carbon export below the bloom.
**ECOLOGY OF THE TOXIC MARINE CYANOBACTERIA, *LYNGBYA* spp., IN FLORIDA ESTUARINE AND COASTAL WATERS**

Marine *Lyngbya*, including *L. majuscula*, *L. polychoa*, and *L. confervoides* are opportunistic, toxic cyanobacterial species that form blooms that smother reefs and seagrasses. These communities produce bioactive compounds that impact grazing, C flux and nutrient cycling. In situ nutrient addition bioassays were conducted to determine nutrient(s) stimulatory to growth and nitrogen fixation of *Lyngbya* in Florida coastal waters. In April 2006, we examined effects of dissolved inorganic nitrogen (DIN) and phosphorus (DIP) additions on *L. polychoa* and *L. confervoides*, which co-occurred on a reef off the Broward County (Atlantic) coast. Another bioassay, in July, 2006 at Sanibel Island, FL, (Gulf of Mexico) consisted of DIN and DIP additions to *L. majuscula*. The *Lyngbya* communities revealed complex patterns of nutrient limitation, with most showing N and P co-limitation. Nitrogen fixation was largely confined to nighttime and stimulated by P enrichment, but unaffected by N enrichment. *Lyngbya* populations revealed metabolic flexibility; when N compounds were available, they became oscillating in a similar manner whereby a time-lag may constitute the signal detected by the antenna giving information about the size and position of the particles.

**MICROBIAL ACTIVITY AND COMMUNITY COMPOSITION IN SEEDMENTS ASSOCIATED WITH BRINE SEEPS ON THE LOWER CONTINENTAL SHELF, GULF OF MEXICO**

Brine flows are a common feature of the lower continental slope in the Gulf of Mexico. We examined sediments associated with brine flows in water depths between 1200m and 3300m in the Gulf of Mexico. Brine-impacted sediments were generally characterized by high sulfate reduction rates. One of the most interesting features was a 4 m deep, 180 m wide brine lake (90 ppt salinity) located in Alaminos Canyon block 601. Microbial activity and geochemistry varied substantially within and around the brine lake. Sediment cores were collected from the lake bottom, the lake edge, 2.5m from the lake edge, and about 50m from the lake edge (control). Sulfate reduction rates were highest in the lake edge sediments. Though lake bed and edge sediments contained high methane concentrations, rates of anaerobic oxidation of methane (AOM) were 10 to 100 times lower than sulfate reduction rates. Rates of hydrogeo- morphic netogenesis were comparable in sediment samples collected from within or near the lake. The relationship between microbial community composition and microbial activity, particularly sulfate reduction and AOM, will be discussed.

**AN INTEGRATED ASSESSMENT OF CONSERVATION AND QUALITY STATUS OF AQUATIC ECOSYSTEMS AT THE AQUATIC DISTRICT SCALE**

Nowadays, the Directives 92/43/EC (Habitat Directive) and 2000/60/EC (Water Framework Directive) establish the necessity to apply the concepts of integrated management and sustainable development. These concepts collected the necessity to value the ecosystems state through a multidisciplinary perspective. Accordingly, several methods are now in discussion for the assessment of the structural and functional features of the aquatic ecosystems (ecological status of water bodies, ‘favourable conservation status’ of habitats). This paper investigates the combination for different indicators that take into account the evaluation of river, transitional and coastal ecosystems is presented. For that purpose a generic standardized procedure for assessment the conservation status of aquatic protected habitats is combined with specific indices for each category of aquatic systems, regarding both the physical and ecological integrity, based on the quality elements developed in the current implementation of the Water Framework Directive.

**TURBULENCE EFFECTS ON PLANKTON: A NEW CARTOON**

One approach toward understanding effects of turbulence on small organisms is to place them in a much simpler flow than fully developed turbulence that displays key characteristics of turbulence. The prevailing simplification, often generated in the gap between two counter-rotating cylinders, has been Couette flow in which shear and vorticity have no spatial gradients. We reassert that simplification in light of recent advances in understanding of turbulence and find it valiant in several important respects. The typical planar condition is to be in or near a dissipation-scale vortex and in a gradient of diffusing vorticity. Among the simplest vortices that follow the Navier-Stokes equations is Burgers vortex. We use its steady and unsteady forms with established energy spectra to assess likely biological consequences. It appears that diffusing vorticity is an underappreciated generator of relative fluid motion and nutrient exchange and also a factor of potential importance to processes of encounter, coagulation and chemosensing. We are examining these effects further through a combination of numerical and analog modeling that explicitly includes vortices and spatially varying vorticity.
The goal of our study was to apply novel sensor technology to quantify aerobic respiration in relation to food supply. Sensor spots (based on the dynamic fluorescence quenching principle) were used to perform time-series respiration experiments with high temporal resolution. Compared to traditional methods for oxygen measurements the sensor spot technology was advantageous as it provided sensitive, continuous, and non-invasive oxygen measurements, and allowed the simultaneous determination of oxygen concentration in a number of respiration chambers of different size. Only 3 to 30 individuals (depending on their stage) per respiration chamber were needed to obtain a significant reduction in oxygen concentration over 3 to 5 hours. While we determined the respiration rates of nauplii and early copepodid stages at different food concentrations we also measured the feeding rates for the experimental periods. Oxygen consumption rates appeared to be affected by food concentration. The sensor spot technology is well suited to monitor the metabolic activity of minute metazooplankton organisms at close to in situ conditions.

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TWO-DIMENSIONAL STORM SURGE MODELING AND SCOUR ANALYSIS

Bridges located within complex coastal systems are highly susceptible to scour-related damage resulting from complex flow patterns and extreme flood conditions. Affected by multiple tidal inlets, the State Road A1A Matanzas River bridges in St. Johns County, Florida serve as typical examples. Several physiographic characteristics of the area create complex and potentially extreme flood conditions. These include large marsh expansions, dune overtopping, and the bridges’ proximity to the Matanzas and St. Augustine Inlets. The bridges’ proximity to Matanzas Inlet and dune overtopping allow simultaneous propagation of hurricane surges toward the bridges. A detailed analysis to assess the vulnerability of bridges to storm surge flow-induced scour is presented. This study combines technical modeling and down-slope modeling and coastal engineering methodologies required by the nature of the study area. For the complex hydrodynamic system, a two-dimensional hydrodynamic model describing the entire interconnected system provided predictions of flow conditions necessary to estimate scour during extreme (50- and 100-year) surge flood events at the bridges. Scour computations apply empirical equations developed by the Florida Department of Transportation in conjunction with the University of Florida.

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MERCURY AND OTHER TRACE METAL DEPOSITION TRENDS RECONSTRUCTED FROM A LEAD-210 DATED SEDIMENT CORE FROM BERG RIVER SALT MARSH, SOUTH AFRICA

The Berg River salt marsh is one of very few salt marshes on the west coast of South Africa and thus offers a unique opportunity for reconstructing the history of atmospheric pollution deposition. A sediment core was collected from the Berg River salt marsh for Pb-210 dating in order to reconstruct trends in mercury and other trace metal deposition. This study will compare the resulting metal inventories and temporal changes in accumulated fluxes with modeled atmospheric deposition of Hg and Pb-210. The recent degradation of water quality in the Berg River will also be taken into account and metal tracers of anthropogenic activity will be used to attempt to discern what new sources of pollution could be present.

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INSIGHTS INTO 18 DEGREE MODE WATER FORMATION FROM MEASUREMENTS OF 7BE AT THE BERMUDA TIME-SERIES (BATS) STATION

We applied measurements of Be-7 (half-life 53.3d) to study upper ocean transport properties at BATS in 2007. Be-7 is deposited upon the ocean, mixed within the surface layer and penetrates the seasonal thermocline to depths depending in part on vertical mixing and advective processes. One-dimensional models incorporating seasonal shoaling of the mixed layer during spring-summer indicate that most of the Be-7 within the thermocline is remnant of that in earlier, deeper mixed layers. Profiles taken in the late spring-summer indicate the distribution through the seasonal thermocline can be characterized by 1-dimensional processes. However, several profiles reveal increases in Be-7 activity in the nutricline (down through the mode water) suggesting imbalance from the 1-dimensional model. Further, multi-year analyses of the heat and salinity budgets of the aphytoplankton zone at BATS also reveal significant imbalances during the spring-summer transition. We investigate linkages between these imbalances and the excess Be-7-to determine the common source of these waters. We suggest that the source of imbalance is likely the result of mesoscale eddy transport of recently formed mode water(s) to the local region.

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EXPORT FLUX VARIABILITY DUE TO CHANGES IN PHYTOPLANKTON PHYSIOLOGY

Estimates of phytoplankton sticking efficiency (a) were made in the laboratory within a 1500 liter annular flume mesocosm where the turbulence kinetic energy dissipation rate was comparable to values found at the ocean’s surface on a calm day. The u of Thalassiosira pseudonana varied as a result of physiological state, ranging from 0.0108...
During the bloom initiation to 0.26 and 0.73±0.16 respectively, during the bloom maintenance and senescent phases respectively. During the maintenance phase, the physiology included: (1) diminished phytoplankton photosynthetic quantum efficiency, (2) increased super-oxide dismutase protein expression, reflecting oxidative stress, (3) induction of a biochemical cascade initiating autacoidal programmed cell death, and (4) increased concentration of transparent exopolymer products. Applying a physiologically variable α to a 1-D export flux that decreased that carbon export from a phytoplankton bloom is significantly increased because a low initial sticking efficiency allows for an increase in the critical concentration of algal cells during the late bloom stages. In turn, an increase in a maintaining the dissolved senescent phases, resulted in enhanced export fluxes during the “stickier” stages of the bloom.

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Spatial changes in the population structure and reproductive strategies of two benthic sponges in the Abyssal Northeast Pacific

Two low-lying tufted sponges, Bathedythorup sp. and an undescribed sponge of subfamily Euplectellinidae, have densities of tons to hundreds per hectare and provide areas of dense spicule habitat for other fauna. Sponge abundance and average size were analyzed at Station M (4,100 m depth) over a seventeen-year-time-series using camera-sled transects. The two sponge types had similar variations in density and average body size over time suggesting that the same factors may control the demographics of both species. Peaks in significant cross correlations between increases in particulate organic carbon flux and corresponding increases in sponge density occurred with a time lag of 13 months. When plate sponge abundance was higher, average sponge size was smaller suggesting new recruitment or regeneration of persistent sponge cells. The results also support previous suggestions that increased POC flux may induce recruitment or regeneration in deep-sea sponges. Ongoing research will use genetic markers to test these alternatives.

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THE SAVU SEA OF EAST INDONESIA - SE ASIA'S OPEN OCEAN WILDERNESS: OCEANIC CETACEAN HOTSPOT, TRADITIONAL SPERM WHALING AND INDO-PACIFIC MARINE CORRIDOR

The Savu Sea is located in eastern Indonesia at the nexus of the Pacific and Indian Oceans. It is potentially the most significant area for oceanic cetaceans in the Indonesian Seas. The Soloez-Ador islands especially boost exceptional biodiversity and abundance of large marine life and include critical habitats of regional importance. These islands are further characterized by: a) Exceptional oceanic cetacean diversity including blue and sperm whales, b) Indonesian Flowthrough Current induces major upwelling, c) Transboundary migratory corridors (Indonesia-East Time), d) Near-shore yet deep-sea habitats, e) Traditional sperm whaling village, f) Other fisheries activities with potential for unsustainable (bycatch), g) Long term cetacean studies going on since 2001, h) Rare apex predator-prey interactions (orca-sperm whale attack), i) First ever satellite tagging on Indonesian sperm and blue whales indicate that: j) considerable time spend in these waters, k) movements range 1000 km, l) blue whales may conduct frequent foraging dives. A large-scale Marine Protected Area is planned for the whole Savu Sea. This initiative will increase the representation of cetaceans and deep-sea habitats within regional MPA networks for SE Asia.

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TIME SERIES OF SATELLITE DERIVED PRIMARY PRODUCTION IN THE CALIFORNIA CURRENT

Satellite-derived time series of net primary production (NPP) is calculated for the California Current area using several algorithms. The VGP3 (Behrenfeld and Fickowsky, 1997) and CbPM (Behrenfeld et al., 2005) algorithms yield systematic differences up to 100%. Validation of the various estimates is done using the in situ data measured by the CalCOFI and CCE LTER programs. In the southern Gulf of California the annual cycle of NPP changed drastically in 2001 when the peak NPP value was more than double compared to the mean peak value during preceding years. During each of the following years the peak NPP value was over 30% lower than in 2001 but remained significantly higher than during the pre-2001 period. This shift toward increased peak NPP levels is indicative of increased nutrient loads to the system. Correlates of this regime shift with other environmental variables are examined.

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GLIDER-BASED MEASUREMENTS OF KUROSHIO SEASONAL VARIATION

Kuroshio, the strongest western boundary current in the Pacific, carries significant heat and momentum northward from the tropics. Along its path, it interacts with mesoscale eddies, topography, and modulates internal waves. It often intrudes into the South China Sea via the Luzon Strait. After leaving the Luzon Strait, it flows northward along the east coast of Taiwan and becomes stronger. The dynamic evolution of this is important. Previous observations were taken from mooring ADCP range, and other types of oceanic velocities derived from CTD sections, and subsurface drifters, which provide useful 1-D and 2-D observations in limited spatial or temporal scales. In this study, we analyze extensive continuous repeated hydrographic profiles of the Kuroshio obtained by long-range gliders. The maximum salinity (~34.8) along the Kuroshio main path is obvious. It extends deeper (around 400 m) after passing through the Luzon Strait. The effects of variations of the Kuroshio under the distinct northeast and southwest monsoons will be studied. The derived Kuroshio properties will be compared with historical observations and provide useful physics to further our understanding of the Kuroshio dynamics.

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THE METABOLIC BALANCE OF THE ATLANTIC OCEAN FROM BOTTLE INCUBATIONS AND DISSOLVED OXYGEN/ARGON RATIO MEASUREMENTS

The metabolic balance of the subtropical gyres is a contentious issue. Instantaneous rate measurements from O2 bottle incubations indicate net heterotrophy throughout large areas, but geochemical tracers and particle fluxes suggest net autotrophy or weak metabolic balance. We confirm this discrepancy by combining, for the first time, bottle incubations with a new geochemical approach using continuous measurements of surface O2/Ar ratios by membrane-inlet mass spectrometry to derive the mixed-layer metabolic balance of the subtropical gyres during two AMT (Atlantic Meridional Transect) cruises. The O2/Ar results indicate net autotrophy throughout the Atlantic subtropical gyres. In contrast, bottle incubations show regions of net autotrophy alternating with heterotrophic patches. Generally, both methods give the same sign for the mixed-layer metabolic balance during spring, but opposite signs in autumn. Since the O2/Ar data paint such a consistent picture in time and space, it is unlikely that the net biological O2 flux is directed into the subtropical cal gyres, which would correspond to net heterotrophy. In turn, this means that bottle incubations are unsuitable to correctly represent the net metabolic balance over larger temporal and spatial scales.

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MAJOR BACTERIAL CONTRIBUTION TO THE OCEAN RESERVOIR OF DETRITAL ORGANIC CARBON AND NITROGEN

Non-living organic matter in the ocean is one of the largest and most dynamic reservoirs of organic carbon on Earth, yet the relative contributions from Bacteria, Archaea and Eukarya are unknown. In this study, bacterial biomarkers (D-amino acids and muramic acid) were measured in particulate (POM) and dissolved organic matter (DOM) from the North Pacific and Sargasso Sea to estimate bacterial contributions to non-living marine organic matter. The origin and yields of biomarkers were determined in cultured marine bacteria and indicated that D-amino acids are derived from numerous macromolecules in addition to peptidoglycan. Bacterial detritus was a major component of POM and is an important source of submicron particles and colloids in the ocean. Peptidoglycan was a substantial component of POM but not of DOM. Compositional differences between POM and DOM primarily reflected the selective incorporation of specific bacterial components into these reservoirs. Bacterial organic matter accounted for ~25 % of particulate and dissolved organic carbon, and ~50 % of particulate and dissolved organic nitrogen. These results demonstrate the importance of bacteria in regulating the ocean carbon and nitrogen cycles.

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COMPARISON OF THE SUBMARINE LANDSLIDE OFF KAIJOM VOLCANO WITH THE DERRIS AVALANCHE OFF OISHIMA-OISHIMA ISLAND WHICH GENERATED THE TSUNAMI IN JAPAN

We compared the submarine landslide feature of two areas. One is the submarine landslide off Kaijoum volcano in the southern part of Japan. This submarine landslide has been discovered by Hydrographic and Oceanographic Department of Japan Coast Guard in 2006. The submarine landslide collapses from shelves edge. The submarine landslide deposits have been identified up to 320m depth of water from shelves edge. These width is 7km, and long is also 24km from shelves edge. As a result, H/L is approximately 0.08833. This H/L is...
recent advances is a discovery of multiple predominantly zonal jets. These jets are robust.

Our view of the ocean circulation is changing continually. One of the examples of the
ON THE DYNAMICS OF THE ZONAL JETS IN THE NORTH ATLANTIC
Berloff, P. S.
Kamenkovich, I. V.
plications to our understanding of the functional role of highly aggregated fish species and
that fish are rejoining the group when they have fulfilled their energy requirements after
out early morning were correlated with zooplankton prey abundances, which may indicate
regulated by a balance between the pressures of predation by visually-orientated predators
Pelagic fish schools were observed using combined moored and shipboard acoustic
Kaltenberg, A. M.
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more diverse than the population of AOB amoA genes in both oceans. Clades of AOA, but
increased with depth in both. Phylogenetic analysis indicates depth-dependant stratification
Oceans. AOA and AOB amoA gene abundance increased with depth in Southern Ocean
the polar oceans. Quantitative and phylogenetic analyses of ammonia monooxygenase genes (amoA) in
samples from the Arctic and Southern Oceans reveal differences in distributions of ammo-
oxidizing archaea (AOA) and ammonia oxidizing, beta-proteobacteria (AOB) between the
polar oceans. Quantitative real-time PCR showed that AOA amoA genes are more abundant than AOB amoA genes at all depths sampled in both the Arctic and Southern Oceans. AOA and AOB amoA gene abundance increased with depth in Southern Ocean but not in the Arctic Ocean; however, the ratio of AOA to AOB amoA gene abundance increased with depth in both. Phylogenetic analysis indicates depth-dependant stratification of AOA amoA genes and that the population of AOA amoA genes was more diverse than the population of AOB amoA genes in both oceans. Clades of AOA, but not AOB, amoA gene sequences we found are well-represented by sequences in the data-base. Our results reveal similarities as well as differences in the abundance and distribution of ammonia oxidizing prokaroytes over depth and between the polar oceans.

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The influence of zooplankton prey abundance and daylight on pelagic schooling fish behavior
Pelagic fish schools were observed using combined moored and shipboard acoustic techniques in 2005 and 2006 off the Oregon coast and in Monterey Bay, CA to investigate possible factors controlling schooling behavior patterns. Our results show that schools are regulated by a balance between the pressures of predation by visually-oriented predators and the need of individuals to eat, resulting in a strong diel pattern of formation and dis-
persal. The dawn and dusk periods of school formation and dispersal were analyzed and compared with day length and zooplankton prey abundance. Schools at both locations dispersed rapidly at dusk. However, differences in the rate of school reformation through-
out early morning were correlated with zooplankton prey abundances, which may indicate that fish are rejoining the group when they have fulfilled their energy requirements after nighttime foraging. The dynamics of school formation and dispersal have important im-
plications to our understanding of the functional role of highly aggregated fish species and their ecological interactions with zooplankton prey.

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The analysis of turbulent mixing near topographic features in the indonesian seas based on results of simulations with a regional model
Seasonal variations of distributions of turbulence kinetic energy, master length scale and vertical mixing coefficients near various topographic features are analyzed from results of simulations of the Indonesian Seas circulation with a developed regional model. The circulation is generated by seasonally varying thermohaline factors at the surface, local winds, specified total transports through the main four open ports, and specified vertical distributions of boundary layer mixing rate and salinity at the ports. The model is based on the Princeton Ocean Model and uses the Mellor-Yamada turbulence closure scheme. The horizontal grid spacing is approximately 10km and 29 sigma-levels have been chosen vertically. The Indonesian Seas region is essentially a series of deep adjacent basins sepa-
rate and enclose the Sea and are connected by narrow passages and straits. It is argued that large vertical mixing coefficients at the deep connections between basins are required to sustain deep overturns and upwellings.

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The analysis of pythiolankton parameters in the pisces model
Global ocean biogeochemical models rely on mean and poorly-know parameters to represent pythiolankton physiology. Our goal is to assimilate in situ data to improve the parameters related to mortality, grazing and growing of pythiolankton in a 1D version of the PISCES model. This has been done using the YAO software, which allows to generate the adjoint of a direct model and provides suitable tools to perform data assimilation. YAO was used to assimilate vertical profiles of both nutrients and chlorophyll at each station to estimate both a robust prior and a matrix covariance error to the prior. Assimilation results show that this approach allows retrieving realistic physiological parameters that yield a good agreement between PISCES and data, despite the monthly sampling frequency. We finally discuss the relevance of the physiological parameters at the different stations.
Little is understood about complex nitrogen cycling through estuarine systems, especially bottom-up forces of microbial transformations. Our research quantifies rates of nitrogen fixation and denitrification in a eutrophic southern California estuary and investigates causal relationships with nitrogen enrichment. Field surveys over two years measured fixation and denitrification rates and abiotic characteristics in intertidal mudflats along tidal creeks of Upper Newport Bay Estuary, California. Surveys showed spatial and temporal variability, with low nitrogen fixation activity compared to east coast systems. Denitrification appeared to be more important in this eutrophic estuary. Physical characteristics, including surface organic content, and nutrient availability explained some variability; other processes clearly need to be studied. Manipulative experiments investigated quantitative relationships between fixation, denitrification and factors associated with eutrophication, specifically increased water nitrate and macroalgae mat density. Nitrate enrichment resulted in decreased fixation and increased denitrification. The function of macroalgae on intertidal mudflats is more complex, with increased fixation and decreased denitrification rates beneath dense, but not sparse, mats. Relationships between these microbial processes and eutrophication, especially macroalgae influences, will provide insight into eutrophic estuaries worldwide.

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SIMULATIONS OF THE INTERACTION OF MESOSCALE CURRENTS AND INTERNAL TIDES
Significant progress has been made in understanding the energetic and dynamics of internal tides in the coastal ocean, however, little has been done to examine the interaction of tides with mesoscale dynamics. In this work we investigate the influence of mesoscale currents on internal tides in the Monterey Bay area using the nonhydrostatic SUTANS model. Boundary conditions for tides and currents in SUTANS are obtained by superimposing the tidal currents obtained from OTIS over the mesoscale currents computed by U.S. West Coast simulations using ROMS. Simulations using real as well as idealized bathymetry are performed to gain an understanding of how mesoscale currents modify the internal tidal dynamics in Monterey Bay. Specifically, simulations with only tides, only with currents, and with both tides and currents are compared to assess the relative effects of the currents on the internal tidal flux of energy and flux distribution in the Bay. This work is part of a long-term project in which the submesoscale dynamics computed by SUTANS will be fed back into ROMS in full two-way coupled simulations of tides and currents. This work was supported by ONR Award N00014-05-1-0294.

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INTERDISCIPLINARY MODELING SUPPORT TO CERP WITH THE COASTAL HYCOM SYSTEM
The South Florida (SoFLA) HYCOM (3.6 km resolution) and the embedded, high resolution Florida Keys (FKEYS) HYCOM (900m resolution) encompass all coastal areas that dominate the marine environmental impacts of the Comprehensive Everglades Restoration Plan (CERP): the broad Southwest Florida shelf, the narrow Atlantic Keys shelf, the shallow Florida Bay and Biscayne Bay, including Marine Protected Areas (the Florida Keys National Marine Sanctuary and the Dry Tortugas Ecological Reserve). They also connect Florida’s coastal areas to the adjacent deep Atlantic Ocean. A team of Florida State University and the National Oceanic and Atmospheric Administration State of Florida to accommodate the influence of the strong Loop Current/Florida Current system and associated eddies. Model results are validated against observations and help interpret recent data findings within Florida Bay. Regional rivers (from Shark River to Caloosahatchee River) are found to play a significant role in alleviating Florida Bay hypersalinity conditions through intrusions of low salinity waters in the wet season. A biological lagrangian transport model of coral fish larvae is coupled to the circulation modeling to examine CERP induced impacts of changes in habitat characteristics on fish recruitment for the Florida Keys.

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THE RESEARCH OF DIAPICINAL TURBULENT MIXING IN THE SOUTHERN OCEAN
Enhanced diapycnal turbulent mixing in the Southern Ocean is clearly shown from analyses of the observations in the 19th, 21st, and 22nd China Antarctic Research. The enhanced mixing appears near the bottom of the continental slope, with a maximum diapycnal diffusivity of 6x10^-4 m^2/s and a maximum thickness of hundred meters in the mouth of Prydz Bay. The mixing over the bottom layer of continental shelf is evidently enhanced at sections between the Zhongshan and Changzheng Station. There is a large divergence region (particularly Antarctic Slope Front), where enhanced mixing is found in a large depth range, in the whole Southern Ocean. The enhanced mixing is also seen along and across Antarctic Circumpolar Current (ACC), and sections in Prydz Bay, especially in the weakly stratified Antarctic Deep Water.

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OCEAN MODEL ERRORS IN SEA SURFACE HEIGHTS AND A GLOBAL PATTERN OF MESOSCALE VARIABILITY
Monthly anomalies of sea surface height from satellite altimetry maps are compared with data assimilation and simulation products from a variety of regional and global ocean models, ranging from simple linear-long wave approximation to state-of-the-art eddy-resolving GCMs. While better different in magnitude due to the differences in model complexity, resolution, and data assimilation settings, patterns of error variance for all products have a great deal of spatial similarity. Their common features are recognizable as those of a well-known pattern of mesoscale variability in the surface ocean. All global and regional models considered in this study are shown to underestimate short-term (sub-monthly) and especially small-scale (mesoscale and smaller scales) variability in the ocean. Data assimilation procedures cannot fix this systematic bias in model variance, yet it is correlated with models’ performance on larger and longer scales. Therefore, variances of simulated small-scale and short-term variability relative to the observed variances are important measures of model performance and a natural target for improvement. Model resolution rather than choice of wind forcing seems to be the main controlling factor for these measures.

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HF RADIAR V21: MOVING BEYOND THE STATUS QUO FOR HF RADIAR DATA MANIPULATION, PROCESSING AND MANAGEMENT
Historically, the analysis of HF radar data has relied on relatively simple methods for processing current measurements from HF radars into estimates of the vector current field. These methods, based on least-squares inversion of radial measurements within a certain distance of a point, leave much to be desired in terms of optimal estimation, error propagation, identification of spatial scales, and interpolation. Recently, there have been improvements at all levels of HF radar data processing, ranging from the metadata produced by the instruments to the techniques available for estimating currents and uncertainties. The techniques for processing radials into totals now include a variety of objective mapping or optimal interpolation methods that integrate current estimation, spatial and/or temporal interpolation and error propagation. We have developed a sophisticated Matlab toolbox for HF radar data that includes several of these methods, as well as functions for data manipulation, analysis and visualization. Here, we discuss our understanding of the current state of the art for HF radar processing including an overview of the conceptual links between the different techniques for processing HF radar data, as well as some of the limitations of our current knowledge. We also explain how the Matlab toolbox works, the basic functions it provides, and indicate how it serves as a foundation for future development and innovation in the field.

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MIXED LAYER MODEL PERFORMNACE IN THE MEDITERRANEAN SEA
An eddy resolving (approximately 3.5 km resolution) Hybrid Coordinate Ocean Model (HYCOM) is configured for the Mediterranean Sea. Performance of the model in predicting surface temperature (SST) is then examined using various different mixed layer depth formulations: (1) K–Profile Parameterization (KPP), (2) Goddard Institute for Space Studies (GISS) model, (3) Mellor-Yamada 2.5 turbulence closure (MY2.5), (4) Kraus-Turner (KT) model and (5) Price-Weller-Pinkel (PWP) model. Model simulations are performed using
high temporal resolution (3 and 6 hourly) atmospheric forcing. There is no assimilation of any SST data, and there is no relaxation to any SST climatology. It is found that while all mixed layer models in HYCOM perform nearly same in simulating SST, there can be substantial differences in subsurface temperatures.

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COPEPOD FEEDING QUANTIFIED BY PLANAR LASER IMAGING OF GUT FLUORESCENCE

We have developed a novel imaging system to record individual copepod gut fluorescence in-vivo, as the animal feeds on a continuous source of phytoplankton. Images are collected at a rate of 3-4/min, for several hours, and are detailed enough that discrete gut compartment activity can be resolved. This allows us to quantify the dynamics of gut content, which we then relate to the animal's feeding behavior. We report here observations from two types of experiments. First, we imaged the feeding of the same tethered copepod at 3 different temperatures, and repeated this process for several copepods. Second, we conducted a bolus-chase experiment, where food was cut off after letting the copepod feed for an hour, and the changes in gut activity were recorded. We discuss the implications of these results; in particular we examine the temporal scales that are significant in individual feeding behavior, how these scales can vary at an inter- and intra-individual level under a range of conditions, and how this behavioral variability might be reconciled with data collected in the past.

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NUTRIENT DYNAMICS AT STATION ALOHA

Station ALOHA (22.75 N, 158 W) is the oligotrophic North Pacific Ocean benchmark site of the Hawaii Ocean Time-series (HOT) program. Approximately monthly ship-based sampling since October 1988 combined with higher frequency satellite, mooring and Seadragon observations, has provided a comprehensive data set on physical and biogeochemical characteristics and processes, including nitrogen supply required to sustain primary and export production of organic matter. The discovery of unexpected microbial taxa and new metabolic processes including, but not limited to nitrogen (N) fixation and nitrification pathways, are strongly linked to energy capture and coupled cycles of C, P, N and Fe and climate variability has sustained scientific interest and broadened participation in this two decade long (and continuing) ocean time-series program. Major paradigm shifts include the quantitative role of N fixation in new production, recurrent summertime plankton blooms, decadal-scale variability in primary production and export, and a decoupling of N and P cycles. The recent establishment of the NSF funded Center for Microbial Oceanography: Research and Education (C-MORE), built on a HOT foundation, provides the opportunity for comprehensive field testing of key HOT hypotheses.

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A 1-YEAR MESOSCALE SIMULATION OF THE BIOGEOCHEMISTRY IN THE NORTH-EASTERN ATLANTIC OCEAN

Assumed to be a CO2 sink, the POMME area (NE Atlantic: 16-22°W, 38-45°N) was surveyed in 2000/2001 in order to understand the subduction processes and to study the biogeochemical properties of the subducted water masses. To address these issues, an eddy-resolving in situ study has been performed to sample the ocean dynamics and the ecosystem evolution during one year. The results of a high resolution simulation (5 km) are discussed: it is based on a primitive equations model (OPA 8.2) coupled with a nitrogen-based biogeochemical model (LOBSTER). Initialisation, boundary conditions and validation rely on the in situ and satellite data collected during the POMME cruises. The computed net transfer of water to the inner ocean by subduction of 0.53 Sv mainly occurs in the density class 26.9 - 27.1, corresponding to the subpolar mode waters in agreement.

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INTERANNUAL VARIABILITY OF SEA SURFACE TEMPERATURE IN THE EAST PACIFIC WARM POOL AND CENTRAL AMERICAN RAINFALL

SST in the east Pacific warm pool (EPWP) plays an important role in Central American rainfall, tropical cyclogenesis, and large-scale tropical heating. The first part of this presentation is aimed at understanding what processes govern the interannual variability of SST in the EPWP. Interannual wind stress, shortwave radiation, and precipitation were used as forcing to an ocean general circulation model. The high correlation between the EPWP and ENSO is explained by the fact that equatorial SST anomalies modify the distribution of atmospheric vertical motions and therefore cloud cover and shortwave heating. The second part is aimed at clarifying the role of the EPWP in interannual rainfall anomalies in Central America. An anomalously warm EPWP can trigger a rapid enhancement of the eastern Pacific ITCZ during late rainy seasons following peak ENSO events, which leads to increased rainfall over Central America. Moreover, the timing and amplitude of the SST-enhanced ITCZ depends on the persistence of the ENSO event. Both results emphasize the importance of ENSO prediction, and the need for accurate modeling of tropical atmospheric cells less than ~10 in meridional scale.

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CONTRASTING CONDITIONS IN THE GREENLAND SEA: IMPLICATIONS FOR ENERGY TRANSFER TO HIGHER TROPHIC LEVELS

The Greenland Sea is characterized by Arctic water flowing south from the Arctic Ocean along east Greenland, warm water flowing north from the Atlantic Ocean, and cold Arctic water flowing south in the Sorkapp current, adjacent to the west coast of Spitsbergen. Each of these water masses carries with it different zooplankton communities. Adjacent to Greenland, there are high densities of the lipid-rich copepod Calanus hyperboreus. The Atlantic influenced water carries with it high densities of small Calanus finmarchicus. Adjacent to Spitsbergen, the Sorkapp current carries high densities of medium-sized Calanus glacialis. Zooplanktonivorous little auks (Alle alle) are abundant seabirds that breed adjacent to all of these water masses. Here we examine the impact the different physical and biological conditions have on the distribution of foraging little auks measured by at-sea surveys, their diving behavior (measured by time-depth-recorders), and the prey they feed their chicks. The Greenland Sea provides a good model to explore how future increases in warmer water and decreases in the strength of currents with Arctic origins, may impact upper trophic predators in sub-polar seas.

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TEACHING PHYSICAL CONCEPTS BY OCEAN INQUIRY: REACHING PRE-AND IN-SERVICE TEACHERS

"Tell me and I'll forget, show me and I may remember, involve me reflectively and I'll understand." In our version of this old adage, the last part stresses the spirit of the inquiry-based learning that is the essence of a COSEE-Ocean Systems program developed at the University of Maine by a partnership of educators and scientists. The program offers a collegiate course to target pre-service teachers and science majors contemplating education careers, and summer workshops to target in-service teachers. By focusing on basic physical concepts addressed by national and state learning standards and by providing hands-on inquiry-based activities and opportunities for pedagogical reflections we are able to reach out beyond teachers of marine science and beyond teachers in coastal communities, to teachers of physical sciences in inland and rural communities. We will share our experiences with problems and solutions related to the crossing of "cultural" boundaries to establish a partnership between the college of Education and the School of Marine Sciences, the recruitment and networking of participants, the development and implementation of the course and workshops, and evaluation of our efforts.

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NITROGEN AND OXYGEN ISOTOPE FRACTIONATION ASSOCIATED WITH NITRATE ASSIMILATION DURING CONTINUOUS CULTURE OF A MARINE DIATOM

We investigated the N and O isotope effects (εN and εO, respectively) associated with nitrate assimilation through continuous culture of the marine diatom Thalassiosira weissflogii. Under light limitation, εN and εO, and the size of the internal nitrate pool increased with decreasing light and growth rate, εN reaching 19‰ at 0.25 of the maximum growth rate. In contrast, the same parameters showed no relationship with growth rate under phosphate
limitation, "ε" remaining constant at 5-6‰. "ε" did not diverge coherently from 1:1 across all growth conditions. The results suggest there is no single intrinsic relationship between the rate of net nitrate assimilation and the magnitude of "ε" and "δ". Expansions in nitrate metabolism associated with light-growth limited growth led to increased "ε" and "δ". This effect requires consideration in interpreting modern and paleoceanographic "N" data and may contribute to the high "ε" observed in the deep mixed layers of the Southern Antarctic Zone. The consistent "ε" of 1 associated with nitrate assimilation makes it possible to identify co-occurring N processes that cause deviation from this ratio, such as nitrification.

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PREDICTABILITY LOSS IN AN INTERMEDIATE ENSO MODEL DUE TO INITIAL ERROR AND ATMOSPHERIC NOISE

The predictability of ENSO variability in a version of the Zebiak-Cane coupled model is examined in a perturbation experiment. Instead of assuming that the model is "perfect," it is assumed that a set of optimal initial conditions exists for the model. These states are obtained through a nonlinear minimization of the misfit between model trajectories and the observations. Realistic estimates of the observational error covariance of SST, zonal wind stress, and thermocline depth are used to perturb these initial states, and the error growth is examined. Forecast uncertainty is shown to be most sensitive to initial error in the thermocline depth. This uncertainty leads to larger forecast error growth than continuous stochastic forcing of the zonal wind stress fields. It is demonstrated that during years with negative (and rapidly decaying) Niño-3 SST anomalies (e.g. the time following an El Niño event), there is a suppression of error growth. In years with large warm ENSO events, the ensemble spread is no larger than in moderately warm years. As a result, periods with high ENSO variance have greater potential prediction utility.

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FIVE YEARS OF NORTH ATLANTIC OPEN-OCEAN TIME SERIES STATIONS IN THE ANIMATE CLUSTER

Scientific as well as technological achievements from five years of operation of three multidisciplinary North Atlantic time series observatories (parts of the ANIMATE cluster) will be presented. In general the three open ocean sites are located in very different physical/ecological regions: off Greenland, off Ireland, off Canary Islands. The basic biogeochemical as well as physical settings from the observations will be presented (e.g. seasonal cycle, variability) and compared with climatological estimates. As one example for a joint physical/biogeochemical interpretation of data an ‘apparent’ diurnal cycle in biogeochemical variability) and compared with climatological estimates. As one example for a joint biogeochemical/ecological regions: off Greenland, off Ireland, off Canary Islands. The basic biogeochemical

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ANNUAL AND INTERANNUAL OCEAN VARIATIONS IN THE MINDANAO DOME REGION: OBSERVATIONAL STUDY

The Mindanao Dome, which locates east of Philippines, has been investigated using numerical models so far, however, not fully discussed from the view of observations. We discussed ocean variations with time scales of longer than annual signal in the Philippine Sea mainly focusing the Mindanao Dome. TRITON buoy data at 8N130E, 8N137E and 8N144E, 8N151E show clear annual signal in this region. At 8N, observed annual signal is associated with ascending and descending of thermocline due to westward propagation of Rossby waves rather than local wind effect. Local Ekman pumping effect which is thought to be an important factor for generation of the Mindanao Dome is large at 8N, that is, mechanism of the generation of the Mindanao Dome differs with the latitude. Increasing trend of heat content is also clear at 8N, but not south of 5N after 2003 to 2006. This result indicates that heat has been accumulated not only in the equatorial region but in the off-equatorial region of the western boundary of the tropical Pacific. This result indicates that heat has been accumulated not only in the equatorial region but in the off-equatorial region of the western boundary of the tropical Pacific. This result indicates that heat has been accumulated not only in the equatorial region but in the off-equatorial region of the western boundary of the tropical Pacific.

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MODELING CIRCULATION IN THE LANDFAST ICE ZONE

Inshore of the 20 m isobath arctic shelves are covered by immobile landfast ice preventing the direct transfer of water to the interior shelf in winter. Outer shelf circulation is directly wind-forced whereas inner shelf dynamics are controlled by remotely-established pressure gradients and frictional coupling of the flow field to the bottom and the under-ice boundaries. To demonstrate the effect of landfast ice and winds on shelf circulation beneath fast ice, process type numerical models were used to investigate nearshore flows under landfast ice. Landfast ice was simulated by applying a frictional force to the ocean surface. offshore of the ice, a suite of wind profiles were used to investigate response. Circulation differs markedly between the inner and outer shelf with the transition marked by a velocity front suggesting limited exchange occurs across the landfast ice edge throughout winter. Through vorticity stretching, offshore winds drive a counter flow beneath the landfast ice. The underflow flow field is sensitive to the magnitude of the ice-water friction but less sensitive to the spatial structure of the frictional coupling.

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THE TEACHER-SCIENTIST INSTITUTES OF THE COSEE/GCGM - CATALYZING RELATIONSHIPS AMONG SCIENTISTS AND TEACHERS TO ENRICH CLASSROOM OCEAN SCIENCES LEARNING

A primary strategy used by the Center for Ocean Sciences Education Excellence in the Central Gulf of Mexico (COSEE/GCGM) is the Teacher-Scientist Institute. This institute, held each summer in two Gulf Coast states, includes a week of field study followed by a six-session online institute. The most concrete product is a collection of lesson plans that are aligned to Ocean Literacy principles and concepts, and National Science Education Standards, and made available on the COSEE/GCGM website. Another important result of the institutes is the initiation of relationships among participants. The field institute is professional development for both teachers and scientists. During this powerful experience teachers learn ocean science content from the scientists while beginning to get a feeling for the way scientists conduct research. Likewise, through the process of lesson plan development, teachers introduce scientists to the culture of secondary classrooms, from which graduates enter scientists/university classrooms. This presentation will discuss how the Teacher-Scientist Institutes promote Ocean Literacy, and efforts to sustain the teacher-scientist community as a resource for continued teaching enhancement.

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RETRIEVAL OF OCEAN COLOR INFORMATION OVER THE TURBID WATER AREA

Ocean color remote sensing is the technique to estimate the quantity of the ocean materials (e.g. Chlorophyll-a, Colored dissolved organic matter, Suspended solid, etc.) with the spectral characteristics of the upwelling radiances beneath the surface (called water leaving radiation). Thus, for the satellite observation, the atmospheric correction to retrieve the water leaving radiances is important technique. The major error of the atmospheric correction is caused by the estimation of atmospheric aerosols that is highly variable in both space and time. Especially, in the general algorithm with two near-infrared observation data, the correction over the coastal region becomes more difficult because the influence of the signal other than atmosphere (e.g. turbid water background) cannot be ignored. In this study, as the approach to solve the atmospheric correction problem over the coastal region, we examined the atmospheric correction method with multi-viewing satellite observation data. This method directory estimates the both of the water leaving radiation and aerosol properties by using the directional dependency of atmospheric aerosol scattering. In this paper, we present the application result with POLDER2 multi-viewing observation data around Japan, and also present the comparison results with general algorithm.

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TEMPORAL FLUCTUATIONS OF THE SOUND SIGNALS IN SHELF ZONE IN PRESENCE OF MOVING INTERNAL WAVES

Temporal fluctuations of the sound intensity in shallow water initiated by moving trains of intense internal waves (IW) are considered. Due to the anisotropic structure of IWs, fluctuations can have different mechanisms and in turn different characteristics. We assume that mode coupling, advective variability and/or horizontal refraction are the main reasons for these fluctuations. The amplitude of fluctuations depends upon the direction of propagation of sound signals relative to the direction of IW propagation. We derived an expression for the scintillation index (SI) as a function of frequency, mode number and direction of sound propagation. Theoretical analysis is compared with experimental results from the SWARM95 and SW06 experiments.

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DECADA L CHANGES OF BOTTOM WATER AND MERIDIONAL HEAT/SALT FLUXES ACROSS THE SOUTHERN HEMISPHERE SUBTROPICAL GYRES

Four WHP zonal sections, occupied between 1992 and 1995 across the southern hemisphere subtropical gyres, A10, B3, B4, and P6, were revisited as part of BEAGLE project.
in 2003 and 2004. Variations of water properties are studied following neutral density surfaces as a focus of deep water masses. Circumpolar Deep Water in the Southwest Pacific Basin is found fresher by 0.002 psu. The number is marginally greater than the measurement precision, but systematic errors cannot explain the shape difference of the TS curves and we argue that the difference is significant. The change can be explained by observed freshening of Antarctic Bottom Water formed in the Indian and Pacific Oceans. Results from two OGCMs were adopted to discuss the decadal variations of the meridional heat and salt fluxes across the sections. The fluxes show variability with periods of 2 to 10 years. In particular, the heat flux shows a significant correlation with the Southern Oscillation Index and Southern Annular Mode Index. The correlation is explained mainly by the wind changes over the Pacific.

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DISTRIBUTION OF PHYTOPLANKTON COMMUNITIES AT THREE NE-ATLANTIC SEAMOUNTS AND AN E-MEDITERRANEAN SEAMOUNT DETERMINED BY CHEMOTAXOMETRY

In order to investigate how seamounts possibly influence the distribution and dynamics of phytoplankton communities, the north-eastern Atlantic seamounts Ampere, Great Meteor, Seine and the east Mediterranean Anaximenes Mountain were investigated during long-term sampling and water sampling for defined depths, from the surface to 150 m, were filtered for analysis by chemotaxonomic methods using HPLC of photosynthetic marker pigments followed by analysis with the software CHEMTAX to determine the contribution of different taxonomic groups to the phytoplankton community. The dominant phytoplankton groups at all studied seamounts belonged to the picoplankton (prochlorophytes, cyanophytes, chlorophytes) and nanoplanckton (pyrroesiophytes), characteristic of the oligotrophic regions where the seamounts are located. Exceptionally, at some sampling sites and depths, these dominant taxa were replaced by microplanktonic groups, such as diatoms and dinoflagellates. This could be explained by slight upwelling conditions caused by local topographic features resulting in somewhat higher nutrient concentrations. Moreover, an influence of the seamounts on the vertical distribution of the deep chlorophyll maximum layer could be detected. This consisted mainly in a somewhat shallower DCM layer above the seamount summits indicating a Taylor column.

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ENERGY DISSIPATION OF INTERNAL TIDES IN SAGAMI BAY, JAPAN

To investigate an energy dissipation process in Sagami Bay, Central Japan, Turbopac casts were performed across a shelf near the north coast of the bay in summer, 2007. While the strong vertical shear (the energy dissipation rate of about 1.0×10^-6 W kg^-1) existed near the bottom on the shelf region, the amount of the maxima gradually decayed toward the deep sea region. In addition, the locations of the strong vertical shear were nearly equal as the bottom of the shelf on the deep sea region and slightly deeper or shallower with distance from the shelf. Since the large internal tides, especially semidiurnal period, is observed during summer in the bay, the characteristic slope of the semidiurnal internal tide was estimated using a density profile by CTD observation. The locations of the maxima of the vertical shear overlapped the characteristic slope from the bottom of the shelf break. Thus, it is expected that these strong vertical shears were induced by the scattering of the semidiurnal internal tide at the shelf break.

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CHANGE IN TEMPERATURE OF BOTTOM WATER IN THE PACIFIC

Recent studies have clarified the warming in the Pacific not only in the upper part but also in the deep, for example, in the NADW in the south Pacific by Johnson et al. (1994), in the mid-depth of the Southern Ocean studied by Gille (2002), in deep water in the north Pacific along 47°N by Fukasawa et al. (2004), in deep water along the path of the CDW by Kawano et al. (2006) and in Wake Island Passage by Uchida et al. (2007), and in deep water in the Pacific by Johnson et al. (2007). The warming and warming trend of the global temperatures shown by Wills et al. (2006) and Levitus et al. (2006) is also confirmed in the Pacific on Thermohaline Circulation in the Pacific. In this study, we analyze the data obtained in 2007 by trans-Pacific surveys along 47°N and the International Date Line. The surveys were designed to trace the hydrographic sections where had been observed during the WOCE, and thus improve our understanding on temperature changes in the deep and bottom water of the Pacific.

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CONTRIBUTIONS OF LIVING BACTERIA AND BACTERIAL DETRITUS TO SUSPENDED POC IN THE NORTH PACIFIC GYRE

Accurate measurements of the carbon content of heterotrophic bacteria are essential for quantitative assessments of bacterial contributions to biogeochemical cycles, yet considerable variability (~3 fold) exists among existing estimates of the carbon content of marine bacteria. Amino acid carbon yields in size-fractionated samples and bacterial cultures were used to estimate the average carbon content of heterotrophic marine bacteria in the coastal (8-14 fg C cell^-1) and open ocean (5-7 fg C cell^-1). These values are about 2 to 3 times lower than commonly used values and indicate that contributions of living bacteria to suspended particulate organic carbon (POC) in the open ocean are lower than previously estimated. Carbon-normalized yields of uramic acid, D-alanine and D-glutamic acid, unique biomarkers of bacteria, were used to estimate that bacterial detritus comprised 6-14% of suspended POC at the Hawaii Ocean Time Series station. Bacterial detritus likely comprises a large fraction of the submicron particles and colloids in the ocean.

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LINKING A LOWER TROPHIC LEVEL BIOGEOCHEMICAL MODEL WITH AN UPPER TROPHIC LEVEL ECOSYSTEM MODEL

The Ecopath with Ecosim (EwE) model is widely used in the ecological community to investigate upper trophic level interactions and their effects on commercial fisheries. EwE promotes the ice-drift divergence and lead to more reduction in ice concentration through thinning of surface Ekman layer.
integrates many fisheries-related datasets to estimate energy flows between functional groups and simulates changes based on changing fishing and predation pressure. The EwE model looks primarily at predator-prey relationships as the key force of change in functional group populations, without considering the effects of changing ocean biogeochemistry, which can play a key role in the growth of primary producers and lower trophic level consumers. In this study, we use the results of a full biogeochemical model to force the lower trophic levels. The model considers the biogeochemical pathways of major nutrients as well as dissolved oxygen, dissolved inorganic carbon, and alkalinity, and is integrated with a full ocean-atmosphere physical ocean model. With this information, it predicts the population changes in three size classes of phytoplankton. By using this information in conjunction with the EwE model, we can study the potential effects of biogeochemical changes in the ocean on upper trophic level populations.

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SALINITY-BASED ECOLOGICAL AND HYDROLOGIC GOALS FOR BISCAYNE AND FLORIDA BAYS

Goals for desired ecological conditions for Southern Biscayne Bay and Northeast Florida Bay have been developed to promote the ongoing restoration efforts in South Florida, including CERP. These goals include healthy seagrass communities that support a variety of estuarine ecosystem services, the ability to reach these ecological goals is dependent upon the available fresh water volume, quality, timing and location. Salinity, a direct and integral result of the distribution of fresh waters in the estuarine zone, is used to establish a practical link to the hydrologic restoration targets. Different analytical and modeling methods and associated uncertainties were used to produce a range of estimates for the volume of estuarine fresh water required to reach local restoration goals. Estimated annual volumes for Northeastern Florida Bay are 7.1 x 10^9 m^3/yr, while Southern Biscayne with its far greater tidal exchange rate requires an estimated 1.4 x 10^9 m^3/yr. Both estimates carry uncertainties of approximately 20% and assume a natural hydrograph.

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CLIMATE-DRIVEN CHANGE IN THE BIODIVERSITY SOFT BOTTOM MACRORENSHOS- - ARCTIC CASE STUDY (KONGSFJORDEN, SPITSBERGEN)

Increased interest in consequences of climate change motivates research in high arctic. Glacier retreat and increased input of Atlantic water into arctic fjords are predicted consequences of climate warming. Glacier retreat is accompanied by an increase in meltwater outflow and a flux of inorganic particles and therefore has a direct influence on the benthic communities diversity and its variability. Also the balance between Arctic and Atlantic water conditions in the fjord is probably sensitive to climate changes. Kongsfjorden (79° N) is one of European Biodiversity Research Site. The year-to-year (1997 - 2006) biodiversity in benthos at three monitoring stations in Kongsfjorden is compared. The main aim is to answer the question whether the benthic diversity in Arctic was changing (in the decadal period of time) and whether climatic differences in following years influence the variability in benthic biodiversity. “Warm years” with high amount of Atlantic water advected, warm air temperature and strong glacial outflow are contrasted to “cold years” with local waters domination and less intensive glacial discharge. The patterns of diversity change are related to environmental changes and its climate proxies.

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SEASONAL PATTERNS OF EXCHANGE BETWEEN ST. LOUIS BAY AND MISSISSIPPI SOUND, U.S.A.

The dynamics of estuarine and coastal flow within Mississippi Sound, USA, are being investigated using numerical models. The hydrodynamics for 2005 have been simulated on nested grids as small as 80 m. The flow fields calculated on this grid are used to transport dissolved material using both Lagrangian and Eulerian numerical methods. First, discrete particles were released at several points within St. Louis Bay. The second method calculates the transport of a non-conservative tracer using a 3D transport model. The circulation within the bay is dominated by tidal flow with periodic cold fronts and occasional tropical cyclones. The weak residual tidal flow and asymmetric circulation within the bay can transport dissolved material to the entrance of the bay but is not strong enough to continuously move it into the adjacent sound. Circulation within the bay and sound during cold fronts can assist this tidal flow in transporting dissolved material into Miss. Sound. The dominant mechanism for exchange between St. Louis Bay and Miss. Sound appears to be horizontal advection. The model results suggest that significant exchange occurs during both the increasing and waning phases of a hurricane. This result supports previous field work, which indicates that dioxins and heavy metals from outfalls within the bay are showing up in shellfish and sediments in Mississippi Sound.

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A GLIMPSE OF OCEAN BIODIVERSITY THROUGH EXPLORATION COUPLED WITH TELEPRESENCE

Technology enables each advancement made in exploration, from the poles to the deepest reaches of the ocean, to outer space. Discovery of new life at hydrothermal vents was made possible by submersible technology, and continued enhancements in satellite sensors provide ever-improving discoveries of planetary scale changes like those due to El Nino and those taking place in the deepest parts of the ocean. It is cutting-edge technology that enables us to expand boundaries of the known world while engaging all who wish to be involved in these discoveries in real-time. With the unprecedented advancements in all areas of technology, learning is no longer restricted to a place and time, and students are perhaps the most profoundly affected by this evolution in how they learn and where they learn than any other segment of our society. The NOAA Ship Okeanos Explorer, outfitted with state-of-the-art telepresence capabilities, will enable us to expand the reach of NOAA ocean science in novel ways to students of all ages. This presentation will focus on the status of bringing the unknown ocean world in new ways to all who wish to explore it.

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DECADAL PREDICTION: CLOSING THE GAP BETWEEN CLIMATE PROJECTIONS AND SEASONAL FORECASTS

Predicting climate variations over the next decade has clear socio-economic benefits. Less clear perhaps, but of equal or greater importance, is the reduced uncertainty in climate change projections that will result from better understanding and modelling of the climate system. Here, skilful decadal hindcasts of North Atlantic sector climate are presented. The hindcasts were performed with the MIPI-OM/ECHAM5 model, were ten years long, consisted of three ensemble members, and covered the period 1955 till 2005. Initial conditions were generated by relaxing coupled model sea surface temperature to observations. The model is able to predict Atlantic meridional overturning circulation changes and surface temperature variation over the North Atlantic, North America and Western Europe out to a decade in advance. Our prediction for the next decade indicates a weakening of the MOC and delay in the anthropogenic induced warming of the surface temperature in these regions, and globally. Major differences to seasonal forecasting will be discussed, by presenting results from similarly performed seasonal forecasts. The role of high versus low latitude in the initialisation technique, and the sensitivity to the treatment of salinity are investigated in additional experiments. Sensitivity to model formulation is also assessed with experiments using another model(NEMO/ECHAM5).

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THE DISTRIBUTION OF COLORED DISSOLVED ORGANIC MATTER (CDOM) AND SALINITY ALONG THE SOUTHERN NEW ENGLAND COAST FROM AIRCRAFT REMOTE SENSING

Using in situ measurements of estuary color, algorithms were developed to estimate colored dissolved organic matter absorption at 412 nm (acdOM412) and surface salinity in New England waters. Model estimates were compared with measured CDOM absorption values and surface salinity from Narragansett Bay, Rhode Island. Statistical analysis showed a strong correlation (R = 0.88) between acdOM412 and the ratio of remotely sensed reflectance at 665 and 490 nm. The standard error between measured and predicted absorption values was 0.1 /m. Results also showed a strong correlation (R = 0.92) between acdOM412 and salinity, with a standard error of 0.5 parts per thousand (ppt). The robustness of the acdOM412 algorithm was tested using in situ spectral measurements (2005 - 2007) from Narragansett Bay, the Providence River, and Long Island Sound to predict surface salinity. Test results indicated a very strong correlation (R = 0.92) between measured and predicted salinities with a standard error of 1.0 ppt. Using aircraft spectral data from Long Island Sound to Nantucket Sound, the spatial and temporal variability in acdOM412 and salinity are presented on a regional scale.

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The Alvarado Lagoon System (ALS) consists of shallow rivers and lagoons connected to the Gulf of Mexico (GOMEX) by a narrow channel. We collected samples of water and fishery and human hair and sediment in 2005. Total Hg in sediments ranged from 27.5 to 90.5 µg Hg/g dry weight, with fish and shellfish Hg levels ranged from 0.01 to 0.53 µg Hg/g wet weight. Total Hg in human hair ranged from 0.10 to 3.36 µg Hg/g (n = 47) and 58.9 % of the hair samples were above 1.00 µg Hg/g. Mean hair Hg levels were 1.12 ± 0.62 and 1.48 ± 0.86 µg/g for children (n = 20) and adults (n = 27), respectively. Water column concentrations

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of total unfiltered Hg ranged from 0.9 to 12.6 ng/L. These levels are similar to other estuaries tested, excluding the northern GOMEX. The ALS discharges around 95 kg Hg/yr into GOMEX, approximately 0.38 % of the annual atmospheric Hg deposition, and about 0.43 % of annual Mississippi river discharge.

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SALINITY AND MESO-ZOOPLANKTON COMMUNITIES IN FLORIDA BAY

Florida Bay has significant spatial and temporal salinity variability, due to heterogeneity in freshwater sources, minimal exchange between the four major sub-regions, seasonal cycles of rainfall, runoff, and evaporation, and the influence of large-scale phenomena (i.e. tropical cyclones and El Niño). Furthermore, salinity likely will affect the alibatic parameter most directly affected by CERP activities. Meso-zooplankton occupy a vital link in the pelagic trophic network, providing an energy pathway between phytoplankton and upper trophic levels. Understanding the relationship between meso-zooplankton communities and salinity is necessary to formulate quasititive, testable hypotheses as to the potential effect of CERP projects on meso-zooplankton. To address this issue there has been an ongoing long-term research program to study meso-zooplankton communities in Florida Bay. Analyses will be presented which focus on determining if salinity and other environmental parameters contribute to the observed temporal and spatial variability in meso-zooplankton communities, if high or low salinity extremes have distinct meso-zooplankton communities, and large-scale phenomena alter the meso-zooplankton communities. From these results, hypotheses will be constructed regarding the potential effect of CERP on meso-zooplankton in Florida Bay.

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EVERGLADES RESTORATION AND THE FLORIDA KEYS NATIONAL MARINE SANCTUARY: MONITORING FOR POSSIBLE ECOSYSTEM EFFECTS

The 9,800-square-kilometer Florida Keys National Marine Sanctuary (FKNMS) is located downstream of the Everglades and may be impacted by increased freshwater flows resulting from implementation of the Comprehensive Everglades Restoration Plan. The FKNMS includes extensive areas of seagrass beds, which are sensitive to levels of eutrophication, and the only system of coral reefs in North America. Everglades restoration intends to “do no harm” to the Florida Reef Tract, and an intensive set of monitoring projects will help determine whether this desired outcome occurs and, if not, whether adaptive management of freshwater outflows may need to be invoked. Baselines for FKNMS monitoring were established as early as 1995 and include physical and chemical properties of surface waters and the water column as well as ecological monitoring of seagrass and coral reef communities and associated populations. Results to date indicate that nutrient ratios in seagrasses and relative abundance of seagrasses and macroalgae are particularly informative indicators of water quality to FKNMS managers.

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EVERGALDES RESTORATION AND THE FLORIDA KEYS NATIONAL MARINE SANCTUARY: MONITORING FOR POSSIBLE ECOSYSTEM EFFECTS

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LEAD CONCENTRATIONS AND ISOTOPIC RATIOS IN CORALS AND WATER NEAR BERMUDA, 1780-2000 A.D.

Lead (Pb) naturally occurs in the environment, but the dominant recent sources are anthropogenic. Pb significantly alters the global lead cycle. In order to document the complete history of oceanic, anthropogenic Pb transient in the North Atlantic Ocean, this study focuses on Pb concentrations and isotope records from annually-banded coastal corals near Bermuda during the past 220 years. Anthropogenic lead emissions in this area have been dominated by the industrialization of North America beginning in the 1840s and leaded gasoline, which was introduced in the 1920s, began to phase-out in the mid-1970s and substantially completed by the late 1990s. From the late 1700s to 1900, Pb187/Pb0 and Pb206/67Pb isotope ratios (Pb LR) show peak values in the middle of the 19th Century. We suggest that this signal is a reflection of the early dominance of Upper Mississippi Valley Pb ore in the United States, as is also seen in the estuarine sediments of Rhode Island.

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BIOLICAL CYCLING OF SILICON, NITROGEN AND CARBON IN THE NE PACIFIC AND THE BERING AND CHUKCHI SEA

Diatoms control the cycling of silicon and contribute significantly to the downward flux of biogenic silica (BSi), nitrogen and carbon in many ocean regions. We investigated the contribution of diatoms to primary productivity and nutrient cycling in surface waters across the NE Pacific and Bering Sea during summer and fall 2005. In the NE Pacific [BSi] was 1 µmol L-1, mean particulate Si:C and Si:N ratios were 0.07 and 0.37, respectively, and net BSI production was positive in the euphotic zone. The Bering and Chukchi Seas exhibited [BSi] over 10 µmol L-1. Mean particulate Si:C and Si:N ratios were 0.25 and 1.54, respectively, in the Bering Sea and 0.26 and 1.96 in the Chukchi Sea. Euphotic zone BSI production was positive in the Chukchi Sea, while the Bering Sea exhibited net BSI dissolution. During this study, the highest carbon and nitrate uptake rates were measured in the Chukchi Sea (up to 10 µmol L-1 d-1 and 480 nmol L-1 d-1, respectively). This study was the first to assess diatom dynamics across the subarctic NE Pacific to the western Arctic.

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THE COHERENCE OF UPPER OCEAN HEAT TRANSPORT IN THE WESTERN NORTH ATLANTIC

The coherence of heat transport in the upper 800m of the western North Atlantic is tracked using a thermodynamics-only model, with geostrophic surface velocities specified from altimetric sea surface height and the vertical profile derived from hydrographic data. The model comprises an upper ocean mixed layer and interior layers forced by geostrophic advections. The pathways of mass and temperature transport are examined from the Gulf Stream's separation to beyond the trifurcation into the North Atlantic Current (NAC), the Azores Current, and the southern recirculation return flow. The pathways are complex and vary significantly with time, with surprisingly little coherence in transports along the Gulf Stream itself. Inflow anomalies from the Labrador Current are well-correlated with those in the North Atlantic Current; both are lag-correlated with the NAO and with the Sverdrup transport. The Gulf Stream mass and temperature transport variations are only weakly correlated with either the NAO or the NAC. This description of heat and mass transports bears little resemblance to an ocean heat conveyor belt, at least for the upper limb, and reveals instead nearly independent fluctuations on interannual time scales. The heat budget of the region where the subpolar and subtropical gyres interact (the intersection of the Labrador Current, North Atlantic Current, and Gulf Stream) is examined in detail to determine the heat source for the relatively warm North Atlantic Current.

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Observations of internal waves and turbulence on the near-critical Oregon slope (Moum et al 2002, Nash et al 2007) have identified localized regions of intense mixing at several sites along the slope. A synoptic snapshot of XCP- and LADCP-derived velocities and inferred turbulence during fall 2005 is used to investigate the source of these hotspots. Although barotropic tidal velocities are predominantly along large-scale isobaths, both across- and along-slope topographic interactions may be present as a result of strong baroclinic motions and small-scale, 3-D topography. Tidal fits across-slope velocities display instances of upward and downward phase propagation suggesting the existence of both on- and offshore propagating internal tide energy. At certain locations, turbu-
lence appears closely linked with the along-slope barotropic tide, indicating that large tidal excursions over such scale topography may play an important role in local mixing. Multiple configurations of the nonhydrostatic MIT General Circulation Model are used to (1) estimate the relative contributions of barotropic and baroclinic forcing and (2) better determine the roles of large-scale near critical slopes and small-scale 3-D roughness.

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THE C-MORE EDUCATION AND OUTREACH PROGRAMS

The Center for Microbial Oceanography: Research and Education is a new (August 2006) Science and Technology Center, one of 17 extant centers funded through the NSF Office of Integrative Activities. C-MORE's mandates explicitly include ‘Integrating the research, education, and knowledge transfer components into a coherent program,’ as well as ‘Preparing educational materials designed to enhance public understanding of science, engineering, technology, and educational advances that serve society.’ We are expected to address these mandates through programs that display novelty and creativity as well as effectiveness; it is not enough to simply adopt what has worked before. C-MORE's challenges include integrating education and outreach programs across six widely separated partner institutions ranging from Hawai‘i to Massachusetts, each of which has unique local demographics that offer both opportunities and challenges. Common to all is the habitual isolation of research scientists from public education specialists. C-MORE's still-developing programs, will be described by representatives of the C-MORE senior management team and Education Office, focusing on mechanisms used to facilitate strong involvement of the research team in public education and outreach.

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WHAT CLIMATE SCIENCE NEEDS FROM A SPACE-BORNE MONITORING SYSTEM

Global measurements of sea surface temperature are a critical record for quantifying and understanding global climate change. However, the problem of producing a climate-quality SST data set using space born radiometers is a challenging one. Typical requirements are for an accuracy of better than 0.1K on monthly averages over 2degree areas, and a stability on a global average of better than 0.05K/decade not only during the lifetime of a single satellite, but throughout the combined record. These requirements will be motivated from applications in climate science. To help achieve these targets, GCOS provide 20 key principles of climate monitoring, 10 of which apply specifically to the creation of climate records from satellite data. In situ measurements remain essential as a ground truth for SST analyses, but accurate measurements of SST from space can also help to characterise the in situ record.

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STRATEGIES TO COUNTER ESTUARINE EUTROPHICATION IN THE MID- ATLANTIC REGION

Eutrophic conditions are worsening in many estuarine systems bordered by watersheds with increasing population and agricultural and urban land use. The conversion of natural land covers to farmlands, housing developments, and industrial sites facilitates nitrogen loading into estuarine waters, leading to cascading water quality and biotic impacts, debilitating impairments, and diminished ecosystem services. An array of Mid-Atlantic estuaries, most notably the lagoonal systems with restricted circulation and high residence times, exhibits severely stressed responses due to nutrient over-enrichment coupled to activities of a burgeoning watershed population that also exacerbates atmospheric inputs. The majority of estuaries in this region are now moderately to highly eutrophic and are ranked among the most impacted systems in the United States. Watershed management strategies to reduce nutrient loading in estuaries of this region include upgrading storm water controls, implementing low-impact development and best management practices, advancing open space preservation, and establishing total maximum daily loads (TMDLs) for nutrient limitation.

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USE OF THE ENSEMBLE KALMAN FILTER IN A GLOBAL COUPLED SEASONAL PREDICTION SYSTEM

A multivariate ensemble Kalman filter (EnKF) with covariance localization is used to assimilate in situ temperature and salinity observations and remotely sensed altimetry anomalies into a global OGCM. An online bias correction algorithm is built into the system to account for the fact that the assimilation continuously alters the model climatology. Following the data assimilation, the ensemble of OGCM states is used to initialize the oceanic component of the GMAO coupled forecasting system (GCFS). The GCFS is then run in hindcast mode without any data assimilation to assess the impact of the ocean initialization on its seasonal forecasting skill. To this end, the hindcast skill of the GCFS initialized with the EnKF is compared to that of the production forecasting system in which optimal interpolation is used to initialize the OGCM prior to coupling it to the other CGFS components. Other issues addressed in this talk include (1) the effect of ensemble size on the EnKF performance, (2) the importance of online bias correction when sea surface height anomalies are assimilated, (3) whether the time-dependency of the EnKF covariance model has a measurable impact on the assimilation performance, (4) the adaptive estimation of background-covariance localization scales and (5) the adaptive deflation of distrusted error-covariance estimates.

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THE VIEW FROM THE COOL ROOM: THE RUTGERS UNIVERSITY COASTAL OCEAN OBSERVATORY

The Rutgers University Coastal Ocean Observation Laboratory (RUCOOL) operates a fully integrated, real-time, research-based ocean observatory. RUCOOL provides oceanographers from around the world with a heavy instrumented, cyber-connected, sub-regional observatory for shelf-wide or embedded process experiments. Cost-effective, sustained, spatial sampling of the coastal ocean is accomplished through: 1) Local acquisition of data streams from U.S. and foreign satellites in space, 2) a network of radars deployed along the shore and 3) a fleet of robotic underwater gliders flying beneath the ocean surface. All sensor data is transmitted to and processed in the operations center in near real-time, where it is made available (via the internet) to research universities, state agencies, national agencies, educators and public users. The observatory also serves as an international proving ground for new sensor, platform and communication network development. We'll provide an overview of recently completed (LaTTE, Shallow Water 2006), current (MURI, CODAR National Network), and future (MARCOOS) research activities supported by the observatory.

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EXTRA-EQUATORIAL RESPONSE TO A COMPOSITE EL NINO: INTERIOR VS WESTERN BOUNDARY TRANSPORT

A composite El Nino wind forcing constructed from 6 events during 1965 through 1998 was imposed in a linear Rossby model and an OGCM, with emphasis on the lagged response in the subtropics and the resulting interior vs. western boundary discharge and recharge. The composite identifies important features of the off-equatorial winds that are consistent among these events over 40 years. With stronger composite El Nino curl in the southern hemisphere, its anomalous subtropical currents are larger than in the north, and especially given the nearness of the western boundary in the south, the boundary transports that recharge the west Pacific warm pool following a warm event are also larger. Much of this transport signal can be diagnosed as linear Rossby waves plus a simple model of the western boundary response. Apparently the extra-equatorial component of El Nino, though often ignored, forms a significant part of the subsequent evolution.

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A COLLABORATIVE APPROACH TO ASSESSING CONDITIONS IN COASTAL NATIONAL PARKS

The National Park Service (NPS) Water Resources Division (WRD) has initiated assessments of coastal water resources in 55 coastal and island Parks through the Natural Resource Challenge Watershed Condition Assessment Program. Reports from these assessments are characterizing the relative health or status of Great Lake, estuarine and marine resources in the National Park System and are revealing ecological stressors that may cause impairment. This presentation will describe the program and explore ways to strengthen partnerships among various stakeholders to produce robust and cost-effective monitoring approaches at coastal Parks. Assessing coastal water quality and habitat condition in the Parks provides a platform for cooperative monitoring and watershed management partnerships. For example, dissolved oxygen concentrations were found to be unexpectedly low in estuarine waters at Cumberland Island National Seashore during the summer, which encouraged increased monitoring for hypoxia by the State of Georgia. NPS is developing the next phase of the program to investigate resource problems and fill information gaps by forming monitoring partnerships with states, federal agencies, academia, local watershed groups and programs such as the National Coastal Assessment.

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THE IMPACT OF DIURNAL WARMING ON THE ATLANTIC AIR-SEA CO2 FLUX

Quantifying the air-sea CO2 flux is important for understanding the Earth's carbon cy- cle and for climate change prediction. Here we investigate the impact of diurnal variations in sea surface temperature (SST) on the air-sea CO2 flux over the Atlantic Ocean. We use
hourly satellite data from the geostationary satellite SEVIRI to quantify diurnal variations in sea surface temperature (dSST) and long and short wave radiation. Wind data are from microwave observations (SSM/I, TMI, AMSR, QuSCAT). The gas flux is computed using a modified version of the NOAA-COARE algorithm that incorporates convectively driven gas transfer (Jeffrey et al., 2007) thus allowing flux at the low wind speeds associated with diurnal variations in SST. We compute the CO2 flux twice - first using a foundation SST and the second time using the foundation SST plus dSST. We examine the differences between these two fields over 2004-2007.

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FLOW AND CONCENTRATION RELEASE THROUGH/AROUND MARINE AGGREGATES: A MATHEMATICAL MODELING

There exists a continuous fall of organic waste material from decomposing dead or dying plants or animals (detritus) in the water layer over seas and oceans. These particles coagulate to bigger aggregates, and sink with moderate velocities down to the seabed. Aggregates are considered as food source for other marine organisms. Hence, it is essential to have an estimation of the release of nutrients concentration through them. In this study, we propose the mathematical modeling of flow and concentration leakage from an arbitrarily-shaped porous medium based on the aggregation behavior of the surface waves. The challenge model is that shape of the aggregate content is varied easily, and that it can also account for variable physical properties such as porosity and permeability. After calculating the flow and concentration fields for different real conditions, the drag force experienced by aggregates has been obtained.

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FAST SPINUP OF SEASONALLY-FORCED GLOBAL OCEAN BIOGEOCHEMICAL MODELS USING MATRIX-FREE NEWTON-KRYLOV

A fundamental challenge in global ocean biogeochemical modeling is the fact that many chemical and biological tracers, for example, nutrients, oxygen, toxic elements such as thorium, take several thousand years to equilibrate. Routine simulation of these tracers in coupled physical-biogeochemical models thus remains prohibitively expensive, as does any attempt to systematically understand their sensitivity to different biogeochemical parameterizations or to optimize model parameters. Here, I present a new solution to this "spinup" problem based on transforming the essentially time-dependent problem into a nonlinear algebraic equation that is solved using matrix-free Newton-Krylov (MFNK). To accelerate convergence of the Krylov solver, I have developed a multigrid preconditioner that is relatively inexpensive to compute and apply. Because of its matrix-free nature, this technique can be applied to any existing, seasonally-forced, biogeochemical model. I applied this method to a coupled biogeochemical model with several prognostic tracers, including carbon, phosphorus, and iron. MFNK reduces the spinup time by at least 2 orders of magnitude relative to conventional time-stepping.

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A NEW AIRCRAFT-TOWED PLATFORM FOR AIR-SEA INTERACTION MEASUREMENTS

Direct measurements of air-sea interaction fluxes - momentum, heat, water vapor, and CO2 - are usually obtained from special fixed platforms, buoys or ships at or near the reference height of 10 m above the ocean. Research aircraft offer more mobility, but the lowest height for sustained flux patterns is usually limited to 30 m by most operators. Based on the technology of aircraft towed target drones, a new measurement platform has been developed. The Towed Atmospheric Sampling Platform (TASP) is a modified target drone 22.8 cm in diameter and 213 cm long with a hemispherical nose. It can maintain a radar reference height of 10 m above the ocean. Research aircraft offer more mobility, but the low vertical overlap makes it difficult to resolve the flow at these scales. The TASP has a hemispherical nose that is designed to limit the wind speed at which the drone detaches from the tow. The drone is controlled by a radio signal that is transmitted to the drone via a computer and received by an antenna on the aircraft. The drone is equipped with sensors that measure wind speed and direction, temperature, humidity, pressure, and air density. The data are transmitted back to the aircraft via a communication link. The aircraft is equipped with a computer that processes the data and transmits it back to the ground station via a wireless link. The TASP is designed to operate in winds up to 100 km/h and at altitudes up to 10,000 m.

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MARINE AEROSOLS PRODUCED FROM BUBBLING BUBBLES: PROPERTIES, PHOTOCHEMICAL EVOLUTION, AND OCEANIC FEEDBACKS

Bursting bubbles produced in the oceans by breaking waves inject large quantities of aerosols into the atmosphere. To characterize and study the photochemical evolution of these aerosols, we designed a flow through bubbling apparatus to generate aerosols. Using Sargasso seawater, two aerosol modes were detected. The smaller mode was dominated by chlorinated organic compounds (OC), while the supernatant mode contained soluble organic material (SOM). The supernatant mode was also characterized by the presence of high levels of hydrogen peroxide and other hydroperoxides. The aerosol mode was characterized by the presence of high levels of hydroperoxides, while the supernatant mode was dominated by chlorinated organic compounds (OC).

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FORMATION, SPREADING AND FATE OF LABRADOR SEA WATER

Labrador Sea Water (LSW) has been very well monitored throughout the decades concerning temporal evolution of water mass properties or variability in its formation. In recent years several persistent LSW classes have been identified which result from time-varying convection in the Labrador Sea. Since the end of the 1990s the production of LSW switched from high-density to low-density classes, associated with an overall decline of the LSW formation rate. We review the formation history of these two LSW classes for the period 1987-2007 and put particular focus on spreading pathways of LSW in the interior North Atlantic. When combing hydrographic data with time series derived from moorings we find high levels of meso-scale variability related to intense eddy activity which is overlaying an interannual evolution. Cross-frontal exchange of the boundary current with the North Atlantic Current close to Flemish Cap causes the latter to be the main distributor of LSW types into the interior western subpolar North Atlantic. The results indicate a southward spreading of LSW along the Mid-Atlantic Ridge.

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EVALUATION OF ECOSYSTEM MODEL PERFORMANCE: EXPANSION OF THE REGIONAL TESTBEDS FRAMEWORK FROM THE ARABIAN SEA AND EQUATORIAL PACIFIC TO SOUTHERN OCEAN

Previous efforts to evaluate the performance of ecological models in the regional Ecosystem Modelling Testbeds Project utilized US Joint Global Ocean Flux Study (JGOFS) observations in the Arabian Sea and Equatorial Pacific, sites with very similar sea surface temperatures (SST) of 25-28°C. To further test model performance and portability, a third test site was created at 57ºS 170ºW based on the JGOFS Southern Ocean process study, a region with a mean SST of 4°C. To test this extended testbed framework, two ecosystem models were assessed: a four variable model and a more complex eight variable model. Optimizing the model parameters was performed both for each site individually as well as for all sites simultaneously. The 8 variable model was found to outperform the 4 variable model in both individual and simultaneous site tests with its improved performance improving considerably with the addition of the Southern Ocean testbed. Model performance was found to be sensitive to a combination of factors including temperature, phytoplankton physiology and ecosystem structure.

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LIFT-OFF OF THE COLUMBIA RIVER OUTFLOW

Dynamics of plume lift-off in the tidally-dominated Columbia River nearfield are investigated. During more than 300 plume transects X-band radar tracked surface fronts while
highly resolved velocity, density and turbulence measurements were made. These data capture nearfield evolution and plume front structure. Lift-off represents a transition from barotropically-forced river flow to buoyant gravity current. This transition point is predicted using a Froude number criteria that depends on radial spreading, time variable estuary discharge, and topography. On longer time scales, rotation, coastal flow and sea- sonal variability of river discharge are also important.

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IMPACT OF IN SITU BUOY DISTRIBUTION ON COEFFICIENT ESTIMATION FOR THE PATHFINDER SST ALGORITHM: A CASE STUDY OF NOAA-7 AND NOAA-14 USING BUOY AND SHIP MATCHUPS

The NOAA/NASA Pathfinder SST (PFST) project has the goal of creating the longest, highest resolution, and most accurately quantified SST climate data record from space. PFST extends over 2 decades from 1984-2006. Extending this data record back to 1981 by the addition of NOAA-7 should be a valuable resource. The PFST algorithm uses a statistical approach for coefficient estimation. Standard coefficients are determined monthly for two water vapor regimes using a weighted 5-month window of matchups. For NOAA-7 algorithm coefficients we investigated combining matchups from both buoy and ship observations, and various temporal periods, to minimize any adverse effects of the limited geographic availability of buoy observations during the NOAA-7 operational lifetime. The goal was to balance seasonal atmospheric effects and the need to include observations from a broad geographic range as possible. The coefficient strategy for NOAA-7 was cross-validated by sub-sampling NOAA-14 matchups of buoy and ship observations to simulate the distribution of the NOAA-7 matchups. The accuracy of retrievals from coefficients determined from combined buoy and ship matchups will be presented.

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MORPHOLOGY OF TOMBOLO LIKE DEPOSITS IN THE KOKUSSAN ARCHIPELAGO, WESTERN KOREA

This study presents morphological characteristics of sedimentary deposits that connect two islands in the Kokusanzan archipelago, western Korea. These deposits consist of sand beach on the western side and muddy-sand tidal flat on the eastern side. In the tidal flat, there is an outstanding sedimentary feature, which is a wild goose shaped, gravel bar. During high tide, narrow beach and gravel bar are seen. Aerial photographs show that horizontal geometries of deposits has not significantly changed since 1978, implying that the deposits are quite stable. Since the beach is open to the northwest, it is directly affected by wintertime waves. It seems that sedimentary processes of the deposits are different from those of tombolos. Rather strong tidal currents may be more responsible for forming these tombolo-like deposits.

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COMPARING COLLABORATION EXPERIENCE OF TWO PROFESSIONS: EDUCATORS AND SCIENTISTS IN COSEE GREAT LAKES

Results of baseline studies for COSEE Great Lakes attempts to facilitate collaboration between scientists and educators will be reported. The studies were aimed to characterize and compare collaboration experience between marine/aquatic sciences and primary/secondary teachers in the Great Lakes Region. Three research questions guided the studies: 1) how are K-12 teachers and scientists involved in educational collaboration, 2) what barriers may deter their involvement, and 3) which factors are related to their potential for partners in education collaboration. Comparing responses from scientists (n=94) and educators (n=194) in two baseline studies, their experience in educational collaboration were investigated. The responses of collaboration programs participants (e.g., Lake Erie RV/G Guardian and Lake Superior Exploration workshop) were also compared with those from baseline studies. Regression analyses identified predictor variables accounting for variances of scientists and educators collaboration experience.

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A NUMERICAL EXPERIMENT ON THE PATH VARIATION OF TH CHANGJIANG DILUTED WATER IN SUMMER

In this study we used regional ocean modeling system (ROMS) which is fully three-dimensional, free-surface and hydrostatic primitive-equation model. It was used to simulate the circulation of the East China Sea and the Yellow Sea. We examined the effect of the wind and the discharge on the variability of the Changjiang Diluted Water (CDW) in summer by numerical model experiment using real wind field and river discharge from 1993 to 2002. Effect of wind on dispersion of CDW was evaluated by climatology condition. The domain and southern, southeastern and southwestern winds with speed of 5 m/s were assumed under climate condition. Model result shows that the CDW path change greatly according to the wind direction. Model results using realistic oceanic conditions in 1996, 1998 and 2000 when those prevailing winds are southwestern, southeastern and south- ern were selected to compare to the ideal model results. Model result implies that wind is the main force in determining the variability of CDW. The discharge of the Changjiang River might also be another important factor on the CDW variability.

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THE CHARACTERISTICS OF VARIATIONS OF SURFACE LAYER ANOMALIES IN THE NORTHWESTERN PACIFIC OCEAN AFTER OCT., 1992

The northern Pacific Ocean (NPO) is to be the North Equatorial Current (NEC) and the Kuroshio Current (KC). Spatial distributions of the mean surface layer anomalies (SLA) are divided into the southwestern and northeastern regions sharply by the NEC and the KC in the NPO. The southwestern regions under the direct influence of the NEC and the KC exhibit higher amplitudes of the SLA fluctuations, while the northeastern regions are relatively smaller one. Due to the SLA after 1992, the region of the southwestern Pacific Ocean to be higher SLA is 30Â°N outside the eastern coast of the Japan with mean SLA 25 cm or more in the coastal area of the Japan, and Kuril islands, are also high in range. In the northwestern Pacific Ocean, temporal variation trends of the SLA are mostly rising, where exceedingly high region of high increasing trend of SLA represent over 4.5 cm/yr in region on mean SLA to be high. The special feature in the northwestern Pacific Ocean is on the fact that the increasing and decreasing regions appear alternately parallel to latitude along south-north direction.

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THE VALIDATION OF THE OCEAN COMPONENTS OF NCEP HURRICANE COUPLED ATMOSPHERIC-OCEAN FORECAST SYSTEM

The next generation of NCEP hurricane coupled atmosphere-ocean forecast system in the Atlantic Ocean is based on the HWRF (WRF for hurricane) model and HYCOM models covering the regional ocean model, each of which is nested one-way to the NCEP global atmosphere GFS (Global Forecast System) and operational Atlantic basin RTOFS (Real-Time Ocean Forecast System), respectively. The core of the system development is the two-way coupling of the HWRF and HYCOM models. The primary objective of this study is to validate the two components of the system - model parameters and data assimilation. The coupled model is required to represent physical processes accounting for the hurricane-ocean interaction; and the nesting and data assimilation should provide realistic ocean initial and boundary conditions. The presentation focuses on the ocean contribution to hurricane forecast skill. This will be examined for storms varying in size, intensity, translation speed, etc. over a variety of relevant oceanic conditions (sea surface temperature, mixed layer depth, temperature gradient at the base of the mixed layer).

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EFFECTS OF FRESHWATER INFLOW ON PELAGIC AND BENTHIC COMMUNITIES IN TEXAS ESTUARIES: A MODELING STUDY

A climatic gradient of freshwater inflow has been known to cause differences in benthic community structure and secondary production among major Texas estuaries. There have been studies to develop quantitative relationships between freshwater inflow and benthic biotic indicator variables. While some of these works were done with respect to biological process-based approach, they did not explicitly show the mechanistic relationships between benthic and pelagic ecosystem. Here we present an upgraded version of bentho-pelagic coupled ecosystem model to investigate trophic relationships among nutrients, phytoplankton, benthic flora and macrobenthic fauna in Texas estuaries. We also incorporated this ecosystem model into a box model to simulate effects of episodic flood events on freshwater inflow and subsequent changes in salinity regime. A long-term data set of nutrients, chlorophyll and macrobenthic biomass was used to calibrate and validate the model. We tried to interpret the simulated results in context of net ecosystem metabolism (NEM) that can be used to understand the relevant scales of estuarine ecosystem response to changing environmental conditions.
CLIMATE AND COASTAL ALGAL BLOOMS IN THE SOUTHERN CALIFORNIA BIGHT

Surface chlorophyll measured at the Scripps Pier in the Southern California Bight (SCB) for eighteen years (1983-2000) reveals that the spring algal bloom occurs with irregular timing and intensity from year to year. Unlike surface ice temperature (SST), which is dominated by a regular seasonal cycle. In the 1990’s, the spring blooms occurred earlier in the year and with larger amplitudes compared to those of the 1980’s. The annual mean Pier chlorophyll consequently exhibits an increasing trend with no concomitant trend evident in the Pier SST during the observation period. The interannual variation of the Pier SST and chlorophyll is not correlated with tropical EI Niño conditions over the entire observing period, but a few strong EI Niño and La Niña events have significant impacts on the Pier data. Seasonal anomalies of the SST and chlorophyll have no significant correlation with local/offshore winds, or upwelling index anomalies. Consequently, classical coastal upwelling may not be the process that drives chlorophyll variations in the SCB, perhaps because the sheltered SCB has weaker and less persistent winds and more complicated topography than the northern California Current. A

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DECADE VARIATIONS OF THE CHANGJIANG DILUTED WATER AND SEAWIFS CHLOROPHYLL

It is known that the Changjiang Diluted Water (CDW), which mixed Changjiang summer freshwater discharge and Kunshan Surface Water and/or Taiwan Warm Water, spreads eastwards over the broad area of the East China Sea and reaches as far as Jeju Island to Tushima Strait. It is expected that the distribution of CDW is controlled by the Changjiang summer freshwater discharge and showed significant interannual variations. Here we analyzed the Sea-viewing Wide-field-of-view Sensor (SeaWIFS) chlorophyll-a during 1998-2006 and showed that interannual variations of the spatial distribution of high satellite chlorophyll-a (>0.9-0.4 mg m-3) was well corresponded with distribution of low salinity CDW (<30-32) and showed significant interannual variations. Here we analyzed the Sea-viewing Wide-field-of-view Sensor (SeaWIFS) chlorophyll-a during 1998-2006 and showed that interannual variations of the spatial distribution of high satellite chlorophyll-a (>0.9-0.4 mg m-3) was well corresponded with distribution of low salinity CDW (<30-32) and that interannual variation of the CDW area was associated with the interannual variation of the Changjiang summer freshwater discharge. In order to decide criteria of the higher satellite chlorophyll-a and summer freshwater discharge indicated that low salinity, high satellite chlorophyll-a CDW spread in the East China Sea after 1 to 2 months time lag of the discharge. Satellite chlorophyll-a is a good indicator of the low salinity CDW in the East China Sea.

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ANISOTROPIC RESPONSE OF SURFACE CURRENTS TO THE WIND IN A COASTAL REGION

Coastal surface currents measured off the coast of San Diego are found to have an anisotropic response to wind, possibly as a result of bottom/coastline boundary effects and non-geostrophic local pressure gradients. The anisotropic response function explains approximately 20% more surface current variance in a linear regression than an isotropic wind-ocean response model. Under a steady wind, the isotropic surface current response approximately 20% more surface current variance in a linear regression than an isotropic non-geostrophic local pressure gradients. The anisotropic response function explains

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SIMULATION OF SALINITY RETRIEVAL OVER OPEN OCEANS BY THE SPACEBORNE AQUARIUS INSTRUMENT

Surface salinity observations are important to understand many ocean/ climate phenomena such as the North Atlantic thermohaline circulation, ocean surface freshwater balance, surface ocean oxygenation, and climatic effect on sea level. As a part of such observations, a spaceborne L-band microwave radiometer, Aquarius, is under development by NASA for launch in 2010. The accuracy requirement of the Aquarius mission is set to 0.2 psu over 100km for monthly averaged salinity observations. To examine the feasibility of the accuracy goal, we developed a ‘end-to-end simulator incorporating surface emission model, radiative transfer model for the Earth atmosphere and cosmic background, and ionospheric model. A retrieval simulation corrects for these forward processes to estimate surface salinity. The result shows that surface salinity may be retrieved with an accuracy better than 0.2 psu rms over the global open ocean (warm ocean with surface temperature higher than 10°C, 500km away from the coast, and at 100km spatial resolution). The retrieval error increases toward colder seas. Sensitivity of the retrieval accuracy to different antenna patterns is also studied.

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SIMULATION OF HYPOXIA IN UPPER CHARLOTTE HARBOR, FLORIDA

The Upper Charlotte Harbor, a shallow (-3m) estuary in Southwest Florida has suffered from reduced oxygen levels, hypoxic conditions in near-bottom layer since the late 1950’s, which is related to high primary productivity and changes in nutrient loading in the river. For example, very high nitrogen loading in the river has increased the eutrophication of the estuary. Furthermore, the 1998 Hurricane Andrew was an important factor for the hypoxia condition in the estuary.

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VARIABILITY OF THE SEA WATER TEMPERATURE AND ITS PREDICTION IN TIDAL FLAT

The sea water temperature in subtidal zone shows high frequency variation less than one day due to the advection of warm or cold water from the tidal flat. The water temperature in subtidal zone increase during midnight low water in spring and summer. Heat supply from the heated tidal flat by the strong solar radiation during previous midday low water increase water temperature at midnight low water. In this study, we constructed the one-dimension water temperature prediction model in order to understand the effect of the tidal flat on the water temperature change. The model result represents well the characteristics of observed water temperature. The model enable us to understand quantitatively the effect of the tidal flat on the changes of sea water temperature. Furthermore, the sea water temperature change with high frequency is mainly due to the heat exchange between tidal flats and sea water during the tidal inundation.

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OBSERVATION OF TOPOGRAPHIC ROSSBY WAVES NEAR DOKDO OF THE ULLEUNG INTERPLAIN GAP

Deep flow variability is analyzed using moored current measurements over steep bottom slope near Dokdo of the eastern Ulleung Interplain Gap (UIG), a main passageway for the deep waters exchange between the Ulleung Basin and the Japan Basin in the East/Japan Sea. The observed currents below 300 m show dominant fluctuations at periods near 20 and 40 days and bottom-intensified vertical structure at both periods, which is reasonably consistent with the theory of linear topographic Rossby waves (TRWs). The TRWs found in UIG are characterized by short wavelengths of 17-30 km primarily due to the smallness of the buoyancy frequency below 300 m. Near 20-day periods, a close relationship is observed between upper warm events and deep current fluctuations: the latter are significantly enhanced when the former develop. This indicates local coupling between upper and deep layers over the sloping bottom topography. On the other hand, the 40-day deep current fluctuations appear to be related to the variability of remote winter wind-stress curl in the northern part of the East/Japan Sea from long-term current observation over 10 years.

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INTERACTIONS BETWEEN TIDAL ASYMMETRIES IN VELOCITY, NEAR-BED STRATIFICATION, AND SEDIMENT RESUSPENSION IN AN ESTUARINE TURBIDITY MAXIMUM

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As part of the interdisciplinary Bio-Physical Interactions in Turbidity MAXIMA (BITMAXI) study, biogeochemical transport data were collected near the center of the estuarine turbidity maximum of upper Chesapeake Bay during 2007. Rapidly sampled time series of temperature, salinity, and turbidity were collected using a vertical array of data loggers. Rapidly sampled velocity profile time series were collected using a bottom mounted RDI ADCP in Mdel 12. The moorings were in place during several week-long research cruises, each of which included a daily-anchored anchor station adjacent to the moorings during which detailed measurements of suspended particle size and settling velocity were made. The data show relatively larger near bottom stratification during flood than ebb due to advection of the salt front. The combination of the estuarine circulation and tidal velocity also caused higher bottom shear stress and thus more resuspension during flood. However, the resuspended sediments were confined within 1 m above the bed due to the strong stratification, resulting in very high suspended sediment concentrations. Additions of suspended particle characteristics in relation to these factors will be reported.

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ECOMAR: ECOSSYSTEMS OF THE MID-ATLANTIC RIDGE AT THE SUB-POLEAR FRONT AND CHARLIE-GIBBS FRACTURE ZONE

ECOMAR is a 2 million GBP project aimed at understanding how physical and biogeochemical factors influence the distributions and structure of deep-sea communities, focusing on the Mid-Atlantic Ridge at 4 sites. The RRS James Cook completed the first of three voyages planned under the NERC funded project in August 2007. Long term moorings were placed at four super stations at 2500m equipped with sediment traps, current meters and ADCPs. Video and still images of the sea floor were obtained during five camera vehicle tows and ninelander deployments. Faunal samples were taken with nine mega-core, seven bottom trawls, four baited traps and eight mid-water tow tows. Fifty-eight CTD casts investigated water masses and processes across the ridge and along a TOPEX-Poseidon satellite altimeter track. EK60 acoustic surveys quantified pelagic biomass and optical remote sensing measured primary productivity the position of the sub-polar front. Seabird and cetacean observations (visual and audio) were made throughout the voyage. The ECOMAR area will be revisited by the RRS Discovery in summer 2008 and the RRS James Cook with the Iis ROV in 2009.

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WANTED, MOHAWK GUY AND HIS BAND OF NEogene PLANKTIC FORAMINIFER FRIENDS FOR GAMES AGAINST CALCAREOUS NANNOFOSILS AND OTHER PHYTOPLANKTON

The study of fossil foraminifera, single-celled microorganisms, from ocean sediments retrieved through scientific ocean drilling, has revealed important paleoceanographic events throughout Earth history. From these tiny creatures, scientists can learn about the ancient environment, past climate change, plate tectonic movements, changes in ocean productivity, circulation, and much more. In this presentation, two K-12 teachers will present their work with a University foram specialist to bring these bugs to life in real and exciting ways for their students. They will share the process of working together - educators and scientists - to move from initial concept to final lessons, testing with their students, and the ways they translated high level scientific concepts into engaging geological and biological activities. The presentation will include an introduction to the use of forum bio cards and lessons that incorporate these cards to help students learn how to read and understand authentic data. The research project, the scientist, and the foraminifer species have been personalized to help students make connections between the scientific process and the people who conduct scientific research.

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THE INFLUENCE OF POLICY INDUCEMENTS AND EMBEDDED RELATIONS ON THE FORMATION AND OPERATIONS OF PARTNERSHIPS

Studies of partnerships in the education (and other policy domains) have found that strong embedded relationships and strategic needs among partner organizations increase the likelihood of successful formation and operations. However, policy inducements, in the form of program grants or regulation (for example, mandated testing), have not typically been a factor of analysis. This research builds upon and contributes to partnership research by examining the influence of policy inducements upon partnership formation and the implementation of programs aimed at improving the content knowledge in math and science for teachers and administrators. Of particular interest is whether partner responsiveness to policy inducements stimulates stronger commitments to partnership operations. This study uses a multi-case study comparative design to examine the Systemic Initiative program (SI) and the Math Science Partnership program (MSP) sponsored by the National Science Foundation. Each case traces the life cycle of each grant and the influence of the inter-organizational relationships on outcomes. This work will be discussed in relationship to partnerships such as the Centers for Ocean Sciences Education Excellence (COSEE) and the Integrated Ocean Observing System (IOOS).

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ON THE FLOW OF SOUTH ATLANTIC WATER INTO THE NORTHERN HEMISPHERE

The transport of South Atlantic Water (SAW) into the northern hemisphere represents the warm upper branch of the Atlantic Meridional Overturning Circulation (MOC) and thus has a direct influence on the Atlantic heat budget. Three different mechanisms are known which are responsible for the import of South Atlantic Water into the North Atlantic: (i) transport by a surface current which follows the South American coast, (ii)
transport by rings that travel northwards along the coast, and (iii) transport by so-called Subtropical Gyre Cells in the general vicinity of the Florida Current. The second mechanism is investigated: The propagation and decay of North Brazil Current Rings. Results form direct hydrographic and velocity observations from ship surveys show the presence of North Brazil Current rings at 15°N near Guadeloupe. A high-resolution ocean model, namely the 1/12° FLAME model, is used to examine the northward propagation of NBC rings and their complex interaction with the Lesser Antilles. Together with calculations of the Caribbean inflow the MOC related flow near the Lesser Antilles is discussed and an estimate for the third transport mechanism (the subtropical cells in the interior Atlantic) is given.

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GROSS PRODUCTION AND UNDERWATER NET COMMUNITY PRODUCTION MEASUREMENTS IN THE EQUATORIAL PACIFIC

Primary production in the equatorial Pacific is known for its importance to the worldwide carbon cycle and connections to climate conditions. Here we present data on gross primary productivity and net community productivity (NCP) determined by Δ¹⁸O and O₂/Ar ratios, respectively, both measured from the underway flow system onboard the R/V Kilo Moana. Δ¹⁸O was sampled twice daily while O₂/Ar were measured continuously using an onboard Meso Scale Mass Spectrometric system. As Ar is subject only to physical forcings, calibration can then be made to access biological O₂ supersaturation. Using estimates of gas exchange we were then able to constrain NCP and gross photosynthetic O₂ production between 2°N and 2°S. By these measures the central and western equatorial Pacific are comparable to other biologically saturated regions. An NCP of 80 mmol C m⁻² d⁻¹, varying circa 50% over the scale of 50 to 500 km. The biological production estimates made here are considered in relation to iron measurements and other factors that might be controlling biological production in this climatically important region.

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INSTABILITIES IN BUOYANCY DRIVEN FLOW OVER A SUBMARINE DELTA

A series of oceanographic cruises was conducted during spring-summer of 2004-2005 along the Texas-Louisiana coast. Field measurements show evidence of large-amplitude, shelf-scale disturbances in the distribution of hydrographic properties across the shelf. These wave-like instabilities were also seen in satellite imagery (MODIS, SeaWifs) during the cruises as well as other times of the year. The position of the meander is consistent with the location of shoals, which are remnant subaqueous deltaic features along the Louisiana shelf. Large vertical displacements of isopycnals were observed during late summer in 2004 and summer 2005. ROMS (Regional Ocean Modeling System) was used to investigate the effect of shoaling topography on the transfer of buoyancy through the oceanic water column along the Louisiana shelf. The numerical experiment was conducted in an idealized coastal domain represented as a rectangular box. The domain is bounded by coastline on the northern side and the open ocean on eastern and western edges. The influence of bottom topography, coastal slope and freshwater input on the development of the dynamic instabilities was evaluated and compared with observations of physical and biochemical parameters.

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PARTICULATE NUTRIENTS AND CALCIUM CARBONATE IN THE SUBARCTIC PACIFIC OCEAN.

The subarctic Pacific is a high-nutrients, low-Chlorophyll region, where changes in interannual macronutrient concentrations are small and nitrate levels are rarely limited. But some area in the subarctic Pacific and Bering Sea are estimated to support high primary production due to deeper winter mixing and closer proximity to the Asian iron supply. Here, we analyzed particulate nutrients, calcium carbonate and Chl-a to evaluate the contributions of diatoms and coccolithophorids to chlorophyll biomass during late summer in the subarctic Pacific and its eastern counterpart. We found that we were able to categorize some areas in the subarctic Pacific by concentrations of Chl-a, particulate nutrients and calcium carbonate. The particulate Si concentrations from the diatoms, are lower than that in the eastern subarctic Pacific. The inorganic carbonate concentrations in the western and central subarctic Pacific from coccolithophorids are higher than that in the eastern subarctic Pacific. In summer to early fall of 2005, the productivity of coccolithophorids in the subarctic Pacific is relatively higher than that of diatom productivity except in the eastern subarctic Pacific.

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TURBULENT MIXING ASSOCIATED WITH INTERNAL TIDE IN SURUGA BAY
Internal tides in Suruga Bay are known to be amplified by the topographic effect. Observations using turbulent profiler and ADCP were performed to clarify relation between the internal tides and turbulent mixing. R.V Seiyu-Maru was anchored at the head of Suruga Bay (about 90m depth) and measurements of turbulence were carried out by using Turbomep (Alec Electronics Co.) at about 6 minutes interval from 16:00 on 06 July to 16:20 on 07 July, 2004. We also deployed a bottom mounted ADCP near the anchored station and obtained current data from 8m depth to the bottom at 2m interval in vertical every one minute. Observational data showed details of mixing process due to internal tides. Semidiurnal temperature fluctuation associated with strong bottom current was dominantly found throughout the water column and density overturns were frequently found in the bottom layer. Relatively large energy dissipation rate were found at high stratified regions. Turbulent diffusivity coefficents due to the internal tides were estimated to be 0.07-8.3X10^-4 (m²/s).

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LARVAL DISPERSION OF THE JAPANESE SARDINE INCLUDING IMPACTS OF MEO- AND DECADAL-SCALE SST VARIATIONS

The spawning ground of the Japanese Sardine is in the Pacific waters of western and central Japan. Sardine eggs are transported by the Kuroshio, and reach the nursery ground in the Kuroshio/Oyashio mixed water region. A high-resolution ocean reanalysis data was used (ICOPE, 2003-2006, 1/12 degree and 2-day average) to trace the dispersion of larvae, and the survival rate was estimated considering optimum larval growth condition (13 to 19 degrees C). The model includes realistic meso-scale variability of the Kuroshio path and the associated SST variation. In addition, to implement the decadal SST variation of the high and low catch periods, we used the February SST anomaly of the ocean hind-cast data (OEFS 1950-1999, 1/10 degree, 1 month) of which the second EOF mode well correlates with the long-term changes of the Japanese Sardine mortality rate. The result suggests that the survival rate is high (low) when the Kuroshio takes a meander path (non-meander path) and high (low) during the cooling (warming) phase of the decadal SST change. Association of this SST EOF mode to the PDO is under investigation.

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SEISMIC IMAGES AND PROPERTIES OF MEDITERRANEAN OUTFLOW WATER (MOW)

Seismic reflection data images boundaries between the water masses with different physical properties. Special imaging and inversion techniques are needed to quantify physical properties across the boundaries. A feasibility study of the MOW along a seismic reflection line without simultaneous hydrographic data and a hydrographic survey without simultaneous seismic data document that the quantification by inversion of the seismic data was limited due to an inaccurate starting model for the inversion procedure. During the European funded GO Project (www.dur.ac.uk/ego), seismic data as well as hydrographic data were recorded simultaneously. These contemporaneous measurements of the Laughon phase of the decadal SST change. Association of this SST EOF mode to the PDO is under investigation.

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Continental shelf water mass distribution, transformations and off-shelf transport in a sea ice-ocean model of the Ross Sea, Antarctica

A mesoscale resolution (5 km) sea-ice shelf-ocean model (ROMS-CICE) is implemented to investigate Ross Sea (RS) shelf water mass budgets and dense water production and export. Daily atmospheric forcing is ECMWF ERA-40 except winds over Terra Nova Bay (TNB) are from automated weather stations (AWS). Net High Salinity Shelf Water (HSSW) production in TNB and RS polyna areas are 0.14 and 0.64 Sv over two years of simulation. Ross Ice Shelf (RIS) is a sink for about 0.4 Sv. Low Salinity Shelf Water (LSSW) outflow from beneath RIS cavity is 0.60 Sv. Modified Shelf Water (MSW)/Antarctic Bottom Water (AABW) is abundant over the entire shelf, forming the western anticyclonic cell. net off-shelf and Modified/Lower Circumpolar Deep Water net onshore transport are 2.23 and 0.7 Sv. Using AWS winds over TNB results in a substantial decrease in polyna sea ice production, wide scale dilution of HSSW in the western depressions, disruption of northward coastal HSSW transport, and causes overall decrease in vertically averaged transport on the western RS shelf.

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CARBONIC ACID ACROSS THE PELAGIC SYSTEM AND ON FISHERY RECRUITMENT

Carbon stable isotope analysis was used to infer that pelagic organisms rearing in Prince Charles Mountains waters were affected at approximately 60 degrees north latitude that is separated from the adjacent Gulf of Alaska and Pacific Ocean by a deep (>200m) and broad (>100km) wide shelf, depend in part on organic carbon subsidies of oceanic origin. Pelagic organisms at certain times may consist of more than 50% oceanic carbon. Subsidy shifts in time were systemic and systematic; for example, a strong pulse in oceanic carbon subsidies was observed across a range of species but with differences among them. Herring consistently had the greatest dependence on oceanic subsidies. Inter-annual differences in oceanic subsidies measured in juvenile pink salmon may explain approximately half of the considerable inter-annual variability in marine survival rate that results in run size differences in the tens of millions. Oceanic subsidies suggest that coastal waters may receive seeding from offshore (e.g., larval stages), providing a mechanism for explaining regional long-term shifts in marine populations.
The effects of reduced ocean pH on the growth of non-calculifying organisms are poorly known. We studied the effects of seawater pH on growth in the kelp Alaria marginata. We grew gametophytes (spatuloid stages produced from the germination of spores) at ambient temperatures and low ambient daylight in filtered, raw seawater and in seawater acidified to pH 7.8 and 7.6 by the addition of HCl and by bubbling CO2 through the medium. We measured the length of gametophytes of A. marginata after 4 days and used this as a measure of individual growth rate. We found that gametophyte growth was significantly reduced at pH 7.8 and further reduced at pH 7.6 compared with growth in ambient seawater. Although both HCl- and CO2-acidified seawater negatively affected gametophyte growth, growth rates were more sensitive to acidification by CO2 bubbling than to acidification by addition of HCl. Our results are indicative of a general response of pH among non-calcified brown algae, substantial changes in primary production by marine macrophytes and in the structure and function of nearshore ecosystems can be expected with declining ocean pH.

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PARTICLE DYNAMICS ASSOCIATED WITH PATHOGEN TRANSPORT IN COASTAL LAKE MICHIGAN

Since many pathogens associate with particles, the fate and transport of particles in the coastal zone is an important process in determining the health risk associated with pathogen inputs from storm water, CSOs and river plumes. We are utilizing sediment traps, large volume (>1000 L) filtrations of suspended particulates, and ROV collections of surface sediment to quantify sediment resuspension rates, particle settling rates and particle residence times in the nearshore waters of the Milwaukee Bay - a coastal region of Lake Michigan strongly influenced by the export of materials from the Milwaukee Harbor and its highly urbanized watershed. Activities of the naturally occurring radionuclides Be-7, Pb-210 and Cs-137 have been used to determine the time scales of particle movement. Samples were collected every ~3 weeks from early March through the end of October 2007 at 4 stations from the river mouth to open Lake Michigan, including off the major metropolitan swimming beach. Radionuclide data are being used to help validate the particle dynamics modeled with a fine grid, 3-dimensional hydrodynamic model of coastal currents, temperature fields and particle transport.

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THE DYNAMICS OF NON-LINEAR TIDAL MIXING NEAR TOPOGRAPHY

Elevated mixing near deep-ocean topography appears relatively ubiquitous in the world's oceans. Until recently, the dynamics of this mixing have been opaque. Here we present observations from the Hawaiian Ridge and the continental shelf of the South China Sea and compare them to numerical modeling. The observations show that the near-bottom turbulence is driven by steeply non-linear internal tides that are breaking near the topography. The generated turbulence is orders of magnitude higher than that found just a few hundred meters above, is phase-locked to the internal tide, and shows a pronounced spring-neap cycle. The model demonstrates that these non-linear features originate from hydraulic phenomena where the topographic slopes change from super- to subcritical. The turbulence observed on the supercritical slopes also appears to be directly driven by the steepness of the topography.

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THE FLUX AND ISOTOPIC COMPOSITION OF REDUCED AND TOTAL NITROGEN IN BERMUDA RAIN

The concentration and isotopic composition of total nitrogen (TN) was measured in precipitation samples collected at Bermuda between January and December 2000. By correcting for nitrate, analyzed previously, the concentration and d15N of "reduced" N (i.e., ammonium + organic N + RN) was also determined. The TN precipitation flux (~0.010 to 0.019 mol N 2-yr1) was twice the nitrate precipitation flux, and the mass-weighted annual average d15N of TN ~2.3 permil was higher than the d15N of nitrate in the same samples (~4.5 permil), indicating that RN has a d15N of -0.6 permil. While neither the concentration nor the flux of RN in precipitation showed statistically significant seasonal variation, the d15N of RN did, from -2.7 permil in the warm season to 1.5 permil in the cool season, similar to seasonal nitrate trends. The low d15N of the TN flux is similar to that of N2 fixation, and could explain a significant fraction of the previously documented minimum in nitrate d15N in the Sargasso Sea thermohaline, reducing the amount of N2 fixation needed to explain this isotopic feature.

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HYDRODYNAMIC, FLUVIAL, ANDTECTONIC CONTROLS ON SEDIMENT DISPERSAL AND DEPOSITION ON THE WAIAPA RIVER SHELF, NEW ZEALAND

The Waiapa River drains a small, mountainous catchment composed of easily erodible materials, and delivers an estimated 35 MTy of sediment onto the adjacent, narrow continental shelf. Accumulation of these fluvial sediments on the shelf are influenced by a variety of little-understood processes that operate over a wide range of temporal scales including flood delivery, land use changes, and subsidence. To better understand these erosion margin processes, we used a 3-D numerical model to investigate sediment transport and depositional patterns under varying oceanographic conditions and sediment loads. Suspended sediment transport and escape from the proximal shelf increased with bed shear stresses due to wind-driven currents, but decreased with wave-induced bed shear stresses because these facilitated gravity-driven transport to deeper waters. Deformation practices have produced a 4- to 7-fold increase in fluvial delivery to the shelf within the last 50 years. As load increased, wave-supported gravity flux reached capacity, increasing deposition on the shelf. Coastal morphology and actual depositional patterns implied shelf sedimentation over century time-scales was largely constrained within a subsiding Quaternary basin associated with collision margin tectonics.

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BEYOND STATUS AND TRENDS OF COASTAL CHEMICAL CONTAMINATION: APRAISED BY BIOMONITORING: ACHIEVEMENTS AND CHALLENGES

The French mussel-watch program collected its first bivalve in 1979, and has been monitoring the status and trends of contaminants along the coastline ever since. Spatial and temporal resolutions are high, and have been optimized according to costs and environmental behavior of contaminants. Monitored contaminants show local, regional and temporal variations. The usefulness of this near real time monitoring program is increased by unforeseen environmental applications. Indeed, the mussel tissue samples have been archived into a collection of well characterized marine coastal environmental records which remains available for research purposes until sample exhaustion. In this presentation, we show examples of reconstruction of contamination histories that are solely possible through reanalysis of this collection. Reconstructions range from organic contaminant fingerprinting to metal stable-isotope geochemistry. Despite this biomonitoring's inherent shortcomings, the time series prove invaluable to assess legislation for ecosystems protection. Paradoxically, unintended consequences of the implementation of EU-WFD jeopardize this record in terms of its very existence, quality and continuation.

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THE NATIONAL OCEAN SCIENCES BOWL AS AN INTERSECTION OF OPPORTUNITIES FOR COLLABORATION

The National Ocean Sciences Bowl (NOSB) is an academic competition for high school students. Regional NOSB competitions bring together ocean scientists from multiple institutions, agencies, and businesses with informal educators, graduate and undergraduates, and high school teachers and students for the day of the competition. The Rhode Island and Connecticut Regional Competition (Quahog Bowl), held for a decade at the University of Rhode Island, has developed a large network of partners and institutions. This presentation highlights the diversity and commitment of volunteer participants involved in the NOSB each year. There are great opportunities for networking, making connections, and for interaction with high school educators and students. However, there are also many opportunities to interact and work with the NOSB network that forms around the Regional and National Competitions throughout the year. Ocean science education programs can interact with the NOSB community in several ways, reaching new partners and a large ocean science education audience. This presentation discusses two projects that the authors have integrated into the Quahog Bowl and the NOSB over the last 5 years.

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incerely are used to further examine the hydrodynamics, the bottom boundary layer processes, between fluid mud layers on the shoal during fair weather; sediment is then re-suspended, resulted in substantial changes in the fabric of bottom sediments ranging from variations interactions with bottom sediments over the heterogeneous transgressive deposit. This wind, and thus, wave conditions, created unique bottom boundary layer processes and material (fine sand) to silts and clays. The results of oceanographic deployments on the grained materials. Occasional dispersal of fine-grained sediments (silts and clays) from the with the local hydrodynamics in response to the deposition of fluvially-derived fine-
Bottom sediments on Ship Shoal, a transgressive sand body, interact in a complex way a Kuroshio, and with Kuroshio stratification but no Kuroshio current. The results are used generation and the particle amplitude of IWs. To better understand the influence of the Kuroshio on the IW genera-
ated with the Kuroshio also play an important role in modulating the generation and the amplitude of IWs. To better understand the influence of the Kuroshio on the IW gener-
a, a coupled ocean Nowcast/Forecast System (ONFS) is being used for the study. The NRL ONFS is implemented using a nested grid system. The larger grid which covers the East Asian Seas provides boundary conditions for a higher-resolution grid covering Luzon Strait and northern SCS. Tidal forcing is applied at the open boundary of the high-resolu-
tion domain. Temperature and salinity analyses generated from satellite altimeter and MCST data are assimilated into model to produce a realistic stratification with Kuroshio. Applying the NRL ONFS, numerical experiments are conducted with a Kuroshio, without a Kuroshio, and with Kuroshio stratification but no Kuroshio current. The results are used to interpret the influence of the Kuroshio on the generation of IWs in SCS.

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DYNAMICS OF SEDIMENTS WITHIN THE BOTTOM BOUNDARY LAYER OVER A TRANSFRINGE SHOAL INFLUENCED BY FLUVIAL SEDIMENTS AND WINTER STORMS: SOUTH-CENTRAL LOUISIANA
Bottom sediments on Ship Shoal, a transgressive sand body, interact in a complex way with the local hydrodynamics in response to the deposition of fluvially-derived fine-ground materials. Occasional dispersal of fine-grounded sediments (silts and clays) from the Mississippi River on post-frontal northerly winds regimes in concert with river discharge, results in the textural shift of shoal bottom sediments from coarser-grounded material (fine sand) to silts and clays. The results of oceanographic deployments on the eastern flank of the shoal during spring 2006 show that the directionality of the storm-
wind, and thus, wave conditions, created unique bottom boundary layer processes and interactions with bottom sediments over the heterogeneous transgressive deposit. This resulted in substantial changes in the fabric of bottom sediments ranging from variations between fluid mud layers on the shoal during fair weather; sediment is then re-suspended, transported and re-distributed during pre-frontal and post-frontal phases. The results of additional instrument deployments scheduled for fall 2007 and ongoing numerical model-
ing are used to further examine the hydrodynamics, the bottom boundary layer processes, and associated sediment transport processes during winter storms.

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VARATION OF MARINE ATMOSPHERIC BOUNDARY LAYER OBSERVED OVER THE WINTER KUROSHIO EXTENSION
This study examines the atmospheric boundary layer around the sea surface temperature (SST) front of the Kuroshio Extension (KE) based on the ocean-atmospheric observations conducted on board the research vessel Hakusho-maru from 11-26 January 2006. The GPS sonic observations every 6 hours reveal a well-developed surface mixed layer that varies
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WATER EXCHANGE CONTROLLED BY MIXING PROCESS AT THE MOUTH OF TOKYO BAY
We have conducted a series of field campaigns to observe mixing processes at the mouth of Tokyo Bay. A microstructure profiler (TurboM Map) was deployed to measure the intensity of turbulence. A tidal current at a different phase of tide creates a different level of water exchange through the bay mouth. Our field campaigns were made over several different tidal phases that include ebb tide and spring tide. We present the observed mixing conditions from these experiments. In order to investigate the hydrography of Tokyo Bay, we make use of a three-dimensional hydrodynamic model (GETM) that consists a single water column public domain turbulence model (GOTM). As a Lagrangian approach, following passive particles in the bay are followed to investigate water exchange rate. We present how the tidal forcing condition affects the water exchange based on both the model results and observed data.

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DIGITAL SEAGRASS IMAGING MAPPING IMAGERY REVEALS KARST FEATURES AND NATURAL REEFS OF THE SPRINGS COAST REGION OF FLORIDA
This project used the Intergraph Digital Mapping Camera (DMC) to acquire high resolution imagery of seagrass beds within Florida's Springs Coast region of Florida for the first time. Although earlier aerial mapping surveys focused only on the shallow intertidal seagrasses of this region, limited data have been collected for the offshore seagrasses. Mapping projects in the 1980s and 1990s primarily relied on transect data collected over this extensive region. This paper will present the preliminary results and challenges of the 2007 mapping project. For example, the deep water seagrass edge was captured in the imagery for the southern half of the project area; however, the edge extended beyond the imagery in the northern half. Interpretation of offshore seagrass density has been challenging due to the intricacy of the beds associated with the meandering karst features and varying bottom substrates. Although seagrass coverage is the main focus of the project, digital imagery has provided new information on karst features, reefs, and rock outcrops of this little studied region. The most impressive finding is a large cluster of small reefs (< 1 ha, 2 acres) located approximately 13 km (8 miles) off the coast of northern Hernando County. This cluster of small reefs is concentrated within an 80 ha (200 acres) area. These findings indicate a larger area of natural reefs and greater diversity of benthic strata in this region of the Springs Coast than historically reported.

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EFFECTS OF OCEAN ACIDIFICATION ON PHOTSYNTHETIC PROPERTIES OF MARINE PHYTOPLANKTON
By absorbing excess of anthropogenically-produced CO2, the pH in the upper ocean will decrease by up to 0.8 units within the next 300 years, possibly affecting a variety of biologically important processes such as calcification, metal speciation, and silicic solubility. Changes in ocean's pH may also modify the redox potential of photosynthetic and respiratory electron carriers, directly affecting a range of biophysical processes involved in photosynthesis, carbon assimilation, and respiration. We have grown selected species of phytoplankton and the natural phytoplankton assemblage in laboratory conditions from these experiments, sampling every two months from May through October. Cell numbers ranged from zero to a maximum of approximately 6000 cells/L, resulting in only a few shellfishery closures due to PSP. These data contrast with a 2006 study yielding much higher A. catenella cell numbers (over 50,000 cells/L at one station) and widespread closures of shellfish harvesting. Tracking catenella cell numbers at different phases of day to understand the mechanisms of blooms dynamics could serve as a useful tool for providing early warning of PSP toxicity. Integrating quantification of A. catenella cell number into existing PSP monitoring efforts may guide shellfisheries and public health agencies in their monitoring efforts.

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INVASION POTENTIAL OF THE NEW ZEALAND MUD SNAIL IN LAKE TAHOE AND THE LOWER TRUCKEE RIVER (USA)
The New Zealand Mud Snail (Potamopyrgus antipodarum) is a relatively new invader in the United States. Our objective was to determine the susceptibility of the Truckee River and Lake Tahoe to an invasion by measuring survivorship and growth rates in laboratory mesocosm experiments. One experiment was conducted for each system with three treatments: (1) A high population density treatment, (2) a low population density treatment and (3) a control with no snails. All treatments included rocks with natural periphyton from the respective system. Experiments lasted for 14 days with fresh water was brought in from the respective system every three days. Snail survivorship and growth was positive but varied across ecosystems (Lake Tahoe: 5-40% with an increase in body mass in the low density treatment but a decrease in body mass in the high density treatment; Truckee River: 50-85% with a 99% increase in body mass). In order to determine if there was an influence of UV-light on the snails we conducted a separate experiment and the results of that experiment suggest that the snails do have an aversion to UV-light.

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DEEP OCEAN INERTIA-GRAVITY WAVES SIMULATED IN A HIGH-RESOLUTION GLOBAL COUPLED ATMOSPHERE-OCEAN GCM
A high-resolution global coupled atmosphere-ocean simulation is carried out to investigate the deep ocean inertia-gravity waves. Large (k = 10^{-3} m^{-1}) root-mean-square vertical velocity is found in middepths. Horizontal distribution of large variability roughly corresponds to the wintertime atmospheric storm tracks and is stretched equatorward due to β-dispersion in open ocean with some “shadow regions” behind the obstacles. Frequency spectrum of vertical velocity has strong peaks at around f and 2f (f is equatorward due to β-dispersion in open ocean with some “shadow regions” behind the obstacles. Frequency spectrum of vertical velocity has strong peaks at around f and 2f (f is
examine the effects of carbon dioxide-induced pH changes on larvae, we exposed Lottia digitalis trochophores to CO2 manipulated seawater at pH 7.8, 7.6, and 7.4. We examined the resulting mortality, protoconch dimensions and overall appearance, and larval behavior. With increasing acidification, we saw significantly increased mortality, a higher incidence of malformed protoconch and behavioral differences. Some snails were malformed at lower pH. These results suggest that molluscs larvae may be particularly sensitive to ocean acidification with the potential to seriously affect their population dynamics.

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ASSESSMENT OF GROUNDWATER - SURFACE WATER INTERACTION IN TSUNAMI AFFECTED AREAS

On December 26, 2004 the devastating tsunami waves cause terrible humanitarian disaster affecting thousands of kilometers of coastal belt of the Indian Ocean in SE Asia. Many coastal wetlands get affected by the large inflow of salt seawater and littoral sediment deposition during the tsunami. The longer-term effects of changes in their hydrology caused by changes to coastlines and damage to sea-defenses. Many water quality and associated problems generated by tsunami and influencing coastal environments are related to past and on-going contamination of terrestrial groundwater because this ground water is now seeping out along shorelines affected by tsunami. For example, chronic inputs of fertilizers and sewage on land over several decades has resulted in higher groundwater nitrogen which, because of slow yet persistent discharge along the coast, eventually results in coastal marine eutrophication. Such inputs contribute to the increased occurrences of coastal hypoxia, nuisance algal blooms, and associated ecosystem consequences, and significantly accelerated by tsunami as well as increasing of magnitude of saltwater intrusion. Tsunami creates an accelerating process of salt water intrusion and fresh water contaminations in affected regions that requires a drastic remediation measures. These measures be to economically feasible, environmentally sound and socially acceptable.

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CENSUS OF THE THERMOHALINE ANOMALIES PROPAGATED THROUGH THE NORTIC SEAS DERIVED FROM HISTORICAL DATA 1896-2006

The thermohaline characteristics of the Atlantic water (AW) entering the Nordic Seas (NS) and flowing northward to the Eurasian Arctic are considerably modified along pathway by interacting with the atmosphere and mixing with surrounding waters. The degree of modification depends on atmospheric forcing or upper layer stratification, which determines the ratio between horizontal and vertical exchange of properties. The NS oceanographic database for 1900-2006 and objectively analyzed monthly fields were used to study the temporal-spatial pattern of large-scale temperature, salinity and density anomalies advected northward. The anomalies show event-like behavior with different duration, magnitude and penetration depth depending on upper stratification with generally colder and fresher upper layer condition after the Great Salinity Anomaly propagation. Two different regimes are obvious from the observations with weakened/enhanced downward heat/salt fluxes. Abnormal AW properties were set since the late 1990s with a more intense downwelling event in 2006, which is consistent with the increased salinity in the New Nordic Sea and in the Norwegian Sea.

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A SPACEBORNE ASSESSMENT OF RIVERINE DOC FLUX INTO THE KARA SEA

The Siberian high-flowing Siberian Rivers like Oben, Yenisei, and Lena are thought to be playing an important role in terms of determining the income of carbon into the Arctic Ocean. We have undertaken a pilot satellite-based assessment of carbon flux into the Kara Sea from the Ob River. Inasmuch as the targeted waters are case II waters, we had to develop a special advanced operational algorithm (A0A) to process spaceborne data. The AOA simultaneously retrieves the concentrations of phytoplankton chl, suspended minerals (um) and dissolved carbon (doc) in the Kara Sea and in the estuary of the Ob River. Based on the surface concentrations of doc in the estuary obtained from MODIS as well as on CTD in situ data on the thermocline/ halocline depth, the doc flux into the Kara Sea was assessed. Assessed through the developed methodology, the mean annual carbon flux proved to be 4.8 ± 1012 gC/yr. This estimation is consistent with the in situ data reported in the literature (ca 3.2 ± 1012 gC/Yr). Thus, the developed bio- optical retrieval algorithm and methodological approach can be transferred to other marine and oceanic regions for operational assessment of riverine DOC fluxes.

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HYDROLOGIC AND BIOGEOCHEMICAL STORM RESPONSE IN CHOPTANK BASIN HEADWATERS

During brief storm events, headwater streams transport large quantities of nutrients and sediment to estuaries, contributing to eutrophication. During 2006-07, we measured N, P and seston response at seven agriculturally dominated basins (1-26 km2) with 15-64% hydric soils, capturing 17 out of 30 storms during this period. For these storms, 3-53% of rainfall was discharged as stormflow. Nitrate and conductivity were depressed during storms while phosphate and seston peaked. When plotted against discharge, N exhibited a clockwise loop whereas P exhibited a counterclockwise loop. The volume-weighted mean of phosphate is a positive function of stormflow (r2 = 0.98). In contrast, the volume-weighted mean of nitrate is an inverse exponential function of stormflow (r2 = 0.92), decreasing from baseline nitrate (~200 um) to concentrations approaching twice that of rainfall nitrate (68 uM). Because phosphorus transport is disproportionately weighted towards brief intervals of storm runoff, it is particularly important to measure the P response during events to improve estimates of downstream P loading.

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STORM RESPONSE AT SEVEN AGRICULTURALLY DOMINATED BASINS (1-26 km2) WITH 15-64% NITRATE AND CONDUCTIVITY ARE DEPRESSED DURING STORMS WHILE PHOSPHATE AND SESTON PEAKED. WHEN PLOTTED AGAINST DISCHARGE, N EXHIBITED A CLOCKWISE LOOP WHEREAS P EXHIBITED A COUNTERCLOCKWISE LOOP. THE VOLUME-WEIGHTED MEAN OF PHOSPHATE IS A POSITIVE FUNCTION OF STORMFLOW (R2 = 0.98). IN CONTRAST, THE VOLUME-WEIGHTED MEAN OF NITRATE IS AN INVERSE EXPONENTIAL FUNCTION OF STORMFLOW (R2 = 0.92), DECREASING FROM BASEFLOW NITRATE (~200 UM) TO CONCENTRATIONS APPROACHING TWICE THAT OF RAINFALL NITRATE (68 UM). BECAUSE PHOSPHORUS TRANSPORT IS DISPROPORTIONATELY WEIGHTED TOWARDS BRIEF INTERVALS OF STORM RUNOFF, IT IS PARTICULARLY IMPORTANT TO MEASURE THE P RESPONSE DURING EVENTS TO IMPROVE ESTIMATES OF DOWNSTREAM P LOADING.
utilization increased from 300m to the bottom with a maximum of 2μmol/kg around 500m. Not only the property changes but also the volume flux estimated by an inverse method suggests a slow down of the deep meridional circulation. The meridional heat flux across the line is also estimated using the long term hydrography across the Kuroshio in the Okinawa Trough as well as the P3 data. The variation of the Kuroshio temperature transport agrees with the heat flux variation across the line independently estimated from the atmospheric reanalysis data and heat content change in the North Pacific.

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COASTAL HYCOM MODELING IN SOUTH FLORIDA: EVALUATION OF GODAE BOUNDARY CONDITIONS, RESOLUTION AND FORCING

The South Florida (SoFLA) HYCOM (1/25 degree) and the embedded, high resolution Florida Keys (FREKSYS) HYCOM (1/100 degree) encompass a variety of coastal processes. The broad Southwest Florida shelf, the narrow Florida Keys and Southeast Florida shelf, the shallow Florida Bay and Biscayne Bay and deep regions (the Straits of Florida), including Marine Protected Areas. The presence of the strong Loop Current/Florida Current system and associated eddies connects the local and basin-wide dynamics. Different strategies of nesting to HYCOM GODAE products are evaluated, along with sensitivity to model resolution and atmospheric forcing. Simulations with boundary conditions from a regional data assimilative Gulf of Mexico model improve nested model performance along the narrow Keys shelf. Atmospheric and river forcing are important on the SW Florida shelf. Boundary conditions from the basin-wide North Atlantic HYCOM are essential in capturing Florida Current fluctuations. High resolution in FREKSYS enhances the submesoscale eddy field and the interactions between coastal and large scale flows, an essential aspect of predicting impacts of salinity changes under the Everglades Restoration Project on the fragile Florida Keys National Marine Sanctuary ecosystem.

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TEMPORAL DISTRIBUTION OF BRACHYURAN CRAB LARVAE DURING A TIDAL CYCLE IN A SMALL ESTUARY IN PUERTO RICO

Semiterrestrial brachyuran crabs synchronize larval release with lunar, tidal and light-dark cycles. The influence of adult morphology to adult's tidal release pattern. The purpose of this study is to describe the volume of zoea and megalopa in a small estuary in Puerto Rico during a tidal cycle. It is expected that more larvae will be found during the night as tides goes into the estuaries. A 24 hour sampling was done in June, 2007 during full moon. Sampling was conducted with two stationary stream drift nets placed at the mouth of Roquillas Creek, Manati Puerto Rico. Water was filtered for 45 minutes every hour and volume was measured with a flow meter attached to one of the nets. Results show that density of zoea was higher during the day and lower during the night and that the density of megalopa was higher during the night and lower during the day. Tide was coming into the estuary during the night and out the estuary during the day. Identification of the larva is still ongoing. The results of this study will increase the knowledge of the life cycle of semiterrestrial brachyuran crabs which is necessary for conservation and management of these crabs/species.

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INVESTIGATING TSUNAMI WAVE SCATTERING AND ENHANCEMENT USING ENERGY FLUXES

In the wake of Kuril Island tsunami of Nov., 2006, the sea level at Crescent City (CC) initially surged up to 20 cm and 2-3 hours later the highest wave of about 90 cm was recorded. Numerical experiments identified bathymetric features which scatter the tsunami wave. Results show that density of zoea was higher during the day and lower during the night and that the density of megalopa was higher during the night and lower during the day. Tide was coming into the estuary during the night and out the estuary during the day. Identification of the larva is still ongoing. The results of this study will increase the knowledge of the life cycle of semiterrestrial brachyuran crabs which is necessary for conservation and management of these crabs/species.

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PIGMENT DERIVED PHYTOPLANKTON COMPOSITION ALONG THE WESTERN ANTARCTIC PENINSULA

Current bio-optical models for remote sensing of chlorophyll a are sensitive to changes in specific absorption. Variability in phytoplankton composition is tied to changes in spectral absorption; our ability to follow these changes would be enhanced by a better understanding of community composition. Examined in this study was a thirteen year span (1995-2007) of high-performance liquid chromatography (HPLC) pigments collected as part of the Palmer Long Term Ecological Research project. Phytoplankton composition was estimated using CHEMTAX analysis software, and presented here is the temporal and spatial distribution of those assemblages in surface (50% F_s) and deep euphotic zone (1% F_s) waters. Contribution to total chlorophyll a biomass and population assemblage dynamics are described. Temporal distribution of groups is discussed in terms of anomalies calculated as yearly differences from climatological means. Variability in space and time is examined using principle component analysis, and possible relationships between seasonal sea ice and phytoplankton composition, as well as phytoplankton composition and primary production are discussed. This work will provide a basis for development of a link between optics and taxonomic groups in the Bellingshausen Sea.

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GEOMORPHIC CHANGES OF FINE-GRAINED SEDIMENTARY FURROWS: INSIGHT INTO SEDIMENT TRANSPORT AND DEPOSITION IN THE YORK RIVER ESTUARY

Sedimentary furrows, often seen as narrow longitudinal depressions in fine-grained sediments, have been identified in various geological settings worldwide from continental shelves to estuarine systems. Recent studies have shown that these rectilinear bedforms form parallel to the dominant direction of flow and may be initially created by helical circular circulation located at the sediment-water interface. Hourly changes of furrow morphology were monitored to determine the amount of sediment flux and transport occurring within the York River estuary. Several acoustic and geological data sets from the York River, including roulette and sidescan sonar, sediment cores, CHIRP, and multibeam bathymetry, were used to ascertain the short-term spatial and temporal patterns of these furrows in order to determine their responses to physical forcings. The rotary sonar, scanning at quarter-hour intervals, was used to investigate the seabed, allowing diurnal tidal variations to be captured. By studying furrow morphology, we were able to gain insight on the scale and processes affecting redeposition and sedimentation, as well as assess the possible relationships to underlying stratigraphy and how rapidly these features are mobilized in fine-grained estuarine environments.

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DISTRIBUTIONS OF MERCURY AND METHYLMERCURY IN THE NORTH PACIFIC OCEAN

Fish harvested from the Pacific Ocean are a major contributor to population-wide mercury (Hg) exposure in the U.S. However, limited oceanic Hg data, particularly methylmercury (MeHg), has confounded our understanding of linkages between sources, methylation and attenuation, and the fate and transport of Hg in the ocean. Monitoring Hg in the coastal and open ocean is important for understanding Hg cycling and for evaluating the effects of oceanographic processes on Hg transport. The purpose of this study is to describe the volume of zoea and megalopa in a small estuary in Puerto Rico during a tidal cycle. It is expected that more larvae will be found during the night as tides goes into the estuaries. A 24 hour sampling was done in June, 2007 during full moon. Sampling was conducted with two stationary stream drift nets placed at the mouth of Roquillas Creek, Manati Puerto Rico. Water was filtered for 45 minutes every hour and volume was measured with a flow meter attached to one of the nets. Results show that density of zoea was higher during the day and lower during the night and that the density of megalopa was higher during the night and lower during the day. Tide was coming into the estuary during the night and out the estuary during the day. Identification of the larva is still ongoing. The results of this study will increase the knowledge of the life cycle of semiterrestrial brachyuran crabs which is necessary for conservation and management of these crabs/species.
Formation of mode waters is concomitant with the spring bloom in two different regions of the Atlantic. The timing of mode water formation versus the timing of the spring bloom is of primary importance.

**MODE WATER SUBDUCTION: AN EFFICIENT CARBON PUMP IN THE NORTH ATLANTIC.**

Memery, L.
Levy, M.
Kremeur, A. S.

Later in the season, EPS both contribute significantly to and, by influencing attachment/de-attachment, are left behind in the ice after algae are exported to the water column. We present compelling evidence for the role of EPS networks in the attachment and detachment of ice-algal biomass from sea ice.

**ATTACHMENT AND DETACHMENT OF ICE-ALGAL BIOMASS FROM SEA ICE.**

Juhl, A.

If integrated biogenic silica is decreasing with time at the BATS site, while the opposite is true at the GA site, statistically significant 15-year linear decrease in integrated biogenic silica (p<0.001 that slope = 0). During the same period there are increases in integrated particulate organic carbon and nitrogen, chlorophyll biomass (primarily fall and winter biomass), primary production, the abundances of dinoflagellates and prasinophytes in the upper 200 m, and in nutrient flux to 200 m. However, there is no discernable linear trend in organic matter flux to 300 m. If integrated biogenic silica is decreasing with time at the BATS site, while the opposite is occurring for other autotrophic groups, the resulting shift in phytoplankton community composition could potentially be altering the efficiency of organic matter export in the Sargasso Sea by reducing the role of diatoms in this system.

**EXOPOLYMERIC SUBSTANCES, AN IMPORTANT COMPONENT IN THE ATTACHMENT AND DETACHMENT OF ICE-ALGAL BIOMASS FROM SEA ICE.**

Biomass of sea-ice algae is generally highest in the lowermost centimeters of sea ice, the region where the microscopic habitat structure continuously re-adjusts in response to physical fluxes of heat and solutes. Mechanisms of attachment in such a fluctuating habitat play a key role in the successful colonization of sea ice by algae and other microbes, as well as in the timing of organic export fluxes from the ice to the water column. We show that significant concentrations of exopolymorphic substances (EPS) are always present in sea ice, including during freeze-up, and are therefore continuously available for microbial attachment. We present compelling evidence for the role of EPS networks in the attachment of sea-ice algae during colonization processes. A large pool of these exopolymetric networks and organic material are left behind in the ice after algae are exported to the water column. EPS both contribute significantly to and, by influencing attachment/de-attachment, play a critical role in regulating the organic export from sea ice.

**VERTICAL DISTRIBUTION OF DISSOLVED OXYGEN AND NUTRIENTS IN THE EASTERN MEDITERRANEAN.**

Gertman, I.
Kress, N.
Kress, N.

During the 1990s, influx of dense waters from the Aegean Sea, the East Mediterranean Transient (EMT), changed the deep water circulation in the Eastern Mediterranean and the vertical distribution of its physico-chemical properties. Since 2002, seasonal oceanographic surveys are performed in the easternmost part of the Levantine basin along a 50 mile transect from Israel westwards. While in 1991 there was no evidence of the EMT in the Levantine basin; prior to the EMT two minimum-nutrient layers were present: one at mid depths since 2002 this exists even at the station located 16 miles from shore. Oxygen was decreasing and nutrients decreased towards the bottom. The vertical distribution remained the same between 2002-2006. Only in 2007, more than 10 years after the EMT relaxed, there was a shallowing of the oxygen minimum/nutrient maximum layer to ca. 400m bringing water rich in nutrient closer to the photic zone. Deep winter mixing and mesoscale features may transport these nutrients to the photic zone and induce changes in productivity in this ultra-oligotrophic area.

**TESTING THE APPARENT TSUNAMIGENIC ORIGIN OF 2300 YEAR OLD HIGH ENERGY DEPOSITS FROM LONG ISLAND, NY.**

Vibracores and shallow seismic surveys of Great South Bay backbarrier lagoon reveal a variable but distinct sedimentary deposit, attributable to a high-energy source. These results, together with emerging evidence from other parts of the New York and New Jersey coasts, strongly suggest that a large tsunami struck the area 2300 yBP.

**FACtORS DETERMINING GROWTH AND SURvIVAL IN EARLY LIFE STAGES OF Cods from the North Atlantic.**

Growth and survival in the early life stages of cod are known to be affected by environmental conditions. In particular, variations in temperature and light strongly impact the
growth and feeding conditions for larval cod, creating differential survival conditions between years and between habitats. We compared the latitudinal extreme nursery grounds of larval cod on Georges Bank (42°N) in the Northwest Atlantic and Lofoten (68°N) off the coast of Norway. We applied an individual-based model (IBM) to simulate larval cod growth and survival within each nursery ground for five years. The model is forced with light, idealized prey fields, and temperatures at selected locations for selected years during the spawning season. We then analyzed the results for differences between and within ecosystems. Using our estimated larval cod growth rates from this model, we also quantified the relative roles of environmental variables and feeding environments at the Georges Bank and Lofoten sites and their relationship to field observations.

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NITROGEN TRANSFORMATIONS IN SUBMARINE GROUNDWATER DISCHARGE ZONES: INSIGHTS FROM ISOTOPE PAIRING EXPERIMENTS

We are investigating nitrogen transformations and other biogeochemical processes associated with mixing of water masses within the near-shore aquifer and subterranean estuary of Waquoit Bay, Massachusetts. Where nitrate and ammonium co-occur in field settings, concentration and nutrient enrichment that is coupled to the temporal and spatial distribution of N stable isotopic data suggest substantial loss of both species through a fractionating process. Laboratory experiments employing modified isotope pairing techniques confirm N loss with mixing of nitrate and ammonium-bearing waters and suggest that loss is primarily due to denitrification, possibly coupled to oxidation of Fe(II), with minor occurrence of an anammox-type process. Other concurrent processes include: N reduction, substantial production or release of organic N, apparent ad/desorption of ammonium, and desorption or production of nitrate. Our results suggest that N is actively cycled in nearshore portions of coastal aquifers and that we need to consider a wide range of concurrent transformation pathways in submarine groundwater discharge zones. Such transformations have the potential to modify the composition of chemical species carried by SGD. Carbohydrate isotope pairing experiments are being conducted in flow-through sediment columns to simulate groundwater flow through coastal aquifer sediments.

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DIFFERENT PHOTOPROTECTION AND REPAIR STRATEGIES HELP EXPLAIN SOURCES OF OCEAN-EVOLVED PLANKTON SPECIES DISTRIBUTION

Distributions of diatoms and the haptophyte Phaeocystis antarctica, correlate well with mixed layer dynamics in the Ross Sea, Antarctica, suggesting that the patterns and intensity of light available to phytoplankton may ultimately determine taxonomic composition. Differences in carbon uptake efficiency (P. antarctica takes up more than twice as much CO2 per unit PO4 than diatoms) highlight the possibility that carbon uptake dynamics is this region is not only influenced by changes in seasonal primary production, but also by the role of light in controlling species distribution using cultures of P. antarctica and the diatom, Fragilariopsis gryrius grown under two simulated mixing conditions characteristic of the Ross Sea. Fluorescence properties, photosynthetic rates, xanthophyll cycle pigment concentrations, and D1 concentration were measured in the presence and absence of lincomycin and dithiorthanol (DTT) to assess the relative importance of photoprotection and photorepair mechanisms. Results show that P. antarctica exhibits greater sensitivity than F. gryrius to lincomycin but is less sensitivity to DTT. These results suggest that P. antarctica thrives in a low and variable light environment by maximizing photosynthesis under all conditions while incurring and constantly repairing photodamage. Conversely, F. gryrius relies primarily on xanthophyll cycle-mediated photoprotection allowing this species to thrive in high, constant light conditions.

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DO BIOPHYSICAL COUPLING MODELS PREDICT CARIBBEAN POPULATION CONNECTIVITY? A TEST WITH SIX GASTROPOD SPECIES THAT VARY IN DISPERSAL POTENTIAL

Biophysical coupling models have made clear predictions about gene flow, source biogeographic patterns, and dispersal pathways; however, confirming model predictions. The complex phylogeography of our focal taxa is not readily explainable by oceanographic circulation; patterns of extinction, migration and re-colonization may thus be highly idiosyncratic, even among similar species.

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DESIGNING A "REEF-SAFE" SLOW RELEASE FERTILIZER FOR MANGROVE RESTORATION PROJECTS

In the waterlogged environment of mangrove ecosystems, one of the most difficult challenges young mangrove seedlings have to surmount is lack of nutrients. In order to overcome this problem, restoration efforts generally use slow release fertilizers added when planting propagules on restoration sites. However, waves, tides, and other physical forcings often cause these fertilizers to release too quickly, or wash away. We introduce and demonstrate the effectiveness of a new technique using slow release discs to encapulate fertilizer which releases slowly in a targeted fashion directly to the roots of the young mangrove tree. This novel slow-release fertilizer provides ample nutrients for young mangrove trees while reducing the risk of excess fertilizer introduction into sensitive coastal ecosystems such as coral reefs.

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HYBRIDISATION OF DATA ASSIMILATION METHODS FOR APPLICATIONS IN OCEANOGRAPHY

A data assimilation method based on variational approach is presented. The novelty of the hybrid method consists in a coupling of the cost function of the variational approach with an optimal linear smoother issued from the singular evolved extended Kalman filter (SEEK). The background error covariance matrix of the usual variational framework remains unchanged. In the hybrid method, however, at each transition between the assimilation windows, it is replaced with the one provided by the smoother. The latter is updated whenever new background states are produced. It can be shown that the background states issued from an appropriately constructed variational framework and some particular optimal linear smoother are mathematically equivalent. Hence the matrix injection into the cost function is done in a consistent manner. The hybrid method has been implemented in a shallow water model which mimics a double-gyre circulation in the North Atlantic. Realistic OSSEs have been performed. Comparisons illustrate superiority of the 4D-Var-smoother hybrid over an ordinary 4D-Var on the one hand and on the other over the 4D-Var-filter hybrid.

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IMPLEMENTATION OF GEOHAB CORE RESEARCH PROJECT--HARMFUL ALGAL BLOOMS IN UPWELLING SYSTEMS

The GEOHAB report on HABs in Upwelling Systems (GEOHAB, 2005) specified that GEOHAB would form a Subcommittee for the Upwelling Core Research Project, to work with scientists to ensure coordination of research using the same measurement protocols, sharing data, and contributing to model development. Four major eastern boundary current upwelling systems are represented—the Benguela, Iberian, California, and Humboldt Current—although other systems can be added. The Subcommittee developed 6 potential research projects as a priority for comparative studies including: 1. Effects of nutrients on HAB population dynamics in upwelling systems, 2. Climate and HABs in upwelling systems, 3. Genetic comparisons of HABs in upwelling systems, 4. Coastal morphology and its influence on HABs in upwelling systems, 5. Seeding strategies within upwelling systems and 6. The role of across-shelf and alongshore currents in the transport of HABs in upwelling systems. This presentation will provide an overview and rationale for the programme, and an update on progress towards a collaborative, comparative analysis of these major themes. GEOHAB 2005, Global Ecology and Oceanography of Harmful Algal Blooms, GEOHAB Core Research Project: HABs in Upwelling Systems. G. Pitcher, T. Moita, V. Trainer, R. Kudela, P. Figueiras, T. Probyn (Eds.) IOC an SCOR, Paris and Baltimore. 82 pp.
we derive coupled equations governing the vertical profiles of mean wind speed and turbulent stress, the wave height spectrum, and the length distribution of breaking wave crests. Analytic solutions are obtained for limiting cases when breaking waves support all wind stress. Numerical solutions are obtained for the full problem. The solutions indicate that breaking waves may contribute significantly to the total air-sea momentum flux. The breaking wave contribution increases for stronger, strongly forced wind waves. The model provides a new framework to estimate the air-sea momentum flux over complex surface wave fields, such as those under tropical cyclones.

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GRAVITY CURRENT MIXING IN SHALLOW, WIND-DOMINATED SYSTEMS

Vertical entrainment of dense gravity currents is often studied under the presumption that the ambient fluid is weakly turbulent relative to the underflow. Under such a conceptual model, entrainment into the gravity current is the dominant mixing process. While this approximation is reasonable for oceans or coastal shelf regions, field data from Corpus Christi Bay suggests that this model does not hold for shallow, wind-driven systems. Two decades of water quality sampling, combined with other more recent studies, suggests frequent development of dense underflows leading to hypoxia in the bay. Turbulent wind-driven mixing in this shallow system (whose mean depth is 3.6 meters) is suspected to dominate over underflow-induced turbulence in governing vertical gravity current mixing, making gravity current entrainment in Corpus Christi Bay a multidirectional phenomenon. We present a new conceptual model of gravity current entrainment based on TKE transport that takes ambient turbulence into account, and thus allows for entrainment of both dense fluid into the ambient and ambient fluid into the underflow.

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TEMPORAL CHANGES IN THE δ¹³C-Suess EFFECT AND ANTHROPOGENIC CO2 IN THE SUBTROPICAL SOUTH PACIFIC BETWEEN 1992 AND 2003

We measured stable carbon isotopic ratio (δ¹³C-VPD/δ) of dissolved inorganic carbon (DIC) during a re-visit cruise of WHP-P06 (BEAGLE03) along approximately 32°S in the subtropical South Pacific in August-October of 2003. The δ¹³C data obtained in 2003 were compared to those of WHP-P06 in 1992. For the comparison, we used a multi-parameter linear regression. δ¹³C changes (Δδ¹³C) in surface waters between 1992 and 2003 in the east (about −0.3 %) were lower than those in the west (−0.2 − 0.1 %) while values of depth-integrated Δδ¹³C (δ¹³C-Suess effect) in the east were higher than those in the west. Area weighted mean of the δ¹³C-Suess effect was calculated to be −14 ± 8 m year⁻¹ that is coincident with that of the anthropogenic CO2 accumulation rate (1.0 ± 0.4 m mol² year⁻¹) derived from direct comparison of DIC data according to the global mean of δ¹³C constraint ratio (Δδ¹³C / ADIC) −16 % m mol⁻¹. The observational results agree well with those from an ocean general circulation model (MOM-3).

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ERROR CHARACTERIZATION OF MODIS IR SST RETRIEVALS

MODerate-resolution Imaging Spectrometers (MODIS) Terra and Aqua sensors combined have been providing infrared (IR) sea surface temperature (SST) for nearly seven years. Although SST fields from these sensors have been used regularly for a number of studies, there has not been any comprehensive validation of the MODIS SST retrieval algorithm. In this study, we have used a matchup database of MODIS SST and in-situ SST data primarily from drifting and also from radiometers to validate and estimate the error characteristics of the MODIS SST retrieval algorithm. Analysis of the SST residuals (satellite - buoy) shows a constant bias of about 0.18K and a rms of 0.5K. A number of ancillary data (wind speed, aerosols, microwave SST, etc) are used in the analysis to narrow down the main causes for the global and regional SST error fields.

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BIOLOGICALLY-GENERATED TURBULENCE IN A COASTAL INLET

Bursts of elevated turbulence coinciding with the sunset asent and sunrise descent of backscattering layers in Saanich Inlet are argued to be signatures of turbulent mixing generated by vertically-migrating swarms of krill Euphausia pacifica. Saanich Inlet is highly productive, supporting dense krill swarms with concentrations of up to 10,000 individuals m⁻³. Microstructure profiles were collected every 3 minutes. Acoustic backscatter signals were monitored continuously with a shipboard 200-kHz ASL single-beam echosounder. During day and night, diffusivities are about 0.02 × 10⁻² m² s⁻¹. Though bursts of turbulence associated with krill migration last only 10-15 minutes, on days when they occur, the daily-average diffusivity in the inlet is raised by factors of 100-1000 to (4-40) × 10⁻² m² s⁻¹. Such events need only occur a few times a year in order to contribute comparable mixing in the upper pycnocline as do breaking internal waves. Their frequency of occurrence in Saanich Inlet and in the open ocean is unknown.
PERSPECTIVE ON THE SIGNIFICANCE OF CYANOBACTERIA IN WATER COLUMN VARIATION IN REMOTE SENSING SIGNAL DUE TO VERTICAL DISTRIBUTION OF CYANOBACTERIA IN WATER COLUMN

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PERSISTENT ORGANIC POLLUTANTS IN SUSPENDED PARTICLES IN THE OLGOTRIGOTROPIC NORTHWEST

A field investigation was conducted in the subtropical Northwest Pacific Ocean and adjacent regions during the springtime Asian Dust Storm period in 2007 to study the possible pollution of organic pollutants in suspended particles and zooplankton. We measured persistent organic pollutants (aldrin, chlordane, DDTs, DDEs, and DDDs, HCBs etc) in different particles and found the major compounds detected were DDTs, DDEs, and DDDs etc. The results confirm that some pesticides can be transported to the open ocean from China via the Asian Dust Storm

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REPRESENTER ANALYSIS IN THE COASTAL OCEAN

In one approach to variational data assimilation the optimal correction to the prior solution is constructed as a linear combination of reprenter functions. The reprenters show the trend of influence of a single observation, and can be interpreted as covariances of errors in the prior solution between the observed variable and all the model fields at all locations. We analyze reprenters computed from linear and quadratic modes for a nonlinear hydrostatic primitive equation model of coastal circulation. Error structure and evolution associated with uncertainties in initial conditions and atmospheric fluxes are assessed. The reprenters preserve dynamical consistency in the multivariable correction fields (including phytoplankton and Ekman transport). If a small decorrelation error scale is assumed in the cross-shore direction, an SSH observation contribution to corrections in the wind stress and velocities on a scale of the baroclinic Rossby radius of deformation. In contrast, the reprenter corresponding to an observation of the alongshore surface velocity provides a very local correction. Temporal evolution of the reprenters is influenced by both coastal trapped waves propagation and alongshore advection.

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POPULATION CONNECTIVITY BETWEEN OCEANS IN MESO- AND BATHYPELAGIC COPEPODS OF THE FAMILY SCOLECRITICIDAE

Recent genetic analyses are progressively revealing cryptic species within zooplankton species that have been referred to as cosmopolitan or known to have ocean-wide distributions. However, most studies have focused on the epipelagic species, hence still little is known of the gene flow of populations in the meso- and bathypelagic zooplankton. We examined genetic distances based on two mitochondrial genes (mtDNA: COI and sRNA) from populations of species between the Pacific and Atlantic Oceans in the pelagic copepod family Scolecitrichidae, which is among the most species-rich families in calanoid copepods. Many species of this family, which are widely distributed throughout the world oceans, exhibit specific patterns in their vertical distribution. Mitochondrial DNA analyses showed that population gene flow between the Oceans varies with species and/or habitat depths. In particular, there was a tendency that genetic distance (KCP) between the populations from the two oceans to be higher in the meso- and bathypelagic than in the epipelagic species, the values in the former exceeding 0.15 in some species, suggesting more advanced genetic divergences in the deeper layers.

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EFFECTS OF THE WIND STRESS FIELD AND STRATIFICATION ON THE KUROSHIO PATH VARIATION STUDIED BY A NESTED GRID OGCM

The wind stress field over the North Pacific subtropical gyre and stratification around Japan are considered to be deeply related to the existence of the two stable Kuroshio paths. We measured the temporal evolution of the representers which are assessed. The representers preserve dynamical consistency in the multivariate correction fields (including phytoplankton and Ekman transport). Temporal evolution of the representers is influenced by both coastal trapped waves propagation and alongshore advection.

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CAN FAST REPETITION RATE FLUOROMETRY AND SATELLITE OCEAN COLOR DATA BE COMBINED TO EXAMINE GULF OF MEXICO HYPOXIA?

Summer hypoxia develops in bottom waters of the Northern Gulf of Mexico influenced by discharge from the Mississippi and Atchafalaya Rivers. These nutrient-enhanced waters stimulate phytoplankton primary production thereby increasing organic material delivery to the bottom. Fast Repetition Rate Fluorometry (FRRF) provides vertical profiles of phytoplankton photosynthetic parameters including Fv/Fm, the ratio of variable to maximum fluorescence, Sigma443, the functional cross section of PSI, and Pn, the light-saturated photosynthesis rate. Ocean color observations from satellites can be used to synoptically map chlorophyll a, CDOM, and other parameters, and these data cover the entire shelf. In 2007, FRRF profiles were collected from more than 60 stations on each of two cruises (April, August). Our investigations examined the potential for using FRRF and ocean color data together to improve our understanding of the role that phytoplankton primary production plays in developing and sustaining summer hypoxia.

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MOLECULAR EVIDENCE FOR C4-TYPE C FIXATION IN DIATOMS

The propensity of diatoms to maintain maximal C fixation rates at high bloom densities, wherein CO2 can be as low as 50–150 µmol/L in the modern ocean, has a significant impact on global biogeochemical cycles. The biochemical means by which diatoms continue to grow under these conditions, given the poor substrate affinity of Rubisco for CO2, are not completely understood, butdata have emerged over the last decade or so in support of a C4-type mechanism. We conducted short term pCO2 shift experiments in pH 8.46, decreasing CO2aq from 60 to 7 µmol/L (pCO2 from 1790 to 220 ppm). Prior to and following the transition to lower pCO2, samples were collected for gene transcript analysis using Q-RT-PCR. In T. pseudonana, we observed a rapid 3-fold increase in transcript abundance for organelle-targeted malic enzyme, and a 6-fold increases in two PEPC transcripts. Cytosolic malate dehydrogenase (cytoMDH) mRNA abundance increased ~2-fold, while mitochondrial MDH did not change. Once these initial peaks, transcript abundances decreased considerably over time and were often only ~2-fold higher than pre-shift values. PEFCX transcript abundances were 1-2 orders of magnitude lower than those of PEPC, MDH or PE or regardless of pCO2. These results are consistent with an inducible C4 carbon concentrating mechanism and C fixation pathway involving malate as an initial organic acid.

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VARIATION IN REMOTE SENSING SIGNAL DUE TO VERTICAL DISTRIBUTION OF CYANOBACTERIA IN WATER COLUMN

Increased intensity and potentially harmful effects of cyanobacterial blooms attract the attention of environmental agencies, water authorities and the general public worldwide. Reliable and operational monitoring methods of coastal waters, lakes and ponds are needed. Mapping of extent of cyanobacterial blooms with remote sensing is straightforward, but recognizing waters dominated by cyanobacteria and quantitative mapping of cyanobacterial biomass with remote sensing is complicated. Unlike most algae, cyanobacteria can regulate their buoyancy and move vertically in water column. We used Hydrolight 4.2 radiometric transfer model and spectral retrieval properties of three species of cyanobacteria to study impact of vertical distribution of cyanobacteria on remote sensing signal. The results show that vertical distribution of cyanobacteria in water column has significant impact on the remote sensing signal. This result indicates that developing remote sensing methods for quantitative mapping of cyanobacterial biomass is more complex than quantitative mapping of algal biomass. Moreover, the results also indicate that in situ sampling methods and strategies used for monitoring of algal biomass or calibration/validation of satellite data have to be re-designed for waters where cyanobacterial blooms may occur.
to calculate fluxes of phytoplankton to the Bay for years with strong (2002) and weak (1980) coastal upwelling. This work provides insight into the role of oceanic upwelling, a climate-driven process, in driving phytoplankton blooms in estuaries.


THE SOUTH FLORIDA ECOSYSTEM PORTFOLIO MODEL (EPM) WEB TOOL Urban development pressures in the remaining agricultural and undeveloped lands in Miami-Dade County, Florida are increasingly intense. Decisions to develop, preserve, or restore individual parcels can cumulatively affect regional ecological, environmental, and socioeconomic patterns in complex ways. These decisions ultimately lead to changes in land use/cover, with potential impacts both the Everglades and Biscayne National Park. In response, the U.S. Geological Survey has developed a prototype for a web-based geospatial information tool (the South Florida EPM) that screens future land use/cover patterns in terms of ecological (local and landscape) criteria and water quality and socio-economic indicators. The indicators are chosen to be sensitive to land use/cover, relevant to decision-makers and stakeholders, and indicative of future trends. We envision this tool being used as a web-based portal for communicating Department of the Interior priorities in South Florida’s ecologically sensitive areas that face on-going development pressure.

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DETERMINATION OF SELECTED TRACE ELEMENTS IN BIOMONITORS Marine organisms, such as clams, can be employed as bio-monitors to assess the quality of the marine environment, since they can accumulate, concentrate and retain trace metals and other substances. Clams, Tivela maritima are widely used along the Venezuelan coast. The sea grass, Thalassia testudinum is very abundant in Venezuelan coastal areas and also found world-wide. In this work, we reported determination concentrations of Cd, Cr, Cu, Ni and Zn in the soft tissues of Tivela maritima and in the leaf blades and roots/rhizomes of Thalassia testudinum, which were collected at various sites along the Venezuelan coast. A Statistical analysis (one-way ANOVA) indicated that the different organisms investigated showed different degrees of bioaccumulation of the selected trace metals, thus they could be used as potential biomonitors to study the pollution levels of the selected trace elements in the marine environment. Significant spatial and temporal differences were found for the elemental concentrations of Cr, Ni and V in the soft clam tissue and for V in the sea grass. This work was partially funded by a research grant from the Venezuelan National Science and Technology Foundation (FONACIT: Proyecto de grupo 2005-000774) Mailing address: Centro de Quimica, 8424 NW 56th Street, Suite CCS-00204, Miami, FL, USA, 33166

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THE MERGER RATE IN FREELY-DECAYING, 2-D TURBULENCE Two-dimensional turbulence has long been studied as a paradigm for nonlinear processes in the atmosphere and ocean. Numerical simulations suggest that freely-evolving turbulence is often dominated by long-lived vortices. The vortices merge, shifting energy to larger scales. What determines the merger rate however is an unresolved issue. We examine a new set of numerical experiments which employ different dissipation schemes. The merger rates differ from run to run but are successfully predicted from an empirical relation involving the mean vortex amplitude and the packing fraction. The same relation is found to apply to most previously published experimental results. Interestingly, the relation differs significantly from theoretical expectations.

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WHAT CONTROLS BIOLOGICAL PRODUCTIVITY IN EASTERN BOUNDARY CURRENT SYSTEMS? The major environmental and physical factors controlling biological productivity in Eastern Boundary Current systems (EBCS) are examined through a neural network analysis based on self-organizing maps (SOMs). The method is applied to monthly observations over the period 1999-2004, consisting of remotely sensed sea surface temperature, sea level anomaly, ocean color, and wind speed and direction, in addition to a mixed layer
depth climatology SOMs show substantial differences in each of the four major EBCs and identified a continuum of classes of physical conditions favouring or inhibiting biological productivity. We found that whereas biological productivity in EBCs is enhanced mainly due to the alongshore wind-driven upwelling, it is inhibited by three factors: 1) strong eddy activity, 2) narrow continental shelf, and 3) deep mixed layer. Yet, in case of wide shelf and high upwelling strength, it was found that mixed layer shoaling reduces rather than enhances the productivity. To better understand these empirical findings, we will confront them with results from idealized EBCS setups of the ROMS model.

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FIELD MEASUREMENTS OF CURRENT ATTENUATION AND VERTICAL MIXING IN THE EQUATORIAL PACIFIC

Mean velocity profiles and instantaneous turbulent velocities measured above and within two subtidal eddies (Z. marina) meadows in the San Juan Islands (Washington, USA) are consistent with the mixing-layer hydrodynamics that have been observed in submerged vegetated flows in the laboratory. Velocity profiles had a shear layer with an inflection point just above the meadow, with 50-80% attenuation of tidal currents within the meadow. Reynolds stresses <u'v'> and friction velocity u* were greatest at the top of the canopy, and instantaneous streamwise and vertical velocities above the meadow were dominated by large, low-frequency (<0.017 s-1) fluctuations which enhance vertical mixing. Friction velocity above the meadow was approximately twice that in an adjacent unvegetated region, under equivalent ambient current speeds. Drag coefficients for the meadow decreased with increasing current speed. A gaped canopy was deflected and turbulence penetrated deeper into the meadow. We are investigating the influence of this flow structure on sediment transport. Maximum blade length 1.5 m; blade front area ~3 m²; maximum tidal currents 20 cm/s at one site and 40 cm/s at the other.

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IMPACT OF ASSIMILATED OCEAN COLOR SATELLITE SALINITY ON A NORTHERN GULF OF MEXICO CIRCULATION MODEL

The assimilation of real-time satellite observations into high resolution numerical models can yield more accurate forecasts of ocean currents in both open-ocean and coastal regions. We describe a capability of using MODIS and SeaWiFS ocean color spectral absorption products as an indicator of Sea Surface Salinity (SSS) for near-shore coastal waters (<35 PSU). SSS is closely associated with the fine-scale temporal and spatial variability in the coastal environment due to tidal fluctuations, river discharge (bayous, plumes), and rapidly changing topography and density structure. SSS observations are required for constraining ocean model forecast of surface and subsurface properties. Satellite observations are limited temporally and spatially, but when available can provide initialization for numerical models. We assimilate real-time MODIS SeaWiFS SSS derived from ocean color into a high resolution coastal circulation model running operationally in the northern Gulf of Mexico. The daily Nowcast/Forecast estimates of salinity up to 48 hours are derived at approximately 1.9 kilometer resolution. Modeled surface salinity estimates before and after satellite assimilation are evaluated against salinity measurements obtained from in situ observations.

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ESTIMATING THE ROLE OF SALT DIVERGENCE TERMS IN THE MARINE FRESHWATER BUDGET USING ARGO DATA AS PRECURSOR TO AQUARIUS/ SAC-D SATELLITE SALINITY DATA

Surface layer salt and heat transport terms are evaluated using interpolated SSS and SST fields from Argo combined with satellite derived surface currents (OSCAR). The purpose is to (a) evaluate the importance of surface advection on large scales in the marine hydrologic balance and a precursor to studies using higher resolution SSS fields from the Aquarius/SAC-D mission (launching in 2010), and (b) describe similarities and differences between salt and heat budgets. Contrasts between the mean heat and salt divergences in the equatorial Pacific reveal that meridional advection dominates SSS divergence terms, whereas zonal advection dominates SST divergence. In mid-high latitudes, meridional advection is found to become more important as the effective temperature gradient decreases, and the subarctic gyre in the Pacific Ocean is a region of significant salt transport. In high latitudes, the formation of anti-cyclonic eddies is important for salt transport in the North Pacific. We are developing a diagnostic tool that can be used to identify regions of strong salt transport.

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REMOTE SENSING OF TURBID PLUMES USING MODIS IMAGERY IN THE SOUTHERN CALIFORNIA COASTAL WATERS DURING STORM EVENTS

Water-leaving radiance data obtained from MODIS-Aqua satellite imagery at spatial resolutions of 250 m (band 1) and 500 m (band 4 at 555 nm) are used to study the spatial and temporal variability of turbid plumes in coastal waters of Southern California during strong storm events in the winter of 2004-2005. Our study is focused on the area between Point Loma and the US-Mexican border in San Diego, which is influenced by terrigenous input of particulate and dissolved materials from San Diego and Tijuana river estuaries and non-point sources along the shore. For several rainstorm events, we analyzed a correlation between the satellite-derived plume area and the amount of precipitated water accumulated during storms over the local watershed. The optimal threshold values of satellite-derived normalized water-leaving radiance at 465 nm and 555 nm were identified for distinguishing the plume from ambient ocean waters. In addition to satellite imagery and rainfall data we also use other oceanographic and meteorological data such as ocean currents, wind, and river discharge to study the plume dynamics in relation to environmental factors.

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A VALIDATION EXPERIMENT OF THE NON-HYDROSTATIC FVCOM: SURFACE SOLITARY WAVES OVER FLAT AND SLOW-VARYING TOPOGRAPHY

The unstructured grid Finite Volume Coastal Ocean Model (FVCOM) has been upgraded to a non-hydrostatic version (FVCOM-NH). This new version was validated by conducting a suite of numerical experiments for homogeneous and stratified non-hydrostatic problems. The present work focuses on a detailed analysis of model results for solitary waves under an inviscid condition. In the flat bottom case, the model reproduces the constant amplitude and phase of the analytical solution, demonstrating that the second-order accurate finite-volume method implemented in FVCOM-NH is capable of ensuring both mass conservation and numerical accuracy. In the variable bathymetry case, our setup followed the experimental work of O. Madsen and C.C. Mei (1969). The evolution of the model-predicted solitary wave compared well with both theoretical and laboratory results in the flat bottom and slope regions. The model also successfully reproduced the so-called “fission phenomena”, the disintegration of a solitary wave after it enters the shallow region of constant depth. FVCOM-NH has been applied to realistic studies, including internal wave dynamics on Stelwagen Bank and on the steep slopes of the South China Sea.

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SATELLITE REMOTE SENSING OF THE ROCKY INTERTIDAL USING MODIS AND ASTER SENSORS

In an era of expensive in-situ studies, satellites can provide valuable climate information in ecologically sensitive inter-tidal locations. This paper combines 5 years of thermal in situ data with remotely sensed temperature from three sensors: MODIS/Terra, MODIS/Aqua and ASTER/Terra; and two products: land surface temperature and sea surface temperature. Satellite data were found to differ from logger temperatures an average of 4.5°C (MODIS/Aqua LST), 4.1°C (MODIS/Terra LST), 4.2°C (MODIS/Terra SST) and 4.3°C (ASTER/Terra LST). ASTER was determined to have too few images per scene to be useful for an intensive habitat monitoring program. Tidal stage was found to be a strong factor in determining the logger-satellite temperature difference. Better agreement in temperatures was observed during high tide, exhibiting an average variance from logger temperatures of 4.0°C (MODIS/Aqua LST), 1.9°C (MODIS/Terra LST), and 1.6°C (MODIS/Terra SST). The satellite data have been found to be a promising source of long-term warming or cooling trends and for investigating complex patterns in the variation of biotic thermal stresses along coastal zones.

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IMPACT OF A WARMING OF THE INTERMEDIATE WATER LAYER ON THE EXPORT OF PARTICULATE ORGANIC CARBON IN THE EURASIAN ARCTIC

The observed decline in Arctic ice cover is likely to increase the export of particulate organic carbon (POC) over the Arctic continental shelves. This could lead to a significant sequestration of CO2, particularly over the immense Siberian Shelves. A substantial warming of the Atlantic Water layer in the Eurasian Arctic may further affect the magnitude and nature of POC export over the Siberian Shelves. It is therefore necessary to measure POC fluxes. A reduction in ice cover could result in a significant increase in export. The said mechanisms might also affect the export of carbon into the Eurasian Basin. Long-term sediment traps were deployed in 2005-2006 in the Intermediate Water Layer of the Laptef Sea where POC fluxes reached 1.8 g C m-2 y-1 at 175 m and 3.5 g C m-2 y-1 at 840 m, with the highest fluxes occurring during summer 2006. The annual cycles of POC export will be compared to the temperatures observed in the Intermediate Water layer to determine the relationship between POC fluxes and the Atlantic Water temperature anomalies.

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Diazotrophs utilize dinitrogen gas to meet their nitrogen requirements, which may give Geider, R.
Langlois, R. J.

Factors controlling diazotroph distribution in the ocean remain poorly understood. Bottle experiments were performed under trace metal clean conditions to test the effects of

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NORDEIC SEA OVERFLOWS AND MODELED CLIMATE

The Marginal Sea Boundary Condition (MSCB) of Price and Yang forms the basis of parameterized overflows from the Mediterranean, and Nordic Seas (PNSO) in the ocean component of the Community Climate System Model (CCSM). The numerics involved with two-way exchange between modeled seas on both sides of an overflow are discussed. In particular, the solution to the Nordic Sea case where, unlike the Mediterranean at Gibraltar, the inflow is driven by different physics than the overflow and need not occur at the same location is described. First, the mean North Atlantic tracer distributions, then centennial changes in the long term global climate are compared between solutions with and without parameterized Nordic Sea overflows.

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THE UPWELLING-RELAXATION CYCLE AND ITS EFFECT ON PLANKTON PRODUCTIVITY OVER THE NORTHERN CALIFORNIA SHELF DURING WEST

During the CoOP WEST project, we explored the role of wind-driven transport in plankton productivity over the shelf off Bodega Bay, northern California. Wind forcing varies on synoptic time scales, yielding periods of upwelling interspersed with relaxation periods (weak winds). While upwelling periods are critical for nutrient delivery, relaxation periods are critical for algal bloom development over the shelf. In turn, zooplankton productivity over the shelf depends on the availability of phytoplankton and the ability to be retained in this environment. As expected, a key factor is the relative time scales of physical and biological processes. Phytoplankton blooms exhibiting strong responses to upwelling-relaxation cycles while growth of zooplankton populations depends on more than one upwelling-relaxation cycle. Results from analysis of field observations and models will be presented for the Bodega-Reyes region in 2001-2002 and compared with available results from other regions and other years.

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SEASONAL AND INTER-ANNUAL VARIATION IN BIOGEOCHEMICAL PROCESSES AT THE PORCUPINE ABBYSLINE PLAIN (PAP) OBSERVATORY (49N, 16.5W)

We present a suite of multidisciplinary biogeochemical data measured in situ at the Porcupine Abyssal Plain (PAP) observatory in the North East Atlantic (49N, 16.5W) over the past 20 years. The observations cover the entire water column and the seabed beneath (4800 m). Since 2002 this includes water column measurements of temperature and salinity (to 1000 m) and biogeochemical data at 30 m (including nitrate, chlorophyll and CO2). Benthic studies have been carried out at PAP since 1989 including time-lapse photography; trawls and cores to study the benthic ecosystem and deep sediment traps to measure particle flux. This multidisciplinary data set makes the PAP site a unique surface to benthic observatory in the NE Atlantic. This substantial long-term high temporal resolution data set will be discussed in terms of coupled inter-annual variability between the pelagic and benthic environments. In addition, the importance of the PAP data set in terms of understanding regional and global change will also be addressed alongside other observational data and linked to large-scale climatic indices such as the North Atlantic Oscillation (NAO).

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A VIEW TO A KILL! DEVELOPMENT OF AN IN SITU BASED METHOD FOR IDENTIFICATION OF MARINE ALGAE SPECIES AND QUANTIFICATION OF VIRAL INFECTION

In order to improve our understanding of how algae viruses influence host bloom dynamics, methods allowing the detection and quantification of hosts and infected cells are needed. Although successful identification of some phytoplankton species have been done
using molecular techniques like Fluorescence in Situ Hybridization (FISH) or CARD-FISH, metacontamination is amplified to cell phase. The metagenome signal variations make these methods difficult to apply on algae in environmental samples. Also the sensitivity of these hybridization techniques are such that they are difficult to use on low copy genes or for visualization of intracellular viruses. As an alternative we have investigated the utilization of Loop Mediated Isothermal amplification (LAMP-PCR) as a way of amplifying probe targets. The sensitivity and isothermal properties of LAMP hold many advantages compared to traditional in situ PCR and FISH based detection. We have successfully designed LAMP-PCR primers targeting the Pneumocystis Chrysonomulinae erica and co-occurring viruses CeV. These primers allow for the in situ detection and quantification of P. erica and cells infected with virus.

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POTENTIAL EFFECTS OF RUNOFF, FLUVIAL SEDIMENT AND NUTRIENT DISCHARGES ON THE CORAL REEFS OF PUERTO RICO

Coral reefs have been degraded by human activity in much of the earth's tropical oceans. The potential relation between river sediment and nutrient discharges and degradation of Puerto Rico coral reefs was studied using streamflow-, suspended-sediment, and water-qual-ity monitoring. The highest daily sediment discharge is 70 % of average precipitation (1,600 mm). Annual suspended-sediment discharge from Puerto Rico into coastal waters ranges from 2.7 to 9.0 million tonnes. Storm runoff transports a substantial part of suspended sediment from uplands to the coast, eg. the highest daily sediment discharge is 1 to 3.6 times the annual suspended-sediment discharge. Hurricane Georges distributed an average of 0.8 tonne of sediment per km² of land over 12 days in 1998; a volume of 2.6 billion m³. Runoff of more than 1.0 billion m³ of water and 5 to 10 million tonnes of sediment were discharged to the coast as a result of the hurricane. N and P concentrations in river waters are as much as 10 times the pre-settlement levels. Fecal coliform and fecal strepto- cocci concentrations in many rivers are near or above regulatory limits. Unusual epilimnion and intense sediment discharge, river-borne nutrient and fecal discharge is a less-intense but chronic stressor to coral reefs found near the mouths of rivers. Negative effects of river-derived sediment and nutrient discharge on coral reefs are especially pronounced in nearshore areas of the north, southwest, and west coasts of the island.

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AN INSTRUMENT FOR EXTENDING ARGO TEMPERATURE AND SALINITY MEASUREMENTS THROUGH THE SEA SURFACE

Measurement of sea surface temperature and salinity produces ground truth for satellites including the upcoming Aquarius Mission, but also affords measurements of meteorologi-cal fluxes such as evaporation versus precipitation and ocean heat flux. The SBE 41CP, installed on many ARGO floats in the world's oceans, is pumped to ensure the highest quality data. To avoid degrading the salinity accuracy by ingesting sea surface oils, the pump is turned off at 5 - 10 decibars beneath the sea surface as the ARGO float ascends. The trade-off for achieving sensor stability over the life span of the ARGO float was the forfeiture of very-near-surface temperature and salinity. To address this need, Sea-Bird Electronics has developed a free flushing sensor designed to make temperature and salinity measurements as an ARGO float passes through the sea surface. The sensor will be calibrated by the main CTD on the ARGO float each time a profile is executed. Field trials demonstrate an accuracy of +/-0.004 degrees Celsius and +/-0.002 in conductivity, yielding +/-0.02 in practical salinity.

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SHORT-LIVED RADIOISOTOPE INVENTORIES AS TRACERS OF TERRESTRIAL SEDIMENT DISTRIBUTION ON A WATERSHED SCALE: ST. JOHN, US VIRGIN ISLANDS

Sediments in coastal salt ponds, and near-shore marine environments in the USVI provide a record of sediment accumulation, which reflects natural and anthropogenic activities in adjacent watershed. Sediment accumulation rates in these environments generally in-crease from 0.02-0.10 cm/yr for the last 2,000-5,000 years (based upon 14C dating) to 0.07 cm/yr to 0.20 cm/yr over the past 100 years (based upon 210Pb dating). Sites with the greatest increase in accumulation rate are located in, or adjacent to, watersheds that have undergone land use changes due to anthropogenic activities. Expanding this work to a watershed scale may be accomplished using SLRI (short-lived radioisotope, 210Pb, 137Cs, and 7Be) inventories. Sediment samples were collected in a relatively undisturbed watershed on St. John to determine the feasibility of SLRI inventory partitioning in terrestrial sediment reservoirs (watershed, coast, marine) as a means to identify/quantify locations of erosion and deposition, as well as distribution and accumulation rates. The variability of SLRI in riverine environments is expected to quantitatively describe terrestrial sediment pathways on a watershed scale and linkages between the watershed, coast, and marine environment.

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MODELING NITROGEN AND PHOSPHORUS RETENTION IN THE COASTAL OCEAN AT THE GLOBAL SCALE

Human activity is leading to major increases in terrestrial nutrient inputs to the ocean and a deterioration of coastal water quality in many regions. Here, we present a spatially-explicit model of the coupled nitrogen (N) and phosphorus (P) cycles in the proximal coastal ocean that allows an assessment of the consequences of the changes in river and ground-water fluxes and nutrient transformation and retention in the coastal ocean at the global scale. Our process-based model consists of a "ribbon" of generic box models that are distributed along the entire global coast-line at a half degree resolution. Different parameter-izations for the box models are established using a global coastal typology based on hydrological, lithological, morphological and biogeochemical criteria. In our presentation, we will present results of simulations performed using spatially-explicit nutrient inputs (GlobalNEWS) and other relevant forcings (including light and temperature) and we will discuss the role of various types of near-coastal ecosystems (estuaries, fjords, lagoons, deltas and others) in retention of nutrients at the global scale.

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OXYGEN CONSUMPTION IN PERMEABLE GULF COAST SEDIMENTS

Boundary layer flows and suspended matter and solutes contained within, affect granulometry, porosity, permeability, and microbial activity in near shore salt marshes. Variations in the boundary flow condition or changes in the suspended matter load result in significan-t changes in sediment compaction and permeability, which entail alterations in sediment water exchange of solutes and particulate matter. Thereby episodic events can insti-gate long lasting changes affecting life biogeochemistry at the sea floor, affecting cycles of nutrients and contaminants. Here we report investigations on oxygen consumption rates in permeable Gulf Coast sediments and its temporal and spatial variation. The consump-tion rate measurements were conducted on retrieved sediment cores over a period of one year using the percolation method described by Deleer et al. (2005). Through assessing oxygen consumption rates of the sediment we expect to achieve a better understanding of the role of the permeable sand sediments for the cycling of organic matter in the Gulf coast environment.

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CAUSES AND CONSEQUENCES OF MATE LIMITATION IN THE COASTAL MARINE COPEPOD, TEMORA LONGICORNIS

Coastal marine copepods are likely to be vulnerable to mate limitation as a result of dilute population densities and their need to continuously breed in order to produce multiple fertilized clutches in their lifetime. Despite important implications for predicting copepod population growth, field surveys describing the prevalence of mate limitation in coastal copepod species are lacking. The aim of this study was to determine the preva-lence of mate limitation in the dominant marine copepod, Temora longicornis within the Damariscotta River estuary in Walpole, Maine. Clutches obtained from field-caught females were analyzed using an egg-staining technique to determine the female’s in situ fertilization status. The results of this study indicate that female T. longicornis lay un-fertil-ized eggs in substantial proportions which suggest that nauplii production may be con-strained by mate limitation within this species. This study highlights a need to incorporate fertilization/mate limitation into models describing copepod population growth.

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RECENT OBSERVATIONS FROM THE GREENLAND SEA: SEASONAL TO INTERANNUAL VARIABILITY OF TEMPERATURE AND SALINITY AND IMPLICATIONS ON WATER MASS FORMATION

The Greenland Sea gyre is known for open ocean convection triggered by extreme heat loss to the atmosphere in winter. Since the late 1980’s, convection activity decreased and reached only intermediate depth. Data from ARGO floats and a profiling mooring, from 2000 to 2007, provide a hydrographic time series longer and of significantly higher temporal resolution than any timeseries discussed before that of region. It enables us to describe the typical seasonal cycle and associated interannual variabilities of temperature and salinity for the last decade. The development of heat and freshwater content of the gyre is analyzed in respect to the atmospheric forcing and lateral advection, with possible
Our analysis indicates a consistent bias towards studies on low dispersal/low latitude species. We examined estimates of dispersal in a broad range of marine species through an analysis from the time series of the upward looking sonar data by assuming that bubble clouds are the fetch is short, the penetration depth is lower and does not show a clear correlation observed and the bubble penetration depth linearly increases with the wind speed. When the wind speed exceeds about 10 m/s and the surface wave field is well developed with a long fetch, Langmuir circulations are clearly understood and used to obtain high-resolution images of internal solitary waves (ISWs) developed and used to obtain high-resolution images of internal solitary waves (ISWs). High-frequency broadband (150-600 kHz) acoustic scattering techniques have been used to determine for some of the observed scattering layers. Quantiﬁcation and reducing these atmospheric and watershed sources are important for maintaining and restoring water quality due to eutrophication. We describe the application of a watershed-based nonpoint source nitrogen loading model, previously published by the Marine Biological Laboratory, to estimate inputs of nitrogen to and from coastal watersheds. This relatively simple model can be applied easily to many estuaries so that comparisons can be made between estuaries. The model, applied to forty-nine (49) embayments along the southern New England coast, yielded nitrogen input rates to the estuaries of 21 to 3300 kg N/ha/yr (mean 224, median 67 kg N/ha/yr). A paired comparison of the model output values with the more well-known USGS SPARROW model values showed high goodness of agreement (r² = 0.73, n = 39). Application of the model for multiple estuaries can provide a means for the development of nitrogen load—ecological response models using a comparative estuary approach.

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OBSERVATION OF NEAR SURFACE BUBBLE STRUCTURES USING AN UNDERWATER SONAR SYSTEM

Understanding the bubble injection process by surface breaking waves is important for improved predictions of sea spray generation and air-sea heat and gas exchanges. From January to March 2006, upward looking and sidescan sonar deployments were deployed in Narragansett Bay, RI to monitor the water column. The backscatter intensity data during high wind events were used to examine bubble cloud structures generated by breaking waves. Both the bubble injection depth and the distribution of injection events were estimated using the upward looking sonar. Organized Langmuir circulations were observed using the sidescan sonar data. When the wind speed exceeds about 10 m/s and the surface wave field is well developed with a long fetch, Langmuir circulations are clearly observed and the bubble penetration depth linearly increases with the wind speed. When the fetch is short, the penetration depth is lower and does not show a clear correlation with the wind speed. Spatial distribution of individual bubble clouds may be estimated from the time series of the upward looking sonar data by assuming that bubble clouds are advected by a current model.

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GLOBAL TRENDS IN DISPERSAL AND CONNECTIVITY AMONG MARINE SPECIES

We examined estimates of dispersal in a broad range of marine species through an analysis of published values, and evaluate their applicability using indirect measures of dispersal. Our analysis indicates a consistent bias towards studies on low dispersal/low latitude species. We hypothesize that reports focusing on short distance dispersal are not representative of global trends. This hypothesis is examined using a database of indirect measures of dispersal including planktonic larval duration (PLD, 318 species) and genetic differentiation (FST, 212 species). We observed significant differences in FST (P<0.001) and PLD (P<0.001) between taxonomic groups as well as a weak association between PLD and FST (R=0.4) across groups. Within marine fish (<50% of data sets), species with demersal eggs had lower PLDs (R²=0.76, P<0.001) and higher genetic structuring (R²=0.80, P<0.001). Furthermore, significant increases in dispersal (PLD and FST) were associated with increases in latitude, adult body size, and water depth and latitude was identified as the main explanatory variable. The global trends in dispersal observed here provide a first step towards predicting species-level and regional differences in dispersal.

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COMPARISON OF UPWELLING INDICES USING BLENDED WINDS (COAMPS/QUICKSCAT) AND NOAA PRESSURE FIELDS IN MONTEREY BAY, CALIFORNIA

The rich diversity and abundance of the marine life along the California coast, including Monterey Bay, is intimately linked to the coastal upwelling and the coastal upwelling index (CUI) was developed to quantify the strength and location of upwelling. The CUI is calculated using NOAA Environmental Research Division (ERD) sea surface pressure data. In this study, we examine the impact of using additional data sets to improve the CUI estimates, particularly towards the coastline. We use a Blended Wind product derived from NASA QuickSCAT and Coupled Ocean / Atmosphere Mesoscale Prediction System model outputs to compare with the NOAA CUI for the period September 2006 - July 2007. The correlation between the Blended Wind product and the ERD CUI increased positively as distance from shore decreased. While both showed expected seasonal patterns, the ERD CUI consistently displayed significantly higher variance. An enhanced understanding of upwelling mechanisms and the effects on marine life will be required to meet the demand of industry but also the sustainability of the environment.

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BROADBAND ACOUSTIC SCATTERING FROM NONLINEAR INTERNAL WAVES: IDENTIFICATION OF DOMINANT SCATTERING MECHANISMS

High-frequency broadband (150-600 kHz) acoustic scattering techniques have been developed and used to obtain high-resolution images of internal solitary waves (ISWs) propagating shoreward over the New Jersey continental shelf. Multiple ISWs were tracked and imaged acoustically, while simultaneous direct microstructure measurements and relatively coincident zooplankton net samples were obtained. Multiple scattering layers were often associated with the ISWs, with the backscattering from the different layers exhibiting a consistent frequency trend. This scattering layering was observed at all frequencies at depths associated with large temperature gradients, while at the highest frequencies a deeper scattering layer was sometimes observed, not associated to large temperature or salinity gradients or high dissipation rates. The broadband spectra, together with physics-based scattering models, have allowed the dominant scattering mechanisms to be determined for some of the observed scattering layers.

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MICROZOOPLANKTON DISTRIBUTION AND TROPICAL INTER ActionS DURING ANNUAL HYPOXIA IN LAKE ERIE AND THE GULF OF MEXICO

The northern Gulf of Mexico and the central basin of Lake Erie experience annual hypoxia, covering broad regions in summer and impacting their living resources. However, little is known about its effects on microbial communities. This study examined the composition, distribution, and dynamics of microzooplankton using 16S rRNA gene sequences, shipboard experiments, and real-time flow-cytometry. Examination of planktonic distribution and composition along several continuous transects in the Gulf of Mexico in August 2006-2007 revealed significant spatial heterogeneity. Heterotrophic microbes and diatoms peaked in a mid-shelf warm front and the Mississippi River plume, respectively. Their diel vertical patterns were linked to the fluctuating DO concentrations in the bottom layer, which were apparently influenced by the currents. In both systems, microzooplankton biomass in the hypoxic zone (DO < 1 mg/L) was dominated by oligotrich ciliates and gymnodinid dinoflagellates, which exhibited significant top-down pressure on pico- and nanoplankton. The results of this study indicate that microzooplankton play an important role in the pelagic food web during annual hypoxia.
NEW NITROGEN SOURCES IN THE SUBTROPICAL SOUTH-WEST PACIFIC

New nitrogen supply to the oligotrophic ocean is currently being reassessed in recognition of an increasingly important role of nitrogen fixation. To examine the relative contributions of different nitrogen supply routes, a suite of physical, biological and biogeochemical rate measurements were made during a 13-day Lagrangian study north of New Zealand, in sub-tropical waters at the southern boundary of the nitrogen fixation biome. Measurements were obtained during extreme events associated with nitrogen supply, including the transition of a tropical cyclone to a storm and the development of a surface colonial Trichodesmium bloom. The new nitrogen sources will be assessed in terms of their contribution to community primary production, and considered in the context of modelling nutrient supply in oligotrophic systems and their potential response to climate change.

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THE IMPACT OF ANTENNA PATTERN DISTORTIONS ON THE ACCURACY OF HF RADAR-DERIVED NEAR-SURFACE OCEAN CURRENT RETRIEVALS: A SIMULATION-BASED ANALYSIS

We present a simulation-based analysis of errors in HF radar-derived near-surface ocean current measurements. We examine, in particular, the effects of distortions in the radar receive antenna sensitivity patterns. It is well known that pattern distortions occur to some degree with all radar installations and that the distortions have an effect on the current retrievals, particularly in the case of direction finding radar systems using compact antenna geometries, such as the CODAR Seasonde. We demonstrate a method for quantifying these distortions by a single parameter and relate this parameter to overall performance of the radar system using simulated data. Results show a high correlation between the rms errors in the retrieved radial currents and the antenna distortion parameter. We compare the results obtained when processing data using measured antenna patterns to those obtained when processing using ideal patterns. Throughout this simulation-based analysis we employ a crossed loop dipole antenna geometry, the same antenna geometry used by the CODAR Seasonde radar systems, and standard CODAR data processing software to process the simulated data.

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HOTSPOTS IN THE DISTRIBUTION OF NORTHERN BLUEFIN TUNA IN THE ATLANTIC AND PACIFIC OCEANS

Northern bluefin tuna are among the most valuable fish in the sea. Effective management of their fisheries will require a detailed understanding of their seasonal movement patterns and particularly their use of hotspots. Here we apply electronic tag data to identify such hotspots in the distribution of Atlantic and Pacific bluefin tuna. We focus specifically on hotspots that consistently occur in spring to fall in the Gulf of Maine and off Baja California. By integrating track data with tag measurements of water temperature and remote sensing observations, we identify the physical features underlying these hotspots. Regional scale processes, such as upwelling and high SSTs, are considered in the context of providing real-time wave forecasts from a single high-end computer workstation.

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SPATIAL PATTERNS IN FISHERIES: NEW TECHNIQUES, NEW OPPORTUNITIES FOR ECOSYSTEM-BASED MANAGEMENT

Understanding spatial distribution of fish stocks in the ocean is an important component of the information needed for ecosystem-based fisheries management. Fine-scale distributions can be used in combination with cross-scale oceanographic data to explore management patterns in relation to local and regional environmental conditions. Project CROOS (Collaborative Research on Oregon Ocean Salmon), and work in California, are fishing-industry initiatives involving the active participation of commercial salmon trolls, scientists, and state and federal agencies to develop techniques for fine-scale mapping of Chinook salmon (Oncorhynchus tshawytscha) stock-specific distributions in ocean hazards. Preliminary analysis and a rapid shift in catch patterns in September 2006 corresponded with a change in upwelling patterns and water column hydrography. Distribution differences may enable fishery managers to direct fishing effort toward abundant stocks and away from stocks of conservation concern. This is a new tool for investigating the ocean ecology of a variety of fisheries with potential application to ecosystem-based fishery management. Properly applied, these techniques can lead the fishing community and managers to a more productive relationship.

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A HIGH-RESOLUTION CLOSED-REAL-TIME ATMOSPHERE/WAVE FORECAST SYSTEM FOR THE COASTAL ZONE

Early results are presented from a NOAA funded project involving the configuration of a short-term high resolution wave and atmospheric model forecast system. The coupled modeling system is designed for eventual transition to National Weather Service Forecast Offices in an effort to extend the current open ocean wave forecasts provided operationally by the NOAA/NCEP WaveWatch (WW) model into the coastal zone (i.e., within 100 km of the shoreline). Results from sensitivity tests with the Weather Research and Forecast (WRF) model involving grid resolution, nesting and data assimilation (scatterometer and radial winds) will be presented. Output from embedded high resolution hydrodynamic and wave propagation models will be compared to both buoy and extrapolated WW forecasts. Because the system is intended for operational applications, results are considered in the context of providing real-time wave forecasts from a single high-end linux workstation.

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OPERATIONAL SST BIAS CORRECTION USING AATSR DATA

The operational SST retrieval algorithms often show regional biases of a few tenths of Kelvin, induced by defects in the atmospheric correction techniques that are currently used. These regional biases vary from a data set to another and often lead to data consistency problems for users. A preprocessing step, including a bias correction aiming to homogenize the data sources is thus essential before ingestion of the data in analyses, assimilation in models and more generally before every applications using multiple southern boundary of the nitrogen fixation biome. Measurements were made during a 13-day Lagrangian study north of New Zealand, in sub-tropical waters at the southern boundary of the nitrogen fixation biome. Measurements were obtained during extreme events associated with nitrogen supply, including the transition of a tropical cyclone to a storm and the development of a surface colonial Trichodesmium bloom. The new nitrogen sources will be assessed in terms of their contribution to community primary production, and considered in the context of modelling nutrient supply in oligotrophic systems and their potential response to climate change.

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DYNAMICAL AND STOCHASTIC MODELLING FOR THE EVALUATION OF COASTAL OBSERVATIONAL NETWORKS IN THE BAY OF BISCAY

The exchange processes between continental shelves and the deep ocean involve energetic processes such as slope current variability, eddies and filaments. Unfortunately, these processes exhibit short time and space scales and are therefore difficult to observe. Our objective is to evaluate observational networks in the Bay of Biscay by a stochastic modeling method. A baroclinic coastal ocean model is set up there during summer 2004. Two experiments of simulations are carried out, one with perturbations of the wind stress, and another one with perturbations of the density field. The ensemble spread is considered to provide a good proxy for the model error, given error assumptions such as the ones adopted here. The corresponding model error subspaces are explored, in order to specify their space and time characteristics. Then, several observation networks are defined and their performances are evaluated by studying the eigenvalue spectra and corresponding eigenvectors of the scaled representer matrix.
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SPECIES-SPECIFIC SILIFICATION RATES USING A NEW FLUORESCENT PROBE (PDMPO) IN THE SUB-ANTARCTIC AND POLAR FRONT ZONES (OF THE SOUTHERN OCEAN)

During the SAZ-SENSE cruise, conducted during the austral summer of 2007, we investigated the origin of the high autotrophic biomass accumulation regularly observed in the SAZ (Sub-Antarctic) south-east of Tasmania compared to the relatively poorer waters south-west of the island. As diatoms are an inordinate role in the Si biogeochemical cycle was fully characterised during this cruise, with measurements of siliceous biomass, Si uptake and dissolution rates, and diatom taxonomic diversity. Complimentary to taxonomic identification, particular emphasis was put on the activity of key species in the silification process. The recent development of new molecular markers (fluorescent hybridization methods) have made it possible to visualize important biogeochemical processes such as biogenic silica production down to the level of individual cells. The new PDMPO-marker methodology allows quantification of the relative contribution of each cell or diatom species against total Si uptake rates by using image analysis in epifluorescence microscopy. The first results of this new combined isotopic and fluorescent probe labelling will be presented here and will give fresh insights into who does what within the diatom community.

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TOPOGRAPHIC-CHANGE ANALYSIS OF SANDY HOOK, NEW JERSEY, BASED ON LIDAR DATA

Three lidar surveys at Sandy Hook, New Jersey, acquired in October 2002, April 2004, and May 2005, were used to identify areas that had undergone significant topographic change. The first analytical step calibrated the third lidar datasets to ensure that vertical-elevation values did not change in areas where change was known not to have occurred, such as in parking lots, on tennis courts, and on roofs of flat buildings. Next, elevation-difference maps were created, and areas with vertical change greater than 1 m were analyzed on a smaller scale. The large elevation changes were mostly observed on the beach face along dunes, which were further analyzed for change in volume and surface area. The elevation-difference map between the 2002 and 2005 surveys showed change that occurred because of erosion. The comparison between the 2005 and 2007 surveys revealed a period of depositional change. Although there was erosion in the northeastern section, in the 2002 to 2005 and the 2005 to 2007 survey comparisons, the difference map between the 2007 and 2002 surveys showed the overall trend was depositional throughout the region.

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TEACHING RAPID CLIMATE CHANGE USING EXAMPLES FROM THE GEOLGIC RECORD - A DISCOVRY-BASED LEARNING MODULE FOR THE PALEOECO-EOCENE THERMAL MAXIMUM

Science educators are increasingly incorporating aspects of climate change into primary and secondary school curricula, but teaching about climate change requires context from the geologic record. How has the Earth’s climate varied in the past, and how does the current rate of climate change compare to ancient events? We have created an inquiry-based learning module focused on the Paleocene-Eocene Thermal Maximum (PETM), one of the most prominent and relevant examples of rapid global warming known in the geologic record. The PETM occurred 55 million years ago and was characterized by global warming, significant changes in the carbon and hydrologic cycles, and a myriad of biotic responses. Our learning module is based on two types of primary data - the ‘shipboard data’ collected during Ocean Drilling Program drilling operations aboard the JOIDES Resolution, as well as “shore-based” analyses. The progression of the exercise allows students to experience the initial discovery of the signature of the PETM in deep-sea sediments and then compile data collected from 9 deep-sea drill sites into a global picture to reconstruct the magnitude and scope of the event.

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PARTICULATE ORGANIC MATTER AND BALLAST FLUXES MEASURED USING TIME- SERIES AND SETTLING VELOCITY SEDIMENT TRAPS IN THE NORTHWESTERN MEDITERRANEAN SEA

Gravitational sinking of particulate organic carbon determines most of the rate at which the ocean absorbs CO2 from the atmosphere and sequesters it in the deep ocean. Prompted by suggestions that POC flux into deep water is influenced by ballast mineral
model combines Z-grid and sigma-grid in the vertical direction. Following the UnTRIM model, this new model solves the 3D equations of motion in the unstructured grid using the Eulerian Lagrangian Method without mode-splitting. The model was applied to simulate estuarine/coastal circulation during normal conditions and extreme events, i.e., storm surge and inundation during hurricanes in 2004/2005. While the Z-grid model and sigma-grid model yielded similar results during normal conditions (tides for GOM), simulated storm surge and currents in shallow coastal regions from the Z-grid and sigma-grid models differ significantly. During periods with significant water level fluctuation, sigma-grid model yielded much more accurate water level and currents than the z-grid model, due to the inability of Z-grid to resolve the near-surface layer.

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WAVE EFFECTS ON SEDIMENT TRANSPORT ON THE TIDAL FLAT, GANGWHA, KOREA

Tidal flats of Incheon, Korea are located off the coast of the Han River mouth. The extensive macrotidal mud flats, for which tidal range exceeds 9 m, are unique in that freshwater discharge during the summer wet season influences the region, while strong waves dominate resuspension and transport processes during winter. A field campaign initiated to better understand imparting influences of these processes and a benchtop pod was deployed in a tidal channel in Southern Gangwha tidal flats during November, 2006 and September-October, 2007. Instrumentation on the pod includes one Acoustic Doppler Velocimeter, one Acoustic Backscatter System, and two Optical Backscatter Sensors. Sediment suspension mainly occurred during the accelerating phase of flood and ebb. On the other hand, deposition occurred during the slack after flood when waves were relatively weak. When waves reduced, shear appeared to support sediment suspension even during the slack after the flood. This phenomenon has an important ramification on sediment budget on the upper reach of tidal flat.

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INTERNAL TIDAL CURRENTS IN THE KAOPING SUBMARINE CANYON

Data from five comprehensive field experiments during years 2000-2006 were used to study the internal tidal flow pattern in the Kaoping Submarine Canyon (KPS), Taiwan. The internal tides are large with interface displacements of about 200 m and maxima velocities of over 100 cm/s. They are characterized by a first-mode velocity structure with zero crossing at about 100 m depth. In the lower layer, the currents increase with increasing depth. Vertical phase shift is apparent, especially in the upper layer. Also, the density reaches the maximum at about the end of the flood currents, indicating a predominant standing wave pattern.

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MODELING OF WIND-DRIVEN INTERACTIONS AT THE ESTUARY/OCEAN TRANSITION

This study focuses on the reciprocal influence that an estuary and its adjacent shelf exert under the influence of wind forcing. In particular, the bathymetric effects on the wind-driven circulation at the transition between an idealized estuary and the adjacent ocean are studied with the Regional Ocean Modeling System (ROMS). Distinct simulations are performed to compare wind-driven patterns resulting over flat bottom, under various wind velocities, to those over bathymetry. The effects of density gradients are added to the patterns that arise for wind-driven flow over bathymetry. Finally, the effects of tidal forcing are assessed. The relative contribution of wind and density gradients is described in terms of the non-dimensional Wedderburn number, whereas the competition between tidal forcing and density gradients is depicted in terms of the vertical Ekman number. Results suggest that under most cases of Wedderburn and Ekman numbers tested, the flow is mildly affected by bathymetry. The greatest bathymetric effects are observed at Ekman numbers of order 1, regardless of the Wedderburn number.

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AN UNSTRUCTURED-GRID 3D HYDRODYNAMIC MODEL FOR SIMULATING ESTUARINE AND COASTAL HYDRODYNAMICS DURING NORMAL AND EXTREME EVENTS

An unstructured-grid hydrodynamic model is developed and applied to simulate estuarine and coastal circulation during normal conditions and extreme events. The model was developed using combined finite difference and finite volume methods for unstructured grids (both triangular and quadrilateral). While finite volume method is naturally applicable to unstructured grids, finite difference method is more efficient. In addition, this
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ENSO TELECONNECTION TO THE TROPICAL NORTH ATLANTIC
Studies have shown that the existence of El-Niño in boreal winter does not always guarantee
a warmer-than-normal tropical North Atlantic (TNA) condition the following spring-
summer. In this part, it is due to instances where an interfering positive North Atlantic
Oscillation (NAO) pattern strengthens the North Atlantic sub-tropical high (NASH) and
increases the evaporative cooling over TNA, thus counteracting the opposite tendency
emanating from the Pacific. Other potentially important factors include the changes in
El-Niño and its teleconnection patterns in response to the decadal- to multidecadal climate
fluctuations that modulate the background mean state. In this study, we explore the ENSO
teleconnection to TNA under the influence of decadal-multidecadal (global and regional)
climate fluctuations by a simplified linear model (LBM) and the NOAA Community
Atmospheric Model (CAM) coupled to a slab mixed layer ocean model.
Several sets of model experiments are performed by prescribing the global SSTs while
using the slab ocean model to simulate the SSTs in the TNA region.

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CARBON AND NITROGEN UPTAKE RATES OF PHYTOPLANKTON FROM IN SITU INCURBATIONS UNDERS THE SEA ICE IN THE CANADIAN ARCTIC
Although ongoing changes in climate and ice conditions are expected to alter the carbon
and nitrogen uptake rates of phytoplankton as primary producers in the Arctic Ocean,
recently a few measurements have been done in the Canada Basin. The expedition in 2005
allowed us to provide a valuable data for the uptake rates of phytoplankton under the sea
ice from in situ incubations, compare them with the 2002 data under different environ-
mental conditions in the same basin, and form a backbone for any future discussion of impacts
global warming on the primary productivity in the region. The patterns of nutrient
concentrations were similar, whereas the surface water temperature patterns were quite
different between the two data sets in 2002 and 2005. Since stronger light intensity through
the sea ice reached to the ice bottom in 2005, the carbon and nitrogen uptake rates of phyto-
plankton under the sea ice were higher in 2005 than in 2002. The mean f-ratio from this study in 2005 was 0.31 (±0.12) which is within the range in the Arctic Ocean.

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DECADAL VARIABILITY IN THE INDO-PACIFIC OCEAN INFERRED FROM SATELLITE DATA AND ECCO ASSIMILATION
The nearly one-and-a-half decades of coincident satellite observations of sea surface
height (SSH) and vector wind are used to describe the decadal variability of the Indo-
Pacific region along with and an ECCO ocean assimilation product (http://ecco-group.
org). A near-coherent phase change of decadal SSH and wind is found out over much of the
Indo-Pacific region. The changes in the tropical Pacific tend to lead those in other areas.
The trade winds in the Pacific and Indian Oceans are anti-correlated to each other. Associated
with this is the anti-correlated variability in the strength of the shallow meridi-
onal overturning cells in the two oceans (the subtropical Oceans). Horizontal gyre circula-
tions in the subtropical and subpolar regions also experience near-coherent variation in
their strengths. Atmospheric and oceanic linkages of these variations are discussed.

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HYPOXIA IN LONG ISLAND SOUND: ANTHROPGENIC OR CLIMATE INDUCED?
The factors controlling bottom dissolved oxygen (DO) in Long Island Sound (LIS) exhibit
temporal and spatial changes. For non-summer seasons, the bottom DO is mainly driven by
solubility. During summer, however, intensified stratification under weak wind condi-
tions leads to the depletion of bottom DO from the saturation level. Stratification plays a
role in the variability of the bottom DO for the westernmost and shallow (<15 m) stations,
but its importance diminishes at deep stations (>20 m). The bottom DO tends to reach
its minimum concentration when bottom temperature is around 19~20 °C, although the
importance diminishes at deep stations (>20 m). The bottom DO tends to reach
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importance diminishes at deep stations (>20 m).
cent-chance annual storms can generate elevated water levels on the order of 4 m in the Florida Keys and of order 1.5 m on overland wave propagation. For situations where the maximum elevation of an island is below the 1% SWEL elevation, the parameter of interest governing overland wave propagation is vegetation rather than topography, with regard to the specification of velocity hazard zones. Land-use practices, including the clearing of vegetation, may have an effect on coastal flooding. Wave damping, static set-up and the extent of overland wave propagation as a function of the damping effects of vegetation was examined both spatially and temporally. Velocity hazard delineations were mapped using FEMA’s CHAMP model as a framework to examine changes in zones with respect to the spatial scale of a mangrove stand as well as with temporal changes in mangrove coverage. Linear wave theory was applied to illustrate the effects of the additional damping force on overland wave propagation.

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PRIMARY PRODUCTION OF DISSOLVED AND PARTICULATE ORGANIC CARBON IN OCEANS

Total net primary production (FT) of marine phytoplankton includes recently fixed carbon in both particulate (PP) and dissolved (PD) components (PT=PP+PD). In the absence of PT or PD measurements, publications often assume that PD is negligible, particularly in eutrophic systems, or use the frequently-cited constant value PD/PT=+13%, or select values that seem appropriate within the range of field observations (PD/PT=5 to 40%). A growing number of observations suggest PD/PT=+0%, or compute it from concurrent measurements of FT and PP. Common methods (mainly variants of the C-14 method used to measure PP) reflect a combination of direct release from intact phytoplankton, cell lysis, protoplasm osmotrophy, grazing and excretion, and bacterial osmotrophy and excretion. Community composition and incubation conditions (light, temperature, nutrients and duration) may affect the overall and relative importance of these processes. In addition, filters used to separate particulate and dissolved matter may affect PP and PD. We present a meta-analysis of >1000 published field values from contrasting marine ecosystems, recommend best methodological practices, and discuss the importance of PD in oceans and its biological and environmental controls.

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INTERNAL HYDRAULIC JUMPS GENERATED BY TIDAL FLOW OVER A TALL STEEP RIDGE

The interaction between tidal currents and oceanic topography is known to provide a mechanism for transferring tidal energy into baroclinic motion. This mechanism is hypothesized to provide a significant fraction of the energy needed for deep mixing in the ocean. A subject of ongoing investigation is the partitioning of that baroclinic energy into motions likely to lead to mixing local to the topography and radiating internal waves which ultimately cause mixing elsewhere. Here we examine one process which may lead to local mixing, namely the generation of transient internal hydraulic jumps. These tidally-driven jumps are predicted to occur when the vertical tidal excursion is large, which is shown to occur over a variety of pressures and durations. The vertical length-scale of the jumps is predicted to depend on the flow speed such that the jump Froude number is of order unity. A series of numerical simulations explores the parameter space of topographic slope, barotropic velocity, stratification and forcing frequency. Results agree with the theoretical predictions, with finite amplitude internal hydraulic jumps and overturning forming during strong offshore tidal flow over steep slopes.

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MICROCYSTIS IN THE SAN FRANCISCO ESTUARY

The impact of the recently developed CHAB Microcystis on the San Francisco Estuarine food web is unknown. It is hypothesized that Microcystis contributed to a recent decline in fishery production directly through its toxicity or indirectly through its impact on the structure of the food web. To initially evaluate these hypotheses, phytoplankton, zooplankton and fish were collected bivweekly at 10 stations throughout the estuary in 2005. Microcystis in algal and animal tissue were measured by protein phosphate inhibition method. Microcystins were present at low concentrations throughout the food web. Higher microcystins were associated with different cyanobacteria across the estuary in the surface layer and different phytoplankton communities at depth. Thus, even at low density Microcystis may influence fishery production.

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AEROCBR RESPIRATION AND HYPOXIA IN THE LOWER SI. L. W. ESTUARY: CONSTRAINTS FROM STABLE ISOTOPE RATIOS OF DISSOLVED OXYGEN IN THE WATER COLUMN

Along the Laurentian Channel, a large-volume water body displays persistent hypoxic conditions, with deep-water oxygen (DO) concentrations as low as 51 nmol/L. The present DO deficiency is part of an ongoing trend that persists for at least the last seven decades and can partly be ascribed to an increase in organic particle flux to the sea floor and enhanced bacterial respiration rates. The relative role of the benthic versus the deep pelagic environment as sites of DO consumption, however, remains uncertain. We report concentration and stable isotope measurements of dissolved oxygen in the estuary and the Gulf of St. Lawrence water column, which show a significant increase in the 18O:16O ratio with progressive DO depletion. We discuss the observed net O-isotope effect for community respiration in the deep layer of the estuary in terms of the relative importance of benthic versus water column respiration, and we will compare the findings based on the O-isotope approach with direct bacterial production measurements in the water column and reported estimates on benthic O2 fluxes for the St Lawrence system.

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A BIO-OPTICAL PRODUCT FROM A COUPLED BIO-PHYSICAL OCEAN CIRCULATION MODEL OF THE WESTERN NORTH ATLANTIC

Autonomous observation platforms supply information on the biological, physical and chemical state of the ocean that lends itself to validation of and assimilation into coupled bio-physical circulation models. However, conversions are necessary to relate observed quantities to modeled variables. Traditionally, this conversion is done to observations, for instance, relating the ratio of blue and green light intensity to chlorophyll concentration in the water. We implemented a coupled bio-physical Regional Ocean Model (ROMS) with bio-physical equations to produce fields directly comparable to routine observations from optical sensors on moorings, gliders, floats and satellites. We contrast modeled fields of water leaving radiance at standard wavelengths to corresponding fields from satellite sensors.

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WIND FIELD AND SEA STATE DERIVED FROM TERRASAR X IMAGES

TerraSAR-X is a new X-band radar satellite launched on June 15, 2007. In this mission an operational, space-borne synthetic aperture radar (SAR) system with very high spatial resolution is acquiring imaging modes like Stripmap, Spotlight and ScanSAR. The spacecraft is equipped with a phased array X-band SAR, which can operate in different polarisations and has furthermore beam steering capabilities. Due to its polarimetric and interferometric capabilities as well as the high spatial resolution of up to 1 m, the TerraSAR-X sensor is an interesting tool for coastal oceanography. An overview of several marine applications is given, e.g., current and ocean wave measurements, monitoring of morpho-dynamical processes and high resolution wind field retrieval. A combination of theoretical investigations adapting C-band algorithms and the use of existing experimental data acquired by both airborne and ground based X-band radar is used to derive a new X-band wind field algorithm. Case studies of wind and ocean wave parameter retrievals will be presented, e.g., based on TerraSAR-X scenes taken over the English channel and the coast of Florida.

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SEDIMENT METABOLISM ON THE LOUISIANA CONTINENTAL SHELF

Rates of aerobic and anaerobic sediment metabolism were measured on the Louisiana Continental Shelf during 5 cruises in 2006 and 2007. On each cruise, 3-4 stations were occupied in regions of the shelf that experience summer-bottom water hypoxia. Net DIC, O2, N2, and nutrient fluxes across the sediment-water interface were measured in static core incubations. Sulfate and iron reduction rates were measured in vertical core sections. Sediment cores were also exposed to varying levels of light to assess the photosynthetic potential of benthic microalgae. Whole sediment metabolism was estimated via
a sediment diagenesis model. DIC fluxes did not vary greatly across the shelf with a range of 133 to 5 mole m⁻² d⁻¹, and N₂ fluxes ranged from 0 to -29 and 0 to 1.9 molmes ⁻² d⁻¹, respectively. Experimental and modeling results indicated sulfate and iron reduction were important carbon remineralization pathways. Surface sediments exposed to 0.5 to 1.0% ambient light showed rapid increases in O₂ indicating the potential for benthic photosynthesis. Sediment metabolism will be compared with rates of water-column metabolism measured at the same stations.

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CONDUCTING OCEAN FERTILIZATION IN A RESPONSIBLE WAY

The ocean science community, NGOs, government and the private sector are considering issues related to the potential of ocean fertilization to sequester CO₂. Most issues are scientific and concern the efficacy or the side effects of ocean fertilization. Uncertainty about how commercial ocean fertilization would be conducted has led to additional concern over the types and standards of measurement, independent verification, management of side effects, the availability of data from commercial fertilization projects, deployment in sensitive marine areas, and other issues. Ocean fertilization is likely to take place on the high seas beyond national jurisdictions. There is as yet no clear international regulatory frameworks that apply directly to this activity. This implies that a voluntary code of conduct might be helpful in identifying the standards of responsible behavior. Other fields, like nanotechnology, have dealt with issues of ethics and responsibility in commercialization of scientific ideas. Drawing on such examples, we propose elements that could be included in a code of conduct for responsible ocean fertilization experiments and activities related to commercialization.

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SEASONAL TO PENTADAL CARBON CYCLING IN SANTA MONICA BAY, CA

Time-series measurements of inorganic carbon, nutrients, and physical parameters were initiated in 2003 on a bi-weekly basis in the upper 300m at a coastal site in Santa Monica Bay, CA. Our nearly 5 years of DIC measurements reveal a complex seasonal pattern with a tendency for a maximum in late winter to late spring and a minimum in early summer. The spring time DIC maxima are associated with episodic and short-lived upwelling events that are in general followed by a short period with a moderate to strong decrease in DIC due to both CO₂ outgassing and DIC uptake by phytoplankton, mainly diatoms. Our record also reveals a number of strong drawn-down events that occur in summer and fall, when nitrate is completely exhausted, for reasons not yet fully understood. Over the annual cycle, Santa Monica Bay is mostly undersaturated with respect to atmospheric CO₂, constituting a net sink of the order of 0.5 mol C m⁻² yr⁻¹. Interannual variability in the time-series record is controlled by the frequency and strength of the spring-time upwelling events.

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SIGNALS OF LANDSCAPE DESTABILIZATION ON CONTINENTAL MARGINS—COMPARISONS OF ORGANIC GEOCHEMICAL RECORDS FROM THE EEL AND WAIAPOA SHELVES

The sedimentary and geochemical signals of landscape destabilization are transmitted through small mountainous watersheds to the continental margins with particular efficiency, largely because such systems typically have little capacity for sediment storage. On the continental shelves offshore from both the Del River in northern California and the Waiapoa River on the North Island of New Zealand, for example, historical deforestation is recorded by shifts in the concentration, age and isotopic composition of discrete plant fragments and organic matter bound to mineral grains. These changes likely reflect perturbations in the residence time of OC within the watersheds and the surface mixed layer of the seabed, as well as the relative importance of the key processes of sediment production: bedrock incision, shallow landsliding, and bank failure. Preliminary results indicate that the signals of earlier episodes of landscape destabilization are similarly preserved throughout the Holocene record of the Waiapoa margin.

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INTERNAL TIDE GENERATION BY SURFACE-TIDE/EDDY INTERACTIONS

Internal tide generation by the interaction of surface (barotropic) tidal currents with bottom topography is familiar and well-studied. Internal tides can also be generated by the interaction of surface tidal currents with baroclinic geostrophic eddies. Using a wave-tri-ad approach, it is found that resonant generation of internal tides occurs if the eddy aspect ratio is comparable to that of a semidiurnal internal wave as is the case near 45 degree latitude. The baroclinic tide will become of comparable energy to the barotropic tide in a time of order the inverse geostrophic shear V¹. Analytic solutions are complemented with results from a numerical model.

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ENSO IN THE IPCC-AR4 MODELS: A MULTI-VARIABLE APPROACH

In a pilot study, the sea surface temperature (SST) of the equatorial Pacific was used to characterize the ENSO spatial signature in the models simulating the “Climate of the 20th century” (from IPCC-AR4). Using an original methodology based on self-organizing maps, which allows for intercomparison of all the models, common biases were identified between groups of models in the ENSO variability and during key-phases of El Niño and La Niña (peak, and transition). In the present study, a multi-variable approach (SST, precipitation and winds) is adopted to further identify the physical mechanisms explaining the similarities and differences in the ENSO characteristics simulated, both spatially and temporally, for the pre-industrial conditions (picntr) by the IPCC-AR4 models.

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UTILIZATION OF THE BOTTOM STATIONED OCEAN PROFILER FOR COASTAL OBSERVING APPLICATIONS ON THE WEST FLORIDA SHELF

The Bottom Stationing Ocean Profiler (BSOP) is an autonomous, freely drifting, vertically profiling vehicle designed for applications on the continental shelf. By parking on the bottom in between profiles, BSOP tends to maintain station under typical continental shelf conditions. Designed and developed by the University of South Florida's Center for Ocean Technology, BSOP carries sensors, collects, stores, and transmits data via a bi-directional satellite link, and may be reprogrammed in situ to alter mission objectives. During the past several years, extensive offshore use in a multitude of deployment scenarios has demonstrated the operational uses and limitations of the platform. BSOP performance characteristics and reliability illustrate the utility and potential importance of profiling vehicles for continental shelf applications as part of coastal ocean observing systems.

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A KARENIA ODYSSEY: MODEL IMPLICATIONS FOR CURRENT AND FUTURE UNDERSTANDING

Arrival of iron-rich Saharan dust on the outer West Florida shelf each summer interrupts the normal seasonal succession of phytoplankton, from diatoms to microflagellates, of temperate and subtropical shelves. Instead, iron-starved diazotrophs fix the ubiquitous dinitrogen gas, passing this "new nitrogen" in the form of dissolved organic matter of reduced carbon content to the euphotic zone. Observations of the seasonal succession through time have demonstrated the operational uses and limitations of the platform. BSOP performance characteristics and reliability illustrate the utility and potential importance of profiling vehicles for continental shelf applications as part of coastal ocean observing systems.

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perature in the upper ocean are used to estimate eddy fluxes of heat and momentum in the surface layer of Drake Passage. Fluxes are ensemble averaged along mean streamlines to improve statistical significance. The acceleration/deceleration due to the eddy momentum flux divergence coincides with the merging/diverging filaments of the ACC fronts. Significant along-stream eddy heat fluxes are observed in the Polar Front. The observations are compared to output from a tenth-degree, 40-level simulation of the Parallel Ocean Program (POP) model. Preliminary calculations show that the model has a similar distribution of eddy kinetic energy to the observations, although the absolute values are somewhat smaller.

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A BRIEF OVERVIEW OF INNER SHELF CIRCULATION AND DYNAMICS

Recent progress in our understanding of the inner shelf circulation and dynamics is reviewed. The inner shelf is the region between the surf zone, dominated by surface gravity waves, and the mid shelf, dominated by wind forcing (water depths of ~5 - 50 m). The inner-shelf circulation is central to a wide range of interdisciplinary processes, including coastal upwelling of nutrients, the movement of organisms between estuarine or intertidal waters and the mid shelf during different life cycle stages, the off-shore movement of sediment, the offshore dispersal of pollutants, and the deposition of contaminants such as oil spills onto beaches. Previous studies have focused on along-shelf wind stress as the primary forcing mechanism of inner-shelf cross-shelf circulation. However, recent studies indicate the inner-shelf cross-shelf circulation is forced primarily by surface gravity waves (undertow) and cross-shelf wind stresses, not along-shelf wind stresses. The vertical structure of the wave-driven circulation over the inner shelf is different from the surf zone due to the earth's rotation. Stratification enhances the wind and wave-driven exchange flow but the dynamics of the stratified response are unclear.

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RATING CAGE IN THE UNGAUCED CAQUETA BASIN COMBINING ALTIMETER-DERIVED WATER STAGES AND DISCHARGE PROPAGATED FROM REMOTE STATIONS

Provide distributed discharges is a major task of hydrological monitoring. However, fewer and fewer in-situ measurements are collected each year wherever over the world. From the last two years, virtual gauges have been proposed to increase the density of the river monitoring network in Amazon basin (Leon et al. 2006). In spatial hydrology a virtual station is considered as any crossing of water body surface (i.e., large rivers) by radar altimeter satellite Tracks. We present rating curves obtained for thirteen virtual gauge stations at the main stream of Caqueta Basin, a poorly gauged basin in the Colombian Amazon basin. Water stages have been derived from satellite altimetry (T/P and ENVISAT). Discharges were propagated at the location of the satellite tracks from remote gauging stations using a 1D Muskingum-Cunge model. Validation has been conducted by comparing the results with stages and discharges measured at five in-situ gauges available on the Caqueta main stream. Outflow errors range from 10% to 20% between the upper basin and the lower basin respectively. The method proposed by Leon et al. (2006) to deduce zero flow depth at virtual stations was applied and its allows to find mean absolute differences less than 1.1 m estimated and measured zero flow depth. Finally, a 1.2 x 10-4 m.m-1 mean bottom slope has been obtained for the 730 km long reach of the considered stream.

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A SNAP-SHOT LOOK AT THE 210PO-210PB BALANCE IN WESTERN LONG ISLAND SOUND

We measured Lead-210 and Polonium-210 as well as physical water quality parameters during a 6-day cruise in late June, 2006 between Oyster Bay and Throgs Neck Bridge in the Narrows of Western Long Island Sound. Preliminary results indicate a well mixed water column with high levels of re-suspended sediment carrying excess lead-210. One significant hydrological feature observed was a well-defined border between two distinct water masses north of Hempstead Harbor, in the area of the Hempstead Sill. The western mass was dominated by a high sediment load and low fluorescence, whereas the eastern counterpart displayed higher biological productivity. Elemental analysis is underway to confirm this observation. This study is an attempt to expand on previous observations on estuarine circulation using natural radionuclides conducted during the 1970’s in Eastern Long Island Sound.

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OBSERVATIONS OF PLANT FLOW INTERACTIONS IN THE RIDGE AND SLOUGH LANDSCAPE OF EVERGLADES NATIONAL PARK

Standing biomass exerts considerable control over flow dynamics on the surfaces of coastal wetlands. This presentation will examine surface hydrodynamics and plant flow interactions in the freshwater wetlands of Everglades National Park. During the wet seasons between 2002 and 2007, we routinely measured all 3 velocity components at slough and ridge sites located in upper Shark River Slough. Flow velocities were usually less than 2 cm/s with higher velocities typically occurring in the sloughs compared to the sawgrass ridges (0.50 cm/s and 0.34 cm/s, respectively). In both settings, flow characteristics were strongly affected by the distribution of biomass in the water column; particularly in the slough where both emergent and submerged vegetation were present. Vertical flow profiles and series of clearing experiments showed that flow speeds can increase by as much as three times when submerged biovolume (e.g. utricularia spp. and periphyton) is removed. Interestingly, the presence of emergent stems, did not appreciably affect mean flow speed. These results suggest that both seasonal changes in water level and biovolume control flow in the Everglades.

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ASSESSING THE ISOTROPY OF TURBIDITY USING BROADBAND ACOUSTICS

Acoustic backscatter returns from turbulent oceanic microstructure have the potential to remotely describe temperature and salinity variations and identify turbulent dissipation rates. Oceanic turbulence models that relate acoustic backscatter levels to turbulence parameters generally assume that turbulence is isotropic, and there is a lack of experimental verification or dispute on isotropy or anisotropy is crucial to refining turbulence models and advancing reliable acoustic detection of turbulence. Broadband (150-600kHz) acoustic scattering measurements were performed over the New Jersey continental shelf, observing the passage of internal waves and their turbulent wakes. To address this anisotropy, the instrument collected data in both horizontal (longitudinal) and vertical looking modes while tracking a wave train. In most locations, the acoustic spectra are generally flat or increasing with frequency, and are not consistent with scattering dominated by temperature microstructure. Some locations, however, do show an expected spectral roll-off for turbulent scattering. Preliminary comparisons between vertical and horizontal data show similar spectral levels and frequency dependence, suggesting that if the scattering is due to turbulence, the turbulence is isotropic.

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PHYSIOLOGICAL RESPONSES AND PRODUCTION OF PHYTOPLANKTON DETERMINED FROM VARIABLE FLUORESCENCE QUANTUM YIELD

Biological processes of phytoplankton in the ocean play a dominant role in controlling the global carbon cycle. Understanding the variability in the physiological characteristics of phytoplankton could enhance the ability in predicting productivity, and thus lead to a better understanding in the influence of phytoplankton on global cycling. The present study examined the variability in physiology and productivity of phytoplankton in Sagami Bay, Japan using the fast repetition rate fluorimeter (FRRF), and investigated the possible causes of the variations in these parameters. Diel variations in the functional absorption cross-section (SPS2), photochemical quantum efficiency (Fv/Fm) and productivity were observed. FRRF profiles also showed distinct near-surface quenching. These observations can be viewed as a strategy on balancing carbon fixation and light absorption. Moreover, light availability was shown to be an important factor contributing to the varying Fv/Fm and SPS2. The varying productivity observed could be a result of the Fv/Fm and SPS2 gradients observed. The effect of environmental conditions on phytoplankton physiology observed using the FRRF technique could narrow the gap in our ability to estimate and predict primary productivity.

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SELL DYNAMICS AND FJORD DEEP WATER RENEWAL: IDEALIZED MODELING STUDY

Fjord exchange circulation and its response to abrupt changes in forcing is examined by means of an idealized modeling experiment. Puget Sound, a fjord-type estuary in western North America (State of Washington), is the main context for this study. Parameters of the idealized model are representative of the entrance sill at Admiralty Inlet and the Main basin of the Sound. Sensitivity to some of the model parameters relevant to a 3D realistic model is discussed. An idealized tidal forcing with fortnightly modulation drives a qualitatively realistic cyclic of exchange circulation while the other boundary conditions are kept fixed in time. The cycle is characterized by anisotropy of cloudiness with a sharp front at the leading edge and reversed circulation cells below the sill depth developing between the intrusions. This basic state is then perturbed and response of the circulation to abrupt changes in oceanic salinity and river discharge is examined. Sudden increase in river discharge is shown to prevent onset of the intrusions.
The influence of the Columbia river plume on patterns of phytoplankton growth, grazing and chlorophyll

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EXAMINATION OF ORGANIC MATTER IN SEDIMENT CORES TO ELUCIDATE ANTHROPOGENIC IMPACTS WITHIN THE SACRAMENTO-SAN JOAQUIN RIVER DELTA, CA

Sediment core records of organic biomarkers and stable and radio carbon isotopes provide high time-resolution of anthropogenic activities have altered the sources, amount and "ages" of organic carbon within ecosystems. Anthropogenic impacts including changing land-use practices have impacted systems like the San Francisco Bay and its associated Delta. For this study, sediment cores were collected within the San Joaquin and Sacramento Rivers as well as reference sites representing marsh and agricultural tracts. Dwncore profiles of organic biomarkers and stable isotopes were used to elucidate changes in organic matter sources over time. Radiocarbon (14C, 26O) and organic pesticides (bromodiphenyl ethers (BDE) and DDE (a degradation product of DDT) were used to estimate sediment accumulation. Together, biomarkers and anthropogenic organic compounds document shifts in the relative abundance of carbon from aquatic, terrigenous and anthropogenic sources in response to changes in land use and human activities over historical timescales. By examining sediment records we can better understand how anthropogenic activities impact carbon cycling within coastal ecosystems.

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THE TIME-DEPENDENT SECONDARY CIRCULATION IN A STRAIGHT, PARTIALLY STRATIFIED ESTUARY

Observations are analyzed to quantify the structure of the cross-channel (secondary) circulation in the Hudson River estuary and its dependence on tidal amplitude and fresh-water discharge, at a cross-section where forcing due to curvature is insignificant. For all conditions, the secondary circulation is asymmetric, with strong flows (~20 cm/s) during weak tides and weak flows (~2 cm/s) during strong tides. The structure of the flow is independent of discharge, but dependent on tidal amplitude. During weak tides (strong stratification), secondary flow has a mode-one structure during flood. Fluid flows to the channel from the western flank at the top of the bottom boundary layer and returns to the flank at the surface and the bottom. During strong tides (weak stratification), secondary flow has a mode-two structure during flood. Fluid flows to the channel from the western flank at the top of the bottom boundary layer and returns to the flank at the surface and the bottom. During weak tides, the fluid flow boundary layer reaches the surface, secondary flow has a mode-one structure, with surface flow towards the channel and bottom flow towards the flank. Advection due to secondary flow is a significant term in the along-estuary momentum budget during strong tides, but not during weak tides. However, cross-channel advection is a significant term in the salt balance for both strong and weak tides. In particular, during weak tides, vigorous mixing of stratified fluid occurs where the pycnocline intersects the bottom boundary layer on the flank. This mixed water is injected into the channel interior below the pycnocline. Bottom and sur

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SCIENTIFIC AND OPERATIONAL OCEAN MODELING AND DATA ASSIMILATION

The impacts of human activities on the ocean are increasingly global. To successfully coexist with the ocean and utilize marine resources, our civilization needs to monitor and predict the impacts of our activities, and to develop efficient ocean observing systems. Better scientific understanding and better forecasting of environmental impacts requires synergies between ocean predictions and observations. Important feedbacks include models that learn from and adapt to data, and sampling plans that learn from and adapt to model estimates. Such integrated ocean observing and prediction systems consist of a large set of coupled components, from the data utilized to the numerical schemes, and from the methods employed to the scientific approach of the modeller. All of these components can have a large impact on the outcomes. Examples and results will be provided for physical, biogeochemical and acoustic ocean dynamics and processes in eastern and western coastal US regions, from tidal scales and sub-mesoscales to mesoscales. Recent technical results in adaptive data assimilation, uncertainty estimations, bias corrections, model comparisons and multi-model fusions will be illustrated.

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INTERPRETING THE SEA LEVEL RISE RECORD FROM SATELLITE ALTIMETRY

The TOPEX/Poseidon, Envisat, and Jason-1 satellite altimeter missions provide a 15-year record of global sea level rise, which shows a rate of 3.2 ± 0.4 mm/year with significant interannual variability. Despite evidence of the accelerated melt of continental glaciers, the rate of sea level rise since mid-2004 has been much lower, 1.5 to 2.0 mm/yr, close to the 20th century rate determined by tide gauges. We present a new error analysis of the sea level record and calibration using a tide gauge network. An important goal of climate studies is to determine the relative contribution of steric (heating and salinity) and eustatic (melting ice, runoff, etc.) sea level rise and to understand how and why these contributions vary. Concurrent measurements from the Argo array of profiling floats and the GRACE gravity mission, which respectively measure steric and eustatic changes, provide an independent check. The accuracy of satellite gravity measurements varies significantly with spatial wavelengths. We present a spectral analysis of recent altimetry, hydrographic, and satellite gravity measurements and compare these results to output from GFDL and ECCO models. We also comment on the consistent with a reduction in the rate of ocean heat storage.

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DORVILLEAIDAE AT METHANE SEEP S: A MODEL FOR UNDERSTANDING DIVERSITY ON THE CONTINENTAL MARGIN

Much of the faunal diversity on continental margins is associated with relatively small-scale habitat patches that have varying abiotic and biotic conditions. Methane seeps are one example of highly sulfidic habitat patches on the margin. Dorvilleid polychaetes have a predilection for these sulfidic settings and multiple species in the genera Ophryotrocha, Parogia and Exallopus co-occur at Pacific methane seeps. We combine ecological, geo-
chemical, physiological and phylogenetic approaches to explore the role of sulfide in driv-
ing terms of niche partitioning and evolutionary relatedness. Dorvilleid abundance and dis-
tribution, stable isotope values, environmental sulfide concentrations, and settlement preferences reveal partitioning of species based on geography, water depth, habitat (clam bed, microbial mat), diet, sulfide tolerance, and dispersal ability. Colonization patterns determined from short-term colonization tray deployments with manipulated sulfide levels reflect local habitat composition. Dorvilleid species at seeps are represented by several distinct evolutionary clades. Clades reflect geographic distributions, habitat affini-
ties, and/or reproductive constraints but not uniform sulfide tolerances; instead congeners exhibit divergent trophic and sulfide preferences.


CYCLE BACTERIALLY DRIVEN DIURNAL CHANGES IN THE UPPER OCEAN SULFUR CYCLE

The contribution of the internal tide to shelf circulation is discussed. 

temporal variability of the broader semidiurnal tidal band (including both M2 and S2) was 

with the modeled M2 barotropic tide derived from the Topex/Poseidon altimeter. The long 

interaction of the barotropic tide with topography, such as the steep and rough continental 

the potential activity of the bacterial DMS cleavage enzyme with peak activities occur-

ring in the 6 hours after sunset. This analysis suggests that, in the Sargasso Sea, changes in 

DMS and DMSP concentrations on diurnal timescales may be driven by changes in bacte-

rial DMS production rather than by phytoplankton productivity.

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THE MODULATION OF BIOLOGICAL PRODUCTION BY OCEANIC SUBMESOSCALE TURBULENCE

Submesoscale dynamics modulate biogeochemical budgets in a number of ways. I will re-

view some of these processes, with a focus on mid-latitudes open ocean. First, I will show 

that submesoscale dynamics induce both intense upwelling of nutrients and subduction of 

phytoplankton. Then, I will show some examples of horizontal stirring of phytoplankton 

and discuss the importance of stirring with respect to biogeochemical budgets. Finally, I 

will emphasize that submesoscale dynamics have a strong impact on productivity through 

their influence on the stratification of the surface of the ocean. These processes will be 

illustrated by high-resolution in-situ observations and by high-resolution process-oriented 

model studies. These processes have in common that they concern the short-term, local 

effect of oceanic turbulence on biogeochemistry. Recent modelling efforts to get a com-

plete picture, which also include the far-field long-term effect of eddies, will be presented.

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MICROBIAL FUEL CELLS - FROM LABORATORY STUDIES TO APPLICATIONS

This paper presents results from the deployment of Microbial Fuel Cells (MFCs) in the sea 

and in rivers. Our goal is to use MFCs to power chemical sensors and telemetry systems in 

marine environment and in freshwater aquifers. Direct use of energy generated by (MFCs) 

is obstructed by several factors, of which the low cell potential, low power density and 

fluctuating environmental factors are the most obvious. We have designed a probe, which 

uses energy generated by MFCs and is equipped with power management circuitry and 

microprocessors to control the operation and to decide when and how much energy needs 

to be accumulated and when and how much energy needs to be used for the specific 

tasks - powering the sensors and the telemetry system. All electrical circuits of the probe 

are powered by the energy generated by the MFC. The probe was deployed and tested 

in the sea water - in Newport, Oregon - and in fresh water - in Hayle Creek, Bozeman, 

Montana and in Palouse Creek, Pullman Washington, and in our laboratories.

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VARIABILITY OF THE NORTH ATLANTIC CIRCULATION MEASURED BY THE OVIDE PROJECT

The Ovide (A25) hydrological section extends from Cape Farewell (Greenland) to Lisbon (Portugal), crossing perpendicularly three major currents of the North Atlantic: the east Greenland Current, the Deep Western Boundary Current and the North Atlantic Current. The section, close to the 1997 FourEx section, was performed three times in 2002, 2004 and 2006, collecting physical and biogeochemical measurements at a hundred stations. The significative variability observed in both the estimated transports and the measured water mass properties will be discussed. Establishing a transport budget between the Greenland-Scotland sills and the section, it is possible to calculate the diapycnal transport between the North Atlantic Deep Water and the layer above. A proxy of the Atlantic Meridional Overturning Circulation across the Ovide section is proposed, leading to a discussion on the timescale of its variability and on its connection with the horizontal circulation and the poleward heat transport.

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DEVELOPMENT OF AN AUTOMATED UNMANNED BOAT FOR MEASUREMENTS IN TIDAL PASSES

Three automated unmanned boats (A-Boat) are constructed at the Coastal Studies Institute, Department of Oceanography and Coastal Sciences, School of the Coast and Environment, Louisiana State University. With Visual BASIC, a controlling program is designed to run the remotely controllable boat for round-the-clock repeated sampling in tidally dominated channels. These boats, made with aluminum, plastic, and fiberglass, respectively, have been developed ranging from 10 to 12 ft in length, equipped with electric motors, a high-resolution GPS (60 Hz accuracy), and a windows-based computer system. The A-Boat is monitored on land while the A-Boat does preprogrammed tasks. This is accomplished by a wireless communication that can work for up to 10 km. As an initial test, we have used RD Instruments 600 and 1200 KHz Workhorse Monitor acoustic
Doppler current profilers (ADCP) mounted in one of the two wells on the boat and conducted continuous surveys across several tidal channels on the southeastern Louisiana coast. In this paper, we present some preliminary survey results at the Southwest Pass of the Vermilion Bay. Flow convergence and three-dimensional eddies are observed during the survey.

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**MEAN FLOW EFFECTS ON THE PROPAGATION PATHWAYS OF EDDIES**

In the past we have shown that the large anticyclonic eddies generated south of Hawaii propagates along paths that are difficult to reconcile with existing theory. It was hypothesized that this was due to interactions with the mean flow. This work, however, only tracked a limited number of eddies and used only TOPEX/Poseidon altimeter data. Because of these limitations we were not able to address this hypothesis conclusively. We have since tracked a much larger number of eddies using data from all available satellite altimeters and we are also attempting to make estimates of the evolution of kinetic energy, potential energy and relative vorticity as the eddies propagate away from Hawaii. We will first show the results for this greatly extended set of eddies and show that the problem of unusual paths noted in the earlier work is still present; i.e., it was not an artifact of the small number of eddies and the single altimeter analysis. Second, we will present an evaluation of the mean flow interaction hypothesis posed in the earlier work.

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**LARGE EDDY SIMULATIONS OF ESTUARINE MIXING PROCESSES**

We have developed and validated a new finite-volume Large Eddy Simulation (LES) model for oceanographic applications and used it to investigate mixing processes in stratified estuarine flows. Recent observations have shown that stratification and turbulent mixing exhibit a flood-ebb tidal asymmetry in estuaries and continental shelf regions affected by horizontal density gradients. However, several key questions on the tidal asymmetry remained unanswered. Is the mixing asymmetry caused by the flood-ebb asymmetry in the bed stress or due to tidal straining of the density field? What is the role of the strain-induced buoyancy flux which is stabilizing on ebbs but destabilizing during floods? Can the turbulent transport term supply turbulent kinetic energy (TKE) from the bottom boundary to the pycnocline? We use the LES model to investigate the penetration of relatively driven bottom boundary layer into stratified water in the presence of a horizontal density gradient. By analyzing turbulence fields and comparing the terms in the TKE budget, we examine how different factors affect estuarine mixing under various stratification and tidal current conditions.

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**NUMERICAL MODELING STUDY ON COASTAL OCEAN BIOPHYSICAL RESPONSES TO HURRICANES**

A regional-scale coupled bio-physical model is used to hindcast the circulation and plankton distribution in the Gulf of Mexico (GOM) and South Atlantic Bight (SAB) during the periods of Hurricane Isabel, Ivan and Katrina. The physical model is based on the Regional Ocean Modeling System (ROMS), and the biological model is a nitrogen-based NPZD model. Surface forcing conditions are from the North American Regional Reanalysis (NARR), and the open boundary conditions are obtained through the one-way nesting with the North Atlantic data assimilative Hybrid Coordinate Ocean Model (HYCOM) solutions. Our regional model results are gauged against in-situ mooring observations and satellite remote sensing data. Based on time and space continuous model realizations, we diagnose variability of coastal currents, temperature and salinity fields during the passages of strong hurricanes. We also report our analyses on the relative importance of ocean advection, mixing and local upwelling in determining plankton distributions in the GOM and SAB.

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**NUMERICAL MODELLING OF SEAED DISTURBANCE AND SEDIMENT MOBILITY, AND IMPLICATIONS TO MORPHODYNAMICS ON THE STORM-DOMINATED SABLE ISLAND BANK, SCOTIAN SHELF**

Waves, tidal currents, wind-driven and circulation currents, and sediment mobility were modelled for one full year over the storm-dominated Sable Island Bank (SIB), Scotian Shelf. The mean shear velocity of tidal current and that of the wind-driven and circulation currents are less than 2 cm/s, but the peak mean wave and combined wave current shear velocities reach 4 and 4.5 cm/s respectively. Comparison between the model-predicted shear velocity and bedload threshold suggests that the circulation and wind-driven currents cause minimum sediment mobility on SIB. Tidal current and waves can each cause sediment mobility at least once a year over 36% and 71% of the bank area respectively, while the combined wave-current shear can cause sediment mobility over 93% of the bank area. Calculated time percentages of sediment mobility caused by various processes indicate that wave or wave-dominant disturbance is most important and occurs over >50% of the bank area, while mixed disturbance is also significant and occurs over ~ 30% of the bank area. Tide or tide-dominant disturbance occurs over only 10% of the bank area. Several parameters are proposed as universal indices for quantifying seabed disturbance and sediment mobility for coastal and shelf environments.

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**THE EFFECT OF A ROUGH SEA SURFACE ON INVERTED ECHO SOUNDER PERFORMANCE**

The Inverted Echo Sounder (IES) is designed to measure the round-trip travel time of sound from the sea floor to the sea surface, from which changes in thermal stratification can be inferred. Our application of this technology for the measurement of nonlinear internal waves has motivated an examination of the effect of a rough sea surface on instrument performance. The IES emits a pulse width of duration of a few nanoseconds at a frequency of 12kHz, and detects the backscattered signal using a hard-limiter and threshold-detection circuitry. The primary contribution to short period signal variability is scattering from the rough sea surface. A numerical simulation, which incorporates a representation of the sea surface, underwater acoustic propagation and backscattering, and the analog circuit within the instrument, is implemented so as to identify the extent of surface roughness effects. Pierson-Moskowitz spectra were used to represent a fully-developed sea state, corresponding to different wind speeds. The parabolic equation acoustic model is used to gain an understanding of propagation and backscattering of the IES signal. The calculated acoustic signal is then processed using the simulation of the instrument so as to determine predicted variability in the time series measurement. The probability distribution of travel times is then compared with that observed during deployments in the South China Sea. The instrument performance using alternative surface wave spectra is also explored.

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**VALIDATION OF SUB-KILOMETER SAR WIND PRODUCTS FOR THE NOAA ALASKA SAR DEMONSTRATION**

RADARSAT-1 ENVISAT and ALOS SAR data have been routinely obtained for the NOAA Alaska SAR Demonstration (AKDEMO) project. The AKDEMO is a multi-year demonstration of the production and the use of SAR quantitative and qualitative products in a pre-operational environment. Sub-kilometer ocean surface SAR wind products are generated in near real-time and provided to the National Weather Service for weather analysis and forecasting. Different SAR wind algorithms have been used to derive the wind field. SAR measures the variation in Normalized Radar Cross Section, which is a function of wind velocity and direction. SAR imagery has only one azimuth viewing angle; therefore, to derive the wind velocity, one must obtain the wind direction independently from another source. In this study, we systematically evaluate the AKDEMO SAR wind retrieval accuracy by comparing the SAR wind retrievals with in-situ measurements. SAR wind retrievals with different algorithms and different wind direction inputs, i.e. model or buoy, are compared with the moored buoy winds that match closest in time. SAR wind retrieval consistency is evaluated for different sized area averages of SAR wind measurements.

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**A FAST NEWTON-KRYLOV SOLVER FOR SEASONALLY VARYING GLOBAL OCEAN BIOGEOCHEMISTRY MODELS SUITABLE FOR AUTOMATIC PARAMETER OPTIMIZATION**

We present a computationally-efficient method for obtaining the fully spun-up state of a seasonally-varying global ocean biogeochemistry model. The solver uses a Newton-Krylov method to find the fixed points of the map that assigns to an initial state the value of the model state at the end of a one-year run. Apart from the preconditioner, which we describe in the paper, the method relies on a black-box public-domain Newton-Krylov solver that does not require the explicit construction of the model’s Jacobian matrix. Applied to the PO5.45 plus DOP cycle of an OGCM2.6 model, the solver is more than an order of magnitude faster than the traditional time-stepping approach for spinning up the model. The efficiency of the solver is illustrated by using the seasonally varying globally-gridded PO5.45 climatology to objectively optimize the parameters that control the mean lifetime of semi-labile DOP and the fraction of new production allocated to DOP. The optimization study demonstrates that the information in the seasonal variations of PO5.45 do not provide a significantly stronger constraint than the annually averaged data used in previous optimization studies.
APPLICATIONS OF QUANTARNY AMINE SURFACTANTS AS BIOGEOCHEMICAL TRACERS IN ESTUARINE, COASTAL, AND DEEPWATER SYSTEMS.

Cationic surfactants such as dialkyl(dimethyl)ammonium chlorides (DADMACs) find widespread use as fabric softeners. Other hydrophobic quaternary amine compounds (QACs) are used as disinfectants, and in a wide range of personal care products. Cationic surfactants are very tightly bound to suspended particle and sediment surfaces, and many of them are very persistent in marine waters. New extraction and HPLC-MS detection methods allow for sub-ng/g concentrations to be determined in < 100 mg samples, trace amounts in comparison to concentrations of individual DADMAC homologs that can exceed mg/kg in the most sewage affected harbor sediments. Initial applications of QAC analyses in urban estuarine settings include: tracing sources of organic matter and other superhydrophobic contaminants; constraining estuarine sediment transport; and understanding the persistence in sediments of other organic compounds that share a municipal wastewater source. Given the very high concentrations of DADMACs in sewage sludge, they serve as especially powerful tracers of sludge disposal and deposition at the Deep Water Dump Site (DWD-106). Additional applications of QACs as tracers of sediment age and cross shelf/slope transport will be discussed.

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TEMPORAL VARIABILITY OF OXIDANT AND REDUCTANT SUPPLY TO THE REDOX INTERFACE IN THE CARACAO BASIN AND CONTROLS ON CHEMOAUTOTROPHY.

Rates of chemosynthesis are persistently high in the suboxic interface and upper anoxic zone in the Caracao Basin. Since 1996, we have been making monthly measurements of oxygen and nutrients and two or three profiles per year of chemosynthesis at the CARACAO time series site. In this paper we will present calculations of the vertical fluxes of oxidant and reductant over time and compare them to the chemosynthetic rates and information on the physics of the basin. In general vertical fluxes can only explain a small fraction (less than 10%) of the measured chemosynthesis suggesting that lateral sources of these compounds (and especially of oxidant) probably by Ekman transport, are most important.

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EFFECT OF BENTHIC MICROALGAE ON NUTRIENT BUDGET OF A SHALLOW WATER SYSTEM: A NUMERICAL MODELING STUDY.

Analyzing the nutrient budget of an estuarine ecosystem is important for understanding nutrient inputs, their transformation and ultimate fate. In a shallow water system, the light can reach the bottom, which allows benthic microalgae to perform photosynthesis directly. This activity profoundly influences sediment biogeochemical processes, and thus the nutrient budget. In order to examine the role played by the benthic microalgal, an unstructured grid hydrodynamic model UnTRIM was coupled with the eutrophication model CE-QUAL-IAM and applied to a shallow water system, Lynnhaven River in Virginia. The nutrient budget was analyzed from the well-calibrated models that include a newly constructed benthic microalgal module. Based on the results, it was shown that the major external source for nitrogen and phosphorus was from nonpoint source loadings (91% of the total nitrogen and 95% of the total phosphorus). There were three comparable sinks: (1) export to the Bay (32% for nitrogen and 26% for phosphorus), (2) burial in the deep sediment (31% for nitrogen and 74% for phosphorus), and (3) denitrification in the case of nitrogen (37%). Sensitivity tests showed that, due to benthic microalgae's presence, internal recycling was enhanced, denitrification rate in the sediment increased, and overall export to the Bay was significantly decreased.

Li, Y., University of Virginia Institute of Marine Science, Gloucester Point, USA, yli@vims.edu; Li, M., University of Maryland Center for Environmental Science, Cambridge, USA, mingli@hpl.umces.edu; Zhang, H., University of Maryland Center for Environmental Science, Cambridge, USA, lizong@hpl.umces.edu; EOF ANALYSIS OF WIND-DRIVEN CURRENTS IN CHESAPEAKE BAY.

Both local and remote winds generate currents in an estuary, which can be as important as gravitational circulation in transporting nutrients and contaminants. Previous investigations based on simple analytical models and statistical analyses of sea-level and current-meter data at monitoring stations have suggested that the remote wind affects sea level and volume transport but the local wind dominates the generation of currents. Using outputs from a 3D hydrodynamic model validated against observations, we conducted EOF analysis to separate the two modes of wind-driven currents in Chesapeake Bay. In the along channel section, we found two dominant EOF modes. The first mode shows one-layer flow correlating with sea-level change rate at the estuary mouth and explains 58% of total current variability. The second mode shows two-layer flow correlating with local wind forcing and explains 20% of the total variability. In cross-channel section, both vertically sheared two-layer flows and horizontally sheared three-layer flows (upwind in the deep channel and downwind in shallow shoals) but no significant EOF modes.

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A THREE-DIMENSIONAL VARIATIONAL DATA ASSIMILATION SCHEME IN SUPPORT OF COASTAL OCEAN OBSERVING SYSTEMS.

A three-dimensional variational data assimilation (3DVAR) system (ROMS3DVAR) has been developed for the Regional Ocean Modeling System (ROMS). This system provides a capability of predicting meso- to small-scale variations with temporal scales from hours to days in coastal oceans. Novel strategies are implemented, including the implementation of three-dimensional anisotropic and inhomogeneous error correlations, application of particular weak dynamic constraints, and implementation of efficient and reliable algorithms for minimizing the cost function.

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KUROSHIO IN THE LUZON STRAIT.

Three ADCP were deployed in the central Luzon Strait (LS) to monitor current velocity. The observed current velocity indicated that the Kuroshio consistently flowed into the South China Sea (SCS). Further information was provided by the composite shipboard ADCP data that the Kuroshio intruded into the LS through the deepest channels (~20.5°N). Most of the intruded components made a loop and flowed out of the northern LS while a branch of Kuroshio intruded into the SCS. The MICOM model forced by the monthly wind provided by the ECMWF was used to interpret the observed current velocity. The model results validated by the ADCP data were capable of explaining the annual and interannual variations in the LS and the northern sector of the SCS. The annual transport across the LS is primarily westward. The eastward transport was occasionally found in summer during certain years. Furthermore, the variation in zonal transport was caused by the Sea Surface Height (SSH) variation occurring west of northern Luzon. Wind stress curl is responsible for this SSH variation. The Ekman transport, driven by the monsoonal winds, and Kuroshio strength off LS had little impact on the intrusion since the intrusion itself could be a variation.

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IN-SITU PIV MEASUREMENT OF TURBULENT FLOW STRUCTURES OVER A MUSSEL-COVERED BED IN LAKE MICHIGAN.

A low-cost non-tethered submersible PIV system has been developed to measure small-scale flow structures in turbulent environmental flows. The system consists of a CW DPSS laser (532 nm), a scanning mirror (galvanometer), a CCD camera with GIGE interface, an ultra-compact PC for data acquisition and a USB signal-generating device that controls and synchronizes all components. All the components are battery-powered and can be fitted into a small underwater housing. The capability of the underwater PIV system has been demonstrated through a couple of field deployments in Lake Michigan. 2D turbulent velocity field (~20 by 20 cm) is resolved on a plane perpendicular to the lake bottom, which is covered by Dreissena mussels. Measurement results, including the vertical profiles of mean velocity, Reynolds stress, dissipation rate and the turbulent flux of particles (phyto-plankton and sediment particles), will be presented and discussed.
horizontally across material surfaces within fixed coherent eddies. This non-Lagrangian distribution functions of subsurface RAFOS float displacements from several different primarily responsible for the 'long tails', hence non-Gaussianity, observed in probability Lilly, J.

through emergent marsh areas. occupied only 2-8% of the total cell width, but they played a large role in transport through LIBERTY SCIENCE CENTER to develop RTD lessons using an interactive wall display. Effective data translation must overcome technical, cognitive, and aesthetic challenges and is best facilitated by a team approach. Ocean observatories and their real-time data, provide an excellent means to engage students and the public in environmental research with compelling and relevant stories. Liefjd, I. D., Dauphin Island Sea Lab, Dauphin Island, USA, iliefjd@dil.org.

MATCH AND TEMPORAL VARIABILITY IN ABUNDANCE OF THE DIATOM PSEUDONITZSCHIA SP. IN COASTAL ALABAMA WATERS The potentially-toxic diatom Pseudo-nitzschia is common in the northern Gulf of Mexico. In coastal Alabama, its abundance is monitored by the departments of Public Health (ADPH) and Environmental Management (ADEM) and the Dauphin Island Sea Lab. Seven sites along the Alabama Gulf Coast are monitored weekly to bi-weekly for potentially-toxic microalgae in the BEACH program. Pseudo-nitzschia was detected at densities up to 10^6 per liter in 380 of 606 routine samples (63%) taken between November, 2003, and May, 2007. A cluster analysis of the frequency distributions of abundance at the sites showed that the site of Little Lagoon Pass had a strong dissimilarity compared to other sites. This was due to a higher frequency of bloom densities and a lower frequency of absences, indicating that it is a regional 'hot-spot' for Pseudo-nitzschia. Distributions showed no apparent relationship with temperature, over the range 10 -34 C. There was a weak positive relationship between salinity and abundance, over the range 3 - 35 PSU. Pseudo-nitzschia was absent more frequently from brackish sites. Peaks in abundance occurred in April-May, with secondary peaks in fall. Lightbsey, A. F., St. Anthony Falls Laboratory, University of Minnesota, Minneapolis, USA, aniel@gwcmn.edu.

MEASURING AND MODELING FLOW THROUGH SPATIALLY HETEROGENEOUS VEGETATION There is increasing interest in the internal circulation of both natural and constructed wetlands to better understand and model their ecology, nutrient and pollutant removal, and water storage abilities. Models for the marsh regions within wetland systems often assume uniform vegetation, which is represented by uniform hydraulic roughness. However, velocity heterogeneity is nearly always present and alters the distribution of the chemical and biological transformations that occur within a wetland. Therefore, the identification of fast flowpaths is an important step in understanding overall system function. Here, we describe field work within a 145-ha constructed treatment wetland in EUROPHYPHO BOOSTERS IN THE WESTERN NORTH PACIFIC OCEAN With increased observations of devastating category-5 cyclones, such as Hurricane Katrina (2005) and Supertyphoon Maemi (2003) found to intensify on warm ocean features detect ed by satellite altimeters), there are great interests in investigating the role ocean features play in the intensification of category-5 cyclones. Based on 13 years of satellite altimeter data, in situ and climatological upper ocean thermal structure data, best track typhoon data of the US Joint Typhoon Warning Center, together with an ocean mixed layer model, 30 western North Pacific category-5 super Typhoons occurred from 1993 to 2005 are systematically examined in this study. It is found that warm ocean features act as ‘booster’ to super Typhoons. In regions where the background climatological warm upper ocean layer is too shallow (typically with the depth of the 26C, C isotherm 26C, 60m) to support intensification to the fifth category, the presence of boosters can effectively deepen the warm ocean layer by as much as 70% (i.e., the depth of the 26C, C isotherm reaching 100m). As such, the critical negative feedback to intensity due to typhoon self-induced sea surface temperature cooling can be effectively suppressed so that intensification to the fifth (i.e., the highest) category becomes possible. It is found that in the western North Pacific, 33% (i.e., 10 out of the 30 cases) of the typhoons reached this highest category due to the fuel of boosters. Lin, S., University of Connecticut, Groton, USA, senjie.lin@uconn.edu.

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ASSESSING MITOCHONDRIAL CYTOCHROME B FOR DNA BARCODING IN DINOFLAGELATES
DNA barcoding can be a powerful tool for unraveling biodiversity of dinoflagellates in natural environments. Earlier studies suggest that the conventional DNA barcoding gene mitochondrial cox1 does not provide as good taxon resolution as mitochondrial cox1 in dinoflagellates but systematic evaluation has not been done. In this study, cox1 barcode region was compared with cob for utility in DNA barcoding. Surveying over 30 dinoflagellate species strains in cox1 sequences reveals that a 382-bp fragment of cob is easy to PCR amplify and its resolving power in phylogenetic analysis is equivalent to cob whole gene (~1kb) and surpasses cox1 barcode region. With this cox1 barcode primer set, we analyzed dinoflagellate diversity in Long Island Sound (LIS). Dinoflagellates from orders of Gymnodiniales, Prorocentrales, Gonyaulacales, Suctoriales (Symbiodinium-like), and Peridiniales (including Pteridium-like organisms) were detected, with the highest Shannon-Weaver diversity index occurring in the summer at the western LIS and the lowest in winter. Gymnodiniales were consistently dominant the dinoflagellate assemblages. Pteridium- and Symbiodinium-related taxa were also found. The results demonstrate that cob is a promising DNA barcoding marker for uncovering dinoflagellate biodiversity.

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THE GLOBAL ZONAL BAND DISTRIBUTION OF DOMINANT HIGH FREQUENCY OSCILLATION: ZERO GROUP VELOCITY ROSSBY WAVE WITH CRITICAL FREQUENCY
Using the altimetry data, we detected a zonal band distribution of dominant high frequency oscillation in the world ocean. In any certain latitude it has a most significant frequency, from 1/30days in about 7°N(S) to 1/120days in about 28°N(S). This dominant frequency is well in agreed with the critical frequency in the latitude, which is derived from WOA01 data, according to the linear theory for the first baroclinic Rossby wave. Because the group velocity is zero for the Rossby wave with critical frequency, the wave energy will be trapped in the local area and do not propagate to anywhere. Considering the energy of other Rossby waves will propagate to the west (long wave) or the east (short wave) with the group velocity, the most significant oscillation in certain latitude could be expected from the Rossby wave with zero group velocity. Our result is a good illustration for the validity of linear wave theory in the World Ocean.

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CELLULAR NITROGEN LEVELS REGULATE NITROGEN UPTAKE BY PRYMNESIUM PARVUM (HAPTOPHYTA) AND ITS INTERACTIONS WITH CO OCCURRING SPECIES.
A Baltic Sea plankton community was grown in mesocosm with dissolved organic matter concentrated from sewage or inorganic nitrogen. After 4 days the ichthyotoxic Prymnesium parvum, cultivated under nitrogen sufficient and deficient conditions, was added to both plankton communities. Uptake rates of 15N labeled dissolved inorganic (nitrate) and organic (urea, glycine and glutamic acid) nitrogen by P. parvum were measured in concentration gradients every 24h for three days. Prymnesium parvum was able to take up amino acids (AA) more efficiently than nitrate and urea at low concentrations. Nitrogen deficient cells had higher nitrate uptake rates (0.7-1.8 fg (g atom-N (cell h)^(-1)) than nitrogen sufficient cells (<0.5 fg (g atom-N (cell h)^(-1)). Incubation of nitrogen deficient P. parvum cells with the nitrate grown community lead to an increase of intracellular nitrogen and uptake rates of nitrate grown community lead to an increase of intracellular nitrogen and uptake rates of nitrate (0.7-1.8 fg (g atom-N (cell h)^(-1)) throughout the experiment. This dataset shows that nitrogen uptake by P. parvum are affected by intracellular nitrogen levels, availability of substrate and availability of prey.

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DETAILED SPATIAL AND TEMPORAL MEASUREMENTS OF SPONGE EXCUSSION PLUMES MEASURED IN SITU UTILIZING THE AQUARIUS REEF BASED OBSERVATORY
Sponges on Caribbean coral reefs are a conspicuous group of abundant sessile organisms that play important roles in element cycling and reef ecology. Sponges, as a group, are thought to dump and filter large volumes of seawater, potentially altering the particulate and dissolved organic and inorganic composition of the seawater. Previous studies, mostly lab-based, reported pumping rates that are low compared to our in situ measurements (up to 110,000 liters of seawater filtered per liter of sponge tissue per day) for a broad range of sponge species. Initially, we used a dye-video technique to acquire “snap shots” of sponge pumping rates, and have since deployed advanced acoustic Doppler instruments during Aquarius missions to obtain high frequency measurements of sponge exhalent water velocities for multiple individuals over 48-72 hour periods. These data reveal that sponges have complex pumping behaviors, occasionally swinging between periods of high pumping to virtually no pumping over a 24 hour period. Rigorous, long-term pumping rate data are crucial for accurately determining sponge-mediated fluxes of various dissolved chemicals that potentially impact the health of coral reef ecosystems.

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EVALUATING OCEANIC MODEL PARAMETERIZATIONS WITH TRANSIT TIME DISTRIBUTIONS
Transit time distributions (TTDs), or age spectra, provide a powerful conceptual framework for evaluating and interpreting the advective-diffusive transport properties of geophysical flows. We describe the results of computing global and regional TTDs in a global ocean GCM with 1 degree nominal resolution. We show how the results depend on different model parameterizations. We further compare them to computed spectra from an eddy resolving model and to constraints derived from observations.

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A COMPARISON OF BIOLOGICAL TRENDS FROM FOUR NORTHERN HEMISPHERE MARINE ECOSYSTEMS
Major features of four marine ecosystems were analyzed based on a broad range of oceanographic, fisheries dependent and independent datasets. The ecosystems analyzed included the Gulf of Maine/Georges Bank in the Northwest Atlantic Ocean, the Norwegian/Barents Seas in the Northeast Atlantic Ocean, and the eastern Bering Sea and the Gulf of Alaska in the Northeast Pacific Ocean. We examined survey trends in major fish abundances, fishery catches, total system fish biomass, zooplankton biomasses, and measures of various species diversity indices. We standardized each time series and examined trends and anomalies over time, using both qualitative and statistical methods. We specifically compared dynamics of functionally analogous species from each of these four ecosystems. Major commonalities among ecosystems included a relatively stable amount of total fish biomass and the importance of large calanoid copepods, small pelagic fishes and gadids. Many of the peaks in these components were synchronous across ecosystems. Major differences between ecosystems included gradients in the magnitude of total fish biomass, differences in lower trophic level production, commercial fish biomass, and timing of major biological events. This work demonstrates the value of comparative analysis across a wide range of aquatic ecosystems, suggestive of common and broad-scale features across all northern hemisphere ocean systems.

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A NEW CHEMICAL LEACH METHOD TO ASSESS THE FRACTION OF PARTICULATE IRON THAT IS AVAILABLE TO PHYTOPLANKTON
Identifying the sources and concentrations of biologically available trace metals in surface waters is fundamental to the distribution of oceanic plankton productivity. In addition
to the dissolved phase, the particulate trace metal pool is also an important source of microelements to phytoplankton. Accurate means of estimation of the fraction of the particulate trace metal phase that can be solubilized over the time frame of phytoplankton generation is necessary to understanding plankton productivity. A comparison of common leach methods was conducted on coastal and riverine suspended particulate matter to determine the differences between several operational definitions of the particulate trace metal fraction. Leachable trace metal concentrations were determined using HR-ICP-MS. A commonly used 25% acetic acid leach ("HAc") was shown to underestimate the labile fraction; in particular, it does not access intracellular trace metals. This study presents a modification of the HAc leach, "HAc+", with the addition of a heating step and reducing agent. Both leach methods (HAc and HAc+) were applied to surface transect samples from the Columbia River plume; HAc+ resulted in a more complete solubilization of the labile particulate iron.

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ESTIMATING SUBSURFACE CROSS-SHORE FLOW FROM OBSERVATIONS OF SURFACE CURRENTS

Observations of nearshore circulation have traditionally been made with in situ arrays of current meters positioned within and very near the surf zone, or in vertical stacks at a few locations. Recent development of remote sensing instrumentation (Dopper radar and video-based PIV) allow for dense measurement of the flow field; however, only at the surface where the currents are generally substantially different than near-bottom flow, particularly in the cross-shore direction. In this work, a simple model is developed that allows for observation of mean surface currents to be used to estimate the cross-shore current. The method assumes that the alongshore gradient of the depth-averaged longshore current can be approximated by the mean surface value. Integrating the depth-averaged continuity equation from the shoreline to a given distance offshore allows an estimate of the depth-averaged mean cross-shore current to be found, provided the depth of the water depth is known. Subsurface mean cross-shore currents are found by assuming a saturated surf zone and vertical balance where the surface mass flux is balanced by a depth averaged mean return flow below the mean trough level (given as a constant fraction of the water depth). Mean cross-shore flows estimated from surface flow fields (obtained using video-PIV techniques) will be presented and compared with a vertical stack of electro-magnetic current meters during the 1997 SandyDuck experiment. This work was sponsored by ONR.

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FERRYBOX MEASUREMENTS: A TOOL TO MONITOR AND ASSESS MESO-SCALE VARIABILITY (GULF OF FINLAND, BALTIC SEA)

External forcing as well as reaction of the pelagic ecosystem to external forcing may have very different temporal and spatial scales. In order to understand the transfer mechanisms between forcing and impact multi-scale monitoring methods with sufficient resolution, duration and extent have to be applied. The occurrence and intensity of meso-scale physical features (upwelling events, fronts etc), which are known to be determinant for biological production, retention and transport, can be estimated using Ferrybox measurements carried out in the Gulf of Finland (Baltic Sea) in a regular basis since 1997. An upwelling intensity index is developed and applied and behavior of a quasi-permanent front is described by means of statistical analysis of collected cross-gulf high resolution temperature and salinity profiles in 1997-2007. Examples, how derived meso-scale indexes are used to understand the variability and forecast changes in the pelagic ecosystem, are shown.

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LARGE-SCALE NEARSHORE MORPHODYNAMICS: MODEL GUIDANCE TO FIELD MEASUREMENTS

Recent modeling studies have identified processes leading to the development of large-scale morphodynamics at alongshore scales of 100s to 1000s of meters. The morphodynamic behavior can be self-organized (e.g., coastal undulations which grow in response to highly oblique incident waves), or externally forced (e.g., shoreline change resulting from an inner shell bathymetric irregularity). However, these model predictions typically lack field verification. Here, the hydrodynamic model Delta3D is used to isolate the forcing (e.g., pressure gradients, radiation stress gradients) for both self-organized and forced morphodynamics, and to quantify the measurements (e.g., sea-surface elevation, wave height and angle) required for field verification. As an example, in the strongly-forced case of an inner-shelf pit and an initially uniform nearshore, model results suggest that nearshore flow gradients and morphological evolution are driven primarily by pressure gradients resulting from sea-surface elevation differences on the order of 3 cm over a distance of 1 km alongshore. In less strongly forced cases, including those with self-organized behavior, gradients are smaller, and thus the required measurement resolution is higher.

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OSCILLATORY FLOWS OVER PERMEABLE WAVE BOTTOM Ripples

In shallow-water environments, oscillatory flows induced by surface waves may generate ripples over flat permeable seabeds. To keep track of the enhanced interfacial flux of solutes, one has to capture simultaneously the flow on either sides of the permeable interface. Exactly this is the key factor if the amount of interfacial exchange of solutes and particulate matter. With the help of a Lattice-Boltzmann Method (LBM), this simultaneous exchange can be calculated very efficiently. The effect of water height, wave number, Pelet and Schmidt number on the interfacial exchange is discussed in detail.

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SPATIAL AND TEMPORAL VARIATION OF PHYTOPLANKTON BIOMASS IN THE GULF OF MEXICO: OBSERVATIONS AND NUMERICAL INVESTIGATIONS

A three-dimensional physical-biological model has been used to investigate spatial and temporal variability of phytoplankton growth dynamics in the Gulf of Mexico (GoM). The physical model is based on the Gulf of Maine Ocean Observing System (GoMOOS) nowcast/forecast system, which has been issuing 48-hour forecasts of physical conditions since January 2002. The biogeochemical processes are simulated with an ecosystem model consisting of multiple nutrients and plankton functional groups. The model results are compared with SeaWIFS derived chlorophyll-a and in situ measurements from GoMOOS moorings for the 2002-2007 period. The model reproduces many observed features favorably, such as the timing and intensity of phytoplankton bloom and their spatial distribution in the GoM. The annual mean depth-integrated primary production has the highest value of 380 mg C/m²/day near the coast and the Georges Bank. Ten model sensitivity experiments have been performed to assess the potential impact of several key factors (wind, light, stratification, depth nutrient concentrations, and river discharge) that regulate nutrient transport and phytoplankton productivity.

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NOAA CORAL REEF WATCH: OPERATIONAL APPLICATION OF SATELLITE REMOTE SENSING DATA IN NEAR-REAL-TIME GLOBAL MONITORING OF CORAL HEALTH

Coral bleaching is one of the major contributors to the worldwide deterioration of coral reef ecosystems over the past few decades. In response to scientific and management needs, NOAA Coral Reef Watch (CRW) developed a suite of operational near-real-time global coral bleaching monitoring products based on satellite sea surface temperature. Our Bleaching HotSpot, Degree Heating Weeks, Bleaching Virtual Stations, and Satellite Bleaching Alerts, are used by resource managers and scientists around the world. Key to
CRW’s success has been an ongoing dialogue with its user community to assess needs and improve both the products and the tools. By breaking 2005 Caribbean bleaching event has again proven the value of CRW’s satellite coral bleaching monitoring in supporting prompt management decision making and survey organizing by reef managers and scientists. To provide improved ecosystem monitoring, NOAA has released experimental doldrums products from satellite winds and work is underway to develop satellite insolation, ocean circulation, and heat storage, from JASON and GRACE, have been developed so that the annual and interannual variations are related to differences in transport of subarctic waters to the offshore branch of the northern California Current. We explore the utility of these oceanic subarctic copepods as indicators of PDO and climate-driven variability in the source waters which enter the coastal upwelling zone off Oregon. Two water type-specific copepod groups occur in coastal waters off Oregon, cold-water and warm-water species. Cold-water species (Pseudocalanus minutus, Acartia longiremis, and Calanus marshalli) dominate in winter, during El Nino events and during summers with weak upwelling. Changes in their biomass and density among years are determined by the source waters which enter the coastal upwelling zone off Oregon. Abundance and variations are related to differences in transport of subarctic waters to the offshore branch of the northern California Current. Analysis of the Simple Ocean Data Assimilation product and other observation data revealed that the central North Pacific is one of the main formation regions for low Potential Vorticity (PV) water. It is found that the low PV water is transported from the central North Pacific toward the east of the Taiwan Island along a subsurface pathway following the subtropical gyre circulation, and it takes approximately 12 years. Propagation of pycnocline thickness anomalies is detected along the pathway, in association with the decadal variability of the subduction rate. The transportation of the low PV water could be as one of the possible feedback mechanisms for the Pacific Decadal Oscillation, because the variation of low PV water in Northwest Pacific has close relation to the dynamic state of Kuroshio Extension and ocean-atmosphere heat exchange.

The distribution of water masses and circulation reflect on the sea surface height for some oceanic regimes. This allows the inference of the ocean internal structure from sea surface height observations. In this study, we combine the estimates of an eddy resolving ocean model with vertical hybrid coordinates, HYCOM, in the Atlantic Basin with altimeter observations from JASON, GFO, and ENVISAT to correct the internal structure of the ocean model. The sampling altimeter patterns allows a limited access to some scales. The approach taken to carry out a multi scale 2DVAR analysis of the deviations of the model sea surface height from the observed absolute sea surface height. The data includes altimeter sea surface height anomalies, and mean dynamic topography estimated from historical data. A vertical 1DVAR analysis is employed to update the model vertical structure. A sensitivity study to data assimilation parameters including 2DVAR scales, selection of mean dynamic topography and vertical 1DVAR algorithms (Cooper Haines, vertical model covariances, etc.) is conducted. Emphasis is given to the ability of the data assimilation scheme to capture large and mesoscale features.

LOW POTENTIAL VORTICITY WATER TRANSPORT FROM CENTRAL NORTH PACIFIC TOWARD TAIWAN ISLAND AND ITS RELATION TO THE OCEAN-ATMOSPHERE EXCHANGE

Analysis of the Simple Ocean Data Assimilation product and other observation data revealed that the central North Pacific is one of the main formation regions for low Potential Vorticity (PV) water. It is found that the low PV water is transported from the central North Pacific toward the east of the Taiwan Island along a subsurface pathway following the subtropical gyre circulation, and it takes approximately 12 years. Propagation of pycnocline thickness anomalies is detected along the pathway, in association with the decadal variability of the subduction rate. The transportation of the low PV water could be as one of the possible feedback mechanisms for the Pacific Decadal Oscillation, because the variation of low PV water in Northwest Pacific has close relation to the dynamic state of Kuroshio Extension and ocean-atmosphere heat exchange.
COLUMBIA RIVER PLUME INFLUENCE ON SUMMER SHELF CIRCULATION AS REVEALED BY A COASTAL OCEAN CIRCULATION MODEL HINDCAST

A hindcast of the Columbia River (CR) estuarine and coastal ocean circulation in summer 2004 is performed using the ROMS model with open boundary conditions from the NCOM model and realistic atmospheric, tidal and river forcing. The model results are used to describe the subtidal evolution of plume patterns in response to local wind and river flow and to examine the plume influence on the shelf circulation and transport. It is found that a bi-haline plume occurs frequently on the Washington shelf (> 75% of time during 6/15-8/30), during weakening of moderate upstream plume favorable wind events as well as with weak downwelling events. Its high frequency of occurrence indicates that the CR water will have significant influence on Washington shelf circulation and mixing dynamics in summer. In a case study of a cyclonic eddy developed through interaction of the plume and the upwelling jet, an important pathway is found for nutrient rich deep canyon waters to be upwelled onto the shelf from Astoria Canyon and transported northward along the shelf.

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TROPHEIC ECOLOGIES OF LARVAL FISHES IN THE LOW-LATITUDE OPEN OCEAN: PREDATION REFUGE AND A FULL TUMMY TO BOOT

The tropical/subtropical open ocean is larval habitat for many species of fish, yet the interactions between fish larvae and the planktonic prey environment in low-latitudes are still poorly understood. To capture broad temporal and spatial variability in larval fish feeding and the feeding environment, two years of monthly sampling was conducted across the Straits of Florida (SOF). Diets of billfishes, tunas and reef fishes were rich with distinct prey selectivity. Before an ontogenetic shift to piscivory, larval billfishes exhibited selection for two species of crustaceans, while larval scobimids fed almost exclusively upon appendicularians. Four genera of scobimids co-occurred in the western SOF where appendicularian abundance was greatest, but only Thunnus spp. and Katsuwonus pelamis were common in the east where prey densities were low. Additionally, these larvae exhibited different vertical separation, with larvae in the SOF (dipluran, scobim and dookey prey) abundances were highest along the western SOF, as were levels of chlorophyll, copepod nauplii and total zooplankton. High feeding incidence and rapid digestion for all taxa indicate that larval fish starvation mortality is low in these warm, oligotrophic waters.

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PAST SEA LEVEL RECONSTRUCTION AND VARIABILITY OF SEA LEVEL TREND PATTERNS

Satellite altimetry has allowed precise mapping of the geographical variability of sea level rates over the last 14 years. Comparisons with steric sea level patterns based on situs hydrographic data and outputs of ocean general circulation models have shown that altimetry-based spatial patterns are mainly caused by non uniform thermal expansion, but in some regions sea level trend patterns result from opposite effects of temperature and salinity change. For the past decades, there are no direct global-scale observations of the spatial trend patterns in sea level but past sea level reconstructions methods that combine long tide gauge records of limited coverage and short 2-D sea level patterns based on satellite altimetry have been developed, with the assumption that the satellite record correctly captures the decadal variability of the spatial trend patterns. Here we present past sea level reconstruction results over the last 40 years based on tide gauge data and EOF analyses of sea level patterns based on runs of the ORCA general circulation model (with and without assimilation). The reconstructed sea level patterns will be compared, the dominant modes of temporal variability will be discussed and sea level hindcasts at tide gauge sites not used in the analysis will be compared to actual observations. Other methods of past sea level reconstruction will be also presented.

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ECOLOGICAL CONTROLS ON THE CARBON CYCLE OF THE MEGKONG RIVER
Outgassing of CO2 derived from respiration of organic matter within the Amazon River may return 0.5 Pg of terrestrial carbon to the atmosphere per year. If river systems throughout the tropics behave similarly, they would recycle a substantial amount of terrestrial carbon to the atmosphere. River metabolism, or the relative rate of community respiration to photosynthesis, provides a benchmark for ecosystem function and an estimate of outgassing, but is unknown for most tropical rivers. We measured ratios of the stable isotopes of dissolved oxygen and dissolved inorganic carbon throughout the Megkong River basin to determine the relative rates and sources of respiration and photosynthesis. A time series of biweekly measurements on the mainstem of the Megkong River at Phnom Penh, Cambodia, shows that the river is net heterotrophic throughout the year at this site, but that the ratio of respiration to photosynthesis (R:P) increases substantially during the flood season. R:P ranged from 2 to 10 during the rainy season and averaged 2.5 during the dry season. We use these measurements to model the annual outgassing of CO2 at this site.

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THE CI-FLOW PROJECT: COMBINING RESOURCES FOR BETTER UNDERSTANDING OF WATER IMPLICATIONS FROM THE SKY TO THE SUMMIT TO THE SEA
For the past seven years, the National Severe Storms Lab has been part of a collaborative effort with Sea Grant, Universities and National Weather Service Forecast Offices in the Carolinas to develop a product to help improve flood observations and forecasts for coastal areas. This project, called the Coastal Inland Flood Observation and Warning project (CI-FLOW), couples a high resolution quantitative precipitation information system with river and coastal/ocean models, which is being demonstrated in the Tar River Basin of North Carolina, where significant flooding from Tropical Storm Dennis and Hurricane Floyd affected the area in 1999. While NSILs expertise focuses on short-term, storm-scale analysis and prediction, the ensemble approach to CI-FLOW encourages the inclusion of other datasets and models to produce information on larger scales. One of the expected outcomes of this project will be to educate coastal constituents from diverse industries on the impacts of variations in the water cycle, to identify their needs and requirements, and to provide them with the tools to manage resources and develop contingency plans.

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SCIENTISTS BRINGING A WAVE OF OCEAN LEARNING TO K-12 CLASSROOMS
This presentation will focus on the interesting, exciting and fun ways that graduate-level scientists from USFs College of Marine Science utilize ocean science education to motivate students about learning and doing science. Participants will learn how summer ocean camps can become a vehicle for preparing scientist-teacher teams to teach about the oceans in the classroom. Training programs engage ocean scientists in inquiry-based teaching that parallels the way scientists conduct scientific research. These trainings include a day at sea doing science aboard a research vessel, in the field exploring multiple marine ecosystems, as well as research labs and classroom settings. We believe that scientists and teachers, who learn together, grow together. The growth is realized at the end of each teaching semester when scientists, teachers and students share about the ocean learning gained throughout the semester. This presentation will highlight the win-win aspect of teacher scientist partnerships, its contribution to ocean science literacy, ocean conservation and stewardship of our natural resources.

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ENSO DRIVES INTERANNUAL AND DEcadAL-SCALE VARIABILITY OF THE ANTARCTIC PENINSULAR MARINE Ecosystem
The West Antarctic Peninsula region is a major source of Antarctic krill (Euphausia superba) to the Southern Ocean. From 1980-2004 primary and secondary production, krill recruitment success and sea ice extent here were significantly correlated with the atmospheric Southern Oscillation Index and exhibited three-to-five-year frequencies characteristic of ENSO variability. This linkage was associated with movements of the Southern Antarctic Circumpolar Current Front and Boundary, changing influence of Oceanic and Weddell Sea waters, eastward versus westward flow and mixing processes that are consistent with forcing by the Antarctic Dipole high-latitude climate mode. Significant ecological changes indicative of a change in Antarctic Dipole forcing after 1998 reflect a climate regime shift. Natural environmental variability associated with interannual- and decadal-scale changes in ENSO forcing must be considered when assessing impacts of climate warming in the Antarctic Peninsula-Weddell Sea region.

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TIDAL MODELING AND TIDALLY-DRIVEN COASTAL FEATURES
Coastal dynamical phenomena can be significantly affected by tidal processes and secondary tidally-driven features. Tidal currents, often a dominant component in a coastal environment, with velocities 50 to 150 cm/s being a common case, generate complex cross-shelf particle transports, highly horizontally inhomogeneous barotropic flow patterns, tidal mixing and internal waves. Correct representation of these tidal processes in regional ocean models is paramount but difficult. The richness in scale and the diversity of the secondary tidally-driven processes (internal waves, tidal fronts, mixing layers) demands a multi-model approach, with several specialized models combined together. Our modeling of tidal phenomena is based on forcing primitive-equation models with our new generalised-inverse and multi-scale barotropic tidal model. This data assimilative tidal modeling system is designed to simulate the barotropic tides at very high resolution and allows to tune its open boundary conditions and model parameters such as friction parameterizations to available regional tide gauge data using the inverse method. We find that the use of multiple localized domains and the data-driven control of open boundary conditions and model parameters are two key elements to successful regional barotropic tidal modeling. Modeling and dynamical results will be exemplified using our recent PLUSIN7 2007 exercise in WA, and AWACS 2006 experiment off the coast of NJ.

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THE COASTAL BOTTOM BOUNDARY LAYER
The bottom boundary layer of a rotating, stratified flow on a continental shelf is examined using theory and numerical simulations (Regional Ocean Modeling System). The flow is driven by a downwelling favorable surface stress which is uniform in the along-shore direction. The stress diminishes in the cross-shore direction and produces Ekman pumping as well as an on-shore Ekman flux. The model starts with a wind stress being applied to a uniformly stratified fluid on an f-plane. The flow is then forced by the boundary layer. The model yields an interior flow, between an upper Ekman layer and bottom boundary layer. The vertical diffusivity of density in the bottom boundary layer is considered to be strong enough to render the bottom boundary layer’s density to be a function of only the offshore position. The along-shore flow has enhanced vertical shear in the boundary layer that reduces the along-shore flow in the boundary layer. However, the velocity at the bottom is generally not zero but produces a stress that locally balances the applied surface stress.

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LIPID BIOMARKER DISTRIBUTIONS IN OCEANIC AND ESTUARINE DISSOLVED AND PARTICULATE ORGANIC MATTER: SOURCE AND DIAGENETIC SIGNATURES
Lipid biomarkers were used to characterize the sources and diagenetic state of ultrafiltered dissolved organic matter (UDOM) and particulate organic matter (POM) from the North Central Pacific, Sargasso Sea and Chesapeake Bay. Abundances and distributions of lipid biomarkers suggests greater reactivity in oceanic organic matter in surface compared to deep waters. At all depths, oceanic UDOM contained greater abundances of reactive lipids compared to the POM, providing a benchmark for ecosystem function and an estimate of outgassing.

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A NEW SOURCE OF IRON TO COASTAL UPWELLING REGIMES
In upwelling regions along the west coast of the United States, low concentrations of dissolved oxygen result in high concentrations of Fe (15-30 nM), over 50% of which is dissolved organic Fe. New sources of dissolved iron to near-surface waters in these upwelling regions are likely to be a balance between the relative inputs of authochthonous vs. allochthonous material, the quantitatively dominant phase in river, coastal and oceanic settings. The results also suggest that the sources of organic matter in each of these environments are likely to be a balance between the relative inputs of autochthonous vs. allochthonous material, the quantitatively dominant. Results from this study support earlier findings on the sources, geochemical character and sources of recycling of dissolved vs. particulate phases of organic matter in river, coastal and oceanic settings. The results also suggest that the sources of organic matter in each of these environments are likely to be a balance between the relative inputs of autochthonous vs. allochthonous material, the quantitatively dominant phase (dissolved vs. particulate) of organic matter, and the extent to which each pool has been recycled.
to these waters from reducing shelf sediments; thereby resulting in a marked increase in Fe(II) concentrations which contribute to elevated dissolved Fe concentrations. During upwelling, this process results in a major new source of Fe which can upwell to surface waters, increasing phytoplankton productivity, which can in turn lead to enhanced export flux, driving the system further into hypoxia, or even suboxic conditions. The mechanism we present here is not limited to this region, and could have a major impact on other productive coastal upwelling regions. Our results suggest that this new source of iron is important in these productive upwelling systems and should be considered in models of oceanic iron cycle.

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OPTICAL CHARACTERIZATION OF PHYSICAL AND BIOGEOCHEMICAL VARIABILITY IN A LAKE MICHIGAN COASTAL ECOSYSTEM

Given the extensive coastline and diversity of coastal ecosystems, the Great Lakes region is particularly sensitive to change, both natural and anthropogenic. Our ability to detect and assess change in large-scale processes in response to changing environmental forcing can be greatly enhanced by optical methods. Here, we review findings involving the application of remote and in situ optical approaches for the study of ecosystem dynamics and associated physical and biogeochemical processes in southern Lake Michigan coastal waters. Observations were made during 1998 through 2000 as part of the Episodic Events - Great Lakes Experiment or EELGE. Strong interannual variability was observed punctuated by an intense 1999 El Nino event. Optical measurements and analyses were used to trace inputs and transport of river-borne materials in coastal waters, to characterize sediment distributions and properties during resuspension events, to track algal distributions, and to assess lake-scale temporal and spatial patterns in primary production. Our results highlight the possibility that climate-related changes could profoundly alter the lake ecosystem with associated impacts on autotrophic productivity, phytoplankton community structure, and terrestrial inputs of materials.

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IMPROVING OCEAN LITERACY THROUGH CASE METHOD TEACHING

Case method teaching, pioneered at Harvard Business School has been shown to be successful in teaching graduate and undergraduate courses in such disciplines as medicine, business, and law. Success in biology courses, genetics, and even elementary subjects has been reported. Faculty report increased development of critical thinking and reasoning skills in a meaningful context through connection of in-class learning with real-world situations. This action research study examines the use of “cases” in regular high school marine science classes. The main focus of the study was to determine the effect of case method teaching on student acquisition of scientific knowledge and attitudes towards science. Student surveys, class discussions, student writing, and assessments were analyzed to determine the degree of effectiveness that the case method can provide in a high school science classroom. Results indicate that use of the case method is sufficient in conveying factual scientific information and highly conducive to teaching scientific ways of thinking. Additionally, students were found to enjoy the case method of learning experience and highly conducive to teaching scientific ways of thinking. Parallels between riverine and nearshore environments will be drawn.

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APPLYING NEARSHORE FLOW MODELS TO RIVERINE ENVIRONMENTS

Tools to predict nearshore flows have matured over the past recent past and efforts are underway to extend the applicability of these tools to the inner shelf. Such models may then also be used in estuaries, and potentially even for predictions in river channels, resulting in models that can cover the entire region from freshwater rivers to the open ocean. This study explores the potential of applying ocean circulation models to the study of riverine environments. In particular, we draw parallels between surf zone longshore currents and river flows and propose to utilize variational data assimilation strategies recently used in determining values for nearshore model free parameters (e.g. friction coefficients) in riverine situations with an interest in determining upstream characteristics such as surface gradients and channel topography. We will begin by considering an idealized 1D situation. However, in reality the river problem is complicated by the presence of bends, meanders, and bars/pools that exist in typical rivers; hence 2D or 3D treatments will also be explored. Parallels between riverine and nearshore environments will be drawn.

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MULTI-YEAR CHANGES IN PHYTOPLANKTON BIOMASS AND COMPOSITION AT THE BERMUDA ATLANTIC TIME-SERIES STUDY (BATS) SITE

Euphotic zone integrated chlorophyll at the BATS site has increased over the past 15 years with a normalized [DIC], phytoplankton biomass and primary production have been steadily, and significantly, increasing, with associated changes in phytoplankton community structure. During this same period there has been a steady decline in bacterial productivity but also shows reasonable correlation with NDBC’s “dominant” period calculation. Results also show that CODAR-derived wave data is a reliable source of wave data. More than a month of CODAR wave data from each site were compared to data acquired from nearby National Data Buoy Center (NDBC) buoys; wave data from two sites north of Point Reyes were compared to NDBC 46013, and three sites south of Point Reyes were compared to NDBC 46026. A range cell-to-range cell comparison was conducted at these sites for further evaluation of consistent sea-state as distance increases from the radar. Results show that waves are homogeneous throughout range in this region. Buoy comparisons revealed strong correlation, particularly for wave height, at all locations. The CODAR wave period - which describes a more centred period - also shows reasonable correlation with NDBC’s “dominant” period calculation. Results presented here suggest that CODAR-derived wave data is a reliable source of wave data.

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THE BERMUDA ATLANTIC TIME-SERIES STUDY: A RESEARCH PLATFORM TO STUDY CHANGE IN THE OLGOTROPHIC SUBTROPICAL NORTH ATLANTIC

Since October 1988 the Bermuda Atlantic Time-series Study (BATS) program has been studying the biogeochemistry of the Sargasso Sea with at least monthly resolution. While the primary focus has been on carbon fluxes in and out of the euphotic zone, many biogeochemical measurements are made to a depth of 4200m. An integrated suite of rate process and biogeochemical measurements is providing valuable ecosystem information over multiple timescales. The BATS core measurements are enhanced by ancillary research projects including studies of the temporal variability of Prochlorococcus ecotypes and other microbial groups, optical oceanography (Bermuda BioOptics Program), and biogeochemistry of organic sulfur and phosphorus, to name a few. While not as dramatic as the hypothesized DOM Shift in the tropical Pacific, there have been important changes in carbon cycling in the Sargasso Sea ecosystem. Over the past 17 years, salinity normalized [DOC], phytoplankton biomass and primary production have been steadily, and significantly, increasing, with associated changes in phytoplankton community structure. During this same period there has been a steady decline in bacterial productivity with some evidence for increased carbon export.

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APPLYING NEARSHORE FLOW MODELS TO RIVERINE ENVIRONMENTS

MULTI-YEAR STUDY OF WAVE MEASUREMENTS AND WAVE HOMOGENEITY FROM FIVE CENTRAL CALIFORNIA CODAR SYSTEMS

CODAR-derived wave data include readings of significant wave height, wave period, wave direction and wind direction. The data from five 12-13MHz Sea sondes on the central California coast were examined to evaluate the effectiveness of operational wave parameters of the CODAR wave software. More than a month of CODAR wave data from each site were compared to data acquired from nearby National Data Buoy Center (NDBC) buoys; wave data from two sites north of Point Reyes were compared to NDBC 46013, and three sites south of Point Reyes were compared to NDBC 46026. A range cell-to-range cell comparison was conducted at these sites for further evaluation of consistent sea-state as distance increases from the radar. Results show that waves are homogeneous throughout range in this region. Buoy comparisons revealed strong correlation, particularly for wave height, at all locations. The CODAR wave period - which describes a more centred period - also shows reasonable correlation with NDBC’s “dominant” period calculation. Results presented here suggest that CODAR-derived wave data is a reliable source of wave data.

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CHESROMS: OPERATIONAL MODELING OF CHESAPEAKE BAY PHYSICS AND ECOLOGY

An operational model of the Chesapeake Bay that is based on the 3-D primitive equation numerical ocean circulation model ROMS (Regional Ocean Modeling System) has been
extended to also include fully coupled components that simulate the Bay’s water quality and biological and chemical cycles. The model provides the necessary components for retrospective and near real time data acquisition and pre- and post- processing, which make it suitable for hindcasting, nowcasting and short time forecasting of the bay-wide physics and ecology. Operational model structures, strategies and implementations will be presented. Preliminary results for temperature, salinity, water level, currents and sea nettle abundance levels based on nowcasting and forecasting from January 1, 2007 to December 31, 2007 will be shown together with comparisons against observations. Future development plans, data assimilation, challenges for coupling with regional meteorological models and results dissemination to the general public will be also discussed.

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Biomass size spectra are sensitive to disturbances that alter the energy balances and transfers within a system, and could be potentially useful ecosystem management tools. As an urbanized estuary, Narragansett Bay has a long history of fishing, nutrient and pollutant loads, invasive species and climatic variability. In addition, tertiary sewage treatment is being implemented around the bay, with possible impacts for primary productivity as well as fish. The Rhode Island Department of Environmental Management’s monthly trawl survey data from 1990-2006 were used to construct fish biomass size spectra for different seasons, years and locations, and the species composition, biomass and slope and intercepts of these spectra were investigated. Generally, slopes of all spectra were steeper than -1, indicating a large biomass. Since 2000 however, slopes in the upper and lower bay have been steadily approaching -1. Upper bay intercepts begin to diverge from the lower bay also around 2000, with intercepts decreasing in the upper bay and increasing in the lower bay. This could indicate overall greater numbers of fish as well as more large fish in the lower bay.

Lonsdale, A.

Factors affecting the distribution and abundance of Beggiatoa spp. Bacterial mats in Hood Canal, WA

Bacterial mats were studied in Lynch Cove, an area that has been described as a ‘dead zone’ due to persistence of low oxygen levels. The objectives of this study were to 1) take sediment samples to identify the bacteria making up the mats, 2) use underwater videography to map the distribution and abundance of the mats in space and time, and 3) examine related sediment and water conditions. The mats were composed of Beggiatoa spp., a type of sulfide-oxidizing bacterium. Video surveys indicated that the mats occurred at water depths of 10-25 m and covered an area of 8.4 km² in the fall of 2006. The spatial coverage of the mats was highly reduced during the subsequent winter but increased in size the following spring and summer. The sediments in the area of the mats had a flocculent layer of organic material, high sulfide levels, and low diversity and abundance of macrofauna. High primary productivity and sedimentation rates likely contribute to the high levels of organic material in the bottom substrate, where decomposition results in high sediment sulfide levels.

Loos, E.

Influence of a large riverine system on the optical properties of surface waters of western Canada: Implications for spectral light availability

The influence of the Fraser River plume on the waters of the Strait of Georgia was assessed based on the biophysical and optical properties of the euphotic zone in late spring and early summer of 2006. From optical measurements of beam attenuation and absorption, and chromophoric dissolved organic matter (CDOM) absorption, particulate absorption and scattering were derived. CDOM fluorescence and water samples were collected for total suspended material and chlorophyll a (chl). Overall, these waters were optically variable, but a well-defined surface layer, which allowed for the optical classification of waters under strong (OM1), medium (OM2), and low (OM3) influence of the riverine waters. Generally, particulate scattering dominated the attenuation in waters under the strongest influence of the river; these values decreased two orders of magnitude in deeper water. The particulate scattering was mostly influenced by inorganic particles, especially in OM1. High loads of inorganic particulate scatterers possibly increased the diffuse light into OM2, thus increasing chl concentrations. Conversely, in deeper waters the relative increase of absorption by CDOM possibly indicate competition with phytoplankton for short wavelength radiation.

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Phytoplankton photosynthetic competence in Caribbean Sea mesoscale eddies as measured by fast repetition rate fluorometry

Caribbean Sea mesoscale eddies result from vorticity advection through passages into the Caribbean area as inferred from satellite SSH. The Caribbean Vorticity Experiment (Cavortex II and VI) undertaken from June 22-27, 2004 and August 28, 2006 to September 8, 2006 were intended to characterize the physical, biogeochemical, and optical structure of the eddies and to assess their influence on biological productivity of the Eastern Caribbean Region. During Cavortex II, satellite altimetry showed a large cyclone interacting with a small anticyclone south of Puerto Rico and for Cavortex VI altimetry showed a large cyclone south of the Dominican Republic. Fast Repetition Rate Fluorometer measurements showed that photosynthetic competence varied widely in areas of upward pycnocline displacement of isohalines and thermal structures. This displacement suggests that nutrient upwelling is responsible for the higher photosynthetic competence observed between the surface and 90 m. Functional absorption cross-section varied inversely to photosynthetic competence even under the influence of upward flux suggesting nutrient stress on the phytoplankton. Phytoplankton photosynthetic parameters developed from radiocarbon incubations of near surface and the deep chlorophyll-a maximum are consistent with these observations.

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How you get there depends on where you start: variation in fiddler crab larval dispersal mechanisms

Successful transport of larvae from adult habitats in estuaries to coastal waters for development can be facilitated by a behavioral mechanism referred to as selective tidal-stream displacement. This suggests that the expression of a circadian rhythm in Uca is associated with the location of the adult habitat relative to development areas. Swimming activity of zoea-1 larvae of fifteen Uca species from seven locations along the Atlantic and Gulf coasts of the United States and the Pacific and Caribbean coasts of Panama were monitored under constant conditions for 72 h. Periodogram analysis of the time series indicated that estuarine species possessed ebh-phased circadian rhythms in swimming. However, coastal species exhibited no clear rhythmic patterns. These results suggest that STST behaviors may have arisen in association with adaptations for estuarine living.

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Anaerobic thiosulfate and sulfur oxidation/dissipation mediated by autotrophic bacteria in the Caribbean’s basin sedimentary redoxcline

The Oxygen depletion below ~250 m within the cariaco basin sets a chemocline between 200 and 400m which represents a perfect site to study autotrophic prokaryotic communi-
ties due to depletions of labile organic matter and the vertical distribution of inorganic electron donors and acceptors. Previous studies have shown enriched microbial communities within the redoxcline that coincide with peaks in dark carbon fixation. This production is believed to be coupled to chemoautotrophic activity fueled by availability of elemental sulfur, thiosulfate and sulfate. Based on most probable numbers (MPN), the abundances of sulfur and thiosulfate disproportionating bacteria are high within the redoxcline of the DON/PS (30–133 cells/ml). Our research focuses on the isolation and metatranscript analysis of the thiosulfate and elemental sulfur utilizing bacteria. In the laboratory, isolations of these phyotypes are underway using dilution to extinction, roll tubes and deep agar stab methods in basal media containing thiosulfate or elemental sulfur as sole energy sources. We will also report on isolations utilizing anoxic chemostats with highly selective inorganic media. Isolations will be verified by standard 16s terminal restriction fragment length polymorphism (T-RFLP).

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DISSOLVED ORGANIC MATTER IN THE CARIACO BASIN

Measurements of dissolved organic carbon (DOC), dissolved organic nitrogen (DON) and dissolved organic phosphorus (DOP) were made at the CARIACO time-series station (10°30' N, 64°40' W) as part of the CARIACO time-series program. There was a marked seasonal variability in DOC concentrations, with low values (~70 μM) during the well mixing season (December-May), due to the injection of cold, DOC-depleted Subtropical Underwater (SUW) near the coast. During the rainy season (June-November) waters were stratified and DON accumulated in the upper 150m of the water column, increasing to ~80 μM. DON and DOP did not show a seasonal trend. Horizontal DOC advection is thought to be the principal mode of carbon export out of the basin, with an estimated 20.18 Gt/year transported into the Caribbean Sea. Classic profiles were obtained for DOM, with concentrations decreasing with increasing depth. Deep (>350m) DOC concentrations in the Cariaco Basin were ~10 μM higher than average deep waters, thought to be the result of particle degradation. This is the first information available on DOM in the Cariaco Basin, an important upwelling site in the Caribbean Sea.

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STATE ESTIMATION IN SUPPORT OF AN IRON FERTILIZATION EXPERIMENT IN THE ANTARCTIC POLAR FRONTAL ZONE

Combining models and data with assimilation or state estimation techniques is promising when both data and models separately exhibit skill. However, in oceanography more often than not, data and in particular sub-surface data are sparse and the prediction skill of ocean models tends to be poor on long time scales. We present a state estimation experiment, in which we exploit the availability of a high-resolution regional data set: Hydrographic, tracer and velocity data from the European iron fertilization experiment (EFEX) are used to constrain a high-resolution coupled ecosystem-ocean circulation model (EFEX) with the experimental site in Atlantic sector of the Antarctic Polar Frontal Zone. The integration time spans the length of the experiment (approximately 39 days). A high resolution hydrographic and ADCP survey during EFEX yielded an exceptionally dense data set. In a first step, temperature, salinity, and velocity data are used to estimate the dynamically consistent optimal trajectory of a regional circulation model with open boundaries and initial conditions as control variables; biogeochemical tracer measurements constrain an ecosystem model in order to optimally estimate model parameters with a particle filter. In a second step, the ecosystem model is coupled to the circulation model in a forward integration to yield estimates of heat and salt budgets, vertical mixing, primary and export production.

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AN AUTOMATED, HIGH PRECISION, MASS-SPECTROMETRIC NOBLE GAS AND HE-4 HE-3 ISOTOPE MEASUREMENT SYSTEM FOR EXTRACTED SEAWATER SAMPLES

The concentrations of dissolved noble gases in seawater are potentially powerful probes of air-sea exchange, water mass formation, and diapycnal mixing processes. In order to provide useful information, these concentrations need to be measured to an accuracy of better than 1 percent, and preferably to levels approaching 0.1 percent. We have developed a fully automated system for the unattended measurement of extracted seawater samples for the abundances and isotopic composition of the noble gases (He, Ne, Ar, Kr and Xe). Gas samples are chemically purified using SAES getters, and the individual noble gases are cryogenically separated using a 4-stage cryogenic trapping system. Abundances of the gases are determined by peak-height manometry using a quadrupole mass spectrometer equipped for ion-counting, and compared to pure-gas standards calibrated to air aliquots of known composition. Helium isotope ratios are determined using a magnetic sector mass spectrometer. The precision of the method is 0.10%, 0.14%, 0.10%, 0.14% and 0.17% for He, Ne, Ar, Kr, and Xe respectively.

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TEMPORAL DISTRIBUTION OF CARDEOMA GUANHUMI LARVAE IN A SMALL ESTUARY IN PUERTO RICO

Cardiosoma guanhumi is a semi-terrestrial brachyuran crab that inhabits coastal tropical areas of the Atlantic Ocean and Caribbean Sea. This land crab shows a complex life cycle with aquatic and terrestrial stages. The temporal distribution and abundance of the larval stages (zoa and megalops) of this land crab is unknown. The purpose of this study is to describe the temporal distribution and estimate density of zoa and megalops in a small estuary in Puerto Rico. Monthly plankton samples were taken with two stationary stream drift nets placed at the mouth of Boquilla’s Creek, Marañ Puerto Rico. Water was filtered for 45 minutes and volume was measured with a flow meter attached to one of the nets. The density of megalops was consistently higher than the density of zoas throughout the study period (May to September 2007). Identification of the larvae to species is ongoing. The results of this study will increase the knowledge the life cycle of a commercially important species in Puerto Rico and are important for the development of a management plan for the species.

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SYNOPSIS OF THE RESULTS OF THE MEHI PROJECT AND ALSO DETAIL NEW MAPPING METHODS OF BENTHIC ZONES

Using the MEHI project, developed by commercial and governmental organizations, and a suite of spatial and temporal data, we were able to map the coral reef ecosystems of the entire West Hawaiian Islands (WHI) using multitemporal satellite imagery. All eight of the islands were mapped using digitalization tools in ArcGIS to create GIS maps of the benthic zones. This work created a map of the major benthic zones. The results of the project further NOAA’s commitment towards compiling a state-of-the-art Reef Task Force’s recommendation to develop shallow-water coral reef ecosystem maps for all U.S. waters by 2009. BAE systems is also developing automated methods of benthic habitat mapping, including tools for simultaneous mapping of benthic, bottom class, and water properties, and algorithms for removing glint and waves. This presentation will focus on the results of the MEHI project and also detail new technologies and algorithms that may be applied in future mapping projects.

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POTENTIAL IMPACTS OF CHARCOAL ON PALEORECONSTRUCTIONS OF ORGANIC MATTER INPUTS TO AQUATIC SYSTEMS

Fire is a major driver of ecosystem processes as it affects the carbon cycle over a vast suite of terrestrial environments from forests to peatlands. Pyrogenic carbon (PyC) is a heterogeneous class of solid residues from combustion that include slightly altered chars, elemental carbon (EC), and carbonaceous soot which are commonly found in terrestrial environments from forests to peatlands. Previous studies have shown that PyC concentrations in the water column can be up to 100% of the dissolved organic carbon (DOC) concentration. However, the precise contribution of PyC to the DOC concentration is unknown. This study examines the potential impact of PyC on the DOC concentration in the DACHART project that aims to quantify the contribution of terrestrial DOM to the DOC concentration in the surface waters of the DACHART region.

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IN FROM THE COLD UNCEUTILIZED PROTESTS IN ARCTIC, A DEEP DARK SECRET

The biogeography and depth distribution of the majority of microorganisms has only begun to be appreciated with the recent explosion in molecular data. The Arctic is a distinct environment with long periods of darkness and low light and provides a particular habitat for phytoplankton and other protists; favoring the maintenance of mixotrophic and completely heterotrophic taxa in the upper mixed layer. Over much of the Arctic Basin the multi-year ice has acted to create conditions that are similar to those in deep oceans.
with stable cold temperatures and no light. Our molecular surveys have shown that many sequences from uncalcified protists in the offshore Arctic Ocean have their closest affinities with deep water temperate and tropical sequences. This suggests the existence of a distinct cold water, low light or dark adapted community maintained along isopycnal surfaces. This pelagic microbial community currently supports a pelagic arctic marine food chain with its distinct biota. Global climate change threatens this balance with a new open ocean habitat created by the loss of multiyear ice over the deep Arctic Basin.

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THE FUTURE OF THE SOUTHERN OCEAN CO2 SINK

The Southern Ocean currently serves as a sink for atmospheric CO2, however the strength of this sink has weakened over the past few decades. It has been suggested that the primary cause of the sink reduction is a trend in the position and intensity of the Southern Hemisphere westerlies and the subsequent increase in the upwelling of carbon-rich water. The wind stress trend will likely continue into the coming century, further weakening the Southern Ocean CO2 sink. However, the coming century may also be characterized by enhanced precipitation over the polar oceans, leading to increased stratification and suppressed upwelling of carbon-rich waters in the Southern Ocean. The trends in stratification and wind stress will have competing influences on future CO2 sink strength, and yet the net effect of these two processes is unknown. Here, we test the sensitivity of the Southern Ocean carbon sink to changes induced by alterations of wind stress, stratification, and the combined effect of the two using an ocean box model.

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MODELING THE ENERGETICS OF SPECTACLED EIDERS DURING LONG-TERM CHANGE IN SEA ICE AND BIGHTS

The world population of Spectacled Eiders, a threatened species, winters in pack ice of the Bering Sea. To assess possible factors in the eiders’population decline, we used historical data on benthic prey, sea ice, and weather in a simulation model of eider energetics that integrated field, laboratory, and remote sensing studies. Density and duration of leads in the pack ice during extreme versus average winters had little net effect on eider energy balance, as flight distance to other leads was usually short when leads closed. Nighttime cost was greatly reduced by the eiders’resting on ice versus floating on water, but this factor was likely unimportant during the eider decline (1970s to 1990s). Despite a major shift in dominance of major prey species, food did not appear to be limiting at the beginning or end of the eider’s decline. After a decade of poor bivalve recruitment, the area of viable habitat for eiders decreased dramatically between the early 1990s and early 2000s. Reduced prey availability and projected loss of ice for nighttime roosting may decrease the eiders’prospects of recovery.

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HYDRODYNAMICS OF FRINGING REEF SYSTEMS: NINGALOO REEF, WESTERN AUSTRALIA

The response of the circulation of Ningaloo Reef (the largest fringing coral reef in Australia) to wave, wind and tidally forcing is investigated using field data and the output from a coupled numerical circulation - wave model. A 6-week field experiment measuring waves, currents, and water levels was conducted during April - May 2006, which focused on the dynamics of flow within a representative reef - channel circulation cell (one of hundreds that comprise the overall system). Results from the study indicate that wave-forcing is the dominant mechanism driving the circulation of Ningaloo Reef, with lagoonal flushing times of 5-8 hours under typical offshore wave conditions. Cross-shelf wave-driven currents, however, were significantly weaker (~0.1-0.2 m/s) than expected from existing one-dimensional analytical models of reef circulation, in part due to the presence of considerable wave setup inside the shallow lagoon that is neglected in these approaches. Preliminary results from the three-dimensional numerical model, presently under development, will be presented.

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RTOFS: REAL TIME HIGH RESOLUTION OPERATIONAL OCEAN FORECAST SYSTEM FOR THE ATLANTIC (265-76N)

RTOFS in the Atlantic Ocean is an NCEP operational ocean forecast system based on HYCOM on a 1200—1684 orthogonal grid with 26 vertical coordinates composed of 21 -isopycnal and 5-level. It is forced with winds, heat flux, evaporation and precipitation every 3 hour [derived from NCEP global atmosphere GFS [Global Forecast System]]; with body and boundary tides. Also forced are river outflows with USGS daily stream flows and RIVDIS climatology. The model assimilates 1. SST from GOES, AVHRR, and in-situ; 2. SSH from JASON, GOFO and ENVISAT; and 3. T/S from ARGO and CTD. The model is run once a day. Each run produces sets of 24-hour nowcast and 120-hour forecasts of hourly barotropic and daily baroclinic properties. The main goal of this development is to establish operational high-resolution ocean forecast system for short-term, (0.1 week), predictions for an Atlantic sector (265-76N) covering both shallow and deep waters. We present the performance of the system in real-time, including validation and evaluation of the system components - data streams, model and data assimilation.

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ON THE SALINIFICATION OF THE MEDITERRANEAN OVERFLOW WATERS

A recent study of the mid-depth waters of the eastern North Atlantic has detailed significant changes in the temperature and salinity of the Mediterranean Water (MOW) over the past fifty years, increases assumed to be linked to changes in the source waters flowing across the Strait of Gibraltar. To test whether this linkage is viable, we have used a simple box model of water mass transformation by marginal seas to predict changes in the overflow water salinity based on salinity changes of the inflow from the North Atlantic, surface fluxes and stratification in the Mediterranean. Surprisingly, the model correctly predicted the observed increase in salinity of the Mediterranean Water (MOW) over the past fifty years, increases assumed to be linked to changes in the source waters flowing across the Strait of Gibraltar. We work indicates that the magnitude of the observed salinity change noted for the MOW cannot easily be explained by source water or volumetric flow changes; rather it is suggested that local circulation change are responsible for the warming and salinification of the MOW reservoir in the eastern North Atlantic.

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TURBULENCE IN REVERSING AND ROTATING TIDAL FLOWS

The disruption rate and friction velocity (Fv) were studied in the East China Sea near the coast of China using ADV and ADCP measurements. Reversing and rotating tidal flows affected small-scale near-bottom dynamics differently. In reversing flows, the near-bottom shear and the shear at the upper levels were almost in phase. In rotating flows, the shear generated near the seafloor, propagated slowly to the water interior with a phase speed of ~ 5 m/s. The highest near-bottom dissipation on a shallow shelf was associated with the stronger flooding current of the reversing tide and the lowest with the reversing ebb current. The log-layer (ADCP-based) and the skin-layer (AVD-based) estimates of Fv showed close correspondence for the reversing tide, but while the tidal vector rotated over a slope- ing bottom the log-layer Fv was approximately twice larger than the skin-layer Fv. The influence of stratification, form drag, and rotation is discussed as possible sources for this discrepancy. Significant departures from the wall-layer parameterization were found when advected warm bottom water caused convective mixing in addition to boundary-induced turbulence.

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SHEAR PROBE MEASUREMENTS FROM SLOWLY MOVING PLATFORMS

Microstructure turbulence measurements using shear probes are typically made from free-fall profilers, which descend at a constant rate, typically between 0.5 m s-1 and 1 m s-1. Several research groups are currently working towards the integration of microstructure shear probes into ocean gliders and profiling floats. These platforms move much slower through the water, between 0.1 m s-1 and 0.5 m s-1, raising the question of angle-of-attack and limitations and whether shear probes are sensitive enough to measure at such slow speeds. This presentation reviews available data that demonstrate that shear probes can successfully operate at profiling speeds of 0.05 m s-1. At these speeds, the lower detection limit of dissipation rates is determined by electronic noise, the upper measurement limit is determined by the angle-of-attack of the oncoming flow. These constraints do not impose a serious limitation on open ocean measurements from gliders and floats.

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LINKAGES BETWEEN ALGAL COMMUNITY COMPOSITION AND WATER CHEMISTRY DATA ON SHORT SPATIAL AND TEMPORAL SCALES

San Francisco Bay is a heavily urbanized estuary with anthropogenically enriched concentrations of nutrients and trace metals. To evaluate the impact of those contaminants, we looked for relationships between algal community composition and water quality variables

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(e.g., nutrients, trace metals, temperature) during the spring 2003 phytoplankton bloom. We analyzed algal community composition and community level approach to uncovering patterns in biological data and linking those patterns to environmental data. The analysis demonstrated that phytoplankton community composition changed significantly over small spatial and temporal (e.g., weekly) scales. Water chemistry variables that best matched patterns in algal community composition were water temperatures (primarily) and dissolved ammonium concentrations (secondarily). When dissolved ammonium concentrations increased during decay of the diatom bloom, Synechocystis sp. grew rapidly, indicating that community composition shifted quickly following an environmental change. Algal community composition was not linked to dissolved trace metal concentrations, despite the known toxicity of some metals (e.g., Cu) to phytoplankton. The absence of such a relationship suggested that algal communities were not impacted by the high trace metal concentrations in the estuary.

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UPPER OCEAN STRATIFICATION AT THE HAWAII OCEAN TIME-SERIES STATION ALOHA

Upper ocean stratification plays an important role in controlling the vertical turbulent fluxes of biogeochemically important compounds. Over the past 19 years, the near-surface weakly stratified mixed layer (ML) thickness at Station ALOHA (22°45'N, 158°W) has varied from a few m to as much as 160 m. The mean annual range is 25-80 m, with the maximum depth in early January, and the minimum depth in early April. The sub-ML stratification, which represents a potential energy barrier to entrainment, varies from a maximum of 1-1.5-km to 4-5 km (1-1.5-km to 4-5 km) in early March, to a maximum of about 1.5-2 km in late September. The timing of the sub-ML maximum stratification is associated with the rapid deepening that typically occurs in the fall. On average, salinity plays a significant role in the reestablishment of stratification in the February-April period, before seasonal heating takes over. The maximum nonseasonal (synoptic and interannual) variability of the mixed layer occurs in February-March. The greatest interannual variation of the maximum stratification occurs in the fall, apparently controlled by salinity variations.

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SEA-ICE RESPONSE TO STRATOSPHERE-SURFACE COUPLING IN THE BEAUFORT SEA

Previous studies have demonstrated an increased frequency of reversals in the Beaufort Gyre circulation associated with the post-circumpolar jet stream in the northern hemisphere, while also demonstrating a lagged response between stratospheric and surface cyclonic activity. In this study, we examine the relationship between polar stratospheric zonal flow variability and surface cyclonic activity in the form of surface air temperature (SAT) gradients. Of particular interest is the nature of the correlation between the lower and middle stratospheric NAM index and SAT gradients. Here we explore possible correlations between the NAM index and SAT gradients at different latitudes as a function of time lag. Statistical analyses demonstrate that SAT gradients in the tropics are highly correlated with strait in the middle (10 mb) and, to a lesser extent lower (50 mb) polar stratosphere, while SAT gradients in high-latitude regions are highly correlated with polar middle and lower-stratospheric zonal winds. Also of interest are time lags between stratospheric and surface processes, and the implications of stratosphere-surface coupling for sea-ice variability in the Beaufort Sea region.

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RELATIVE DISPERSION IN THE GULF STREAM AND ITS RECIRCULATION

As part of the CLIVAR Mode Water Dynamics Experiment (CLIMODE), 60 satellite-tracked surface drifters were released in pairs and trios during the February to March 2007 cruise of the R/V Knox in the Gulf Stream extension. In this talk, we report differences of the drifters is examined as a function of time and separation distance. Isotopic Richardson’s Law behavior is seen for separation distances from 1.5 km to 300 km, with maximum turn-over rates (Vmax) and half-saturation constant (Km) were calculated for glucosidases, peptidases and phosphatase. A decrease in pH led to a significant increase in Vmax of carbohydrates accompanied by a decrease of peptide degradation. Possible implications of this short time changes in heterotrophic organic matter turnover due to acidification will be discussed.

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EXPLORING THE FEASIBILITY OF GLIDER-BASED TRANSPORT, STRATIFICATION, AND ECOLOGY MEASUREMENTS ON THE NEW ENGLAND SHELF BETWEEN MVCO AND LINE W

Autonomous gliders, when used appropriately relative to their inherent capabilities, can provide sustained, low-cost, and robust measurements of key physical and biological parameters. Since October 2006 we have repeatedly occupied a 200 km transect spanning the New England shelf from the Grinnell Vineyard Continental Observatory (MVCO) to the Line W moored array on the continental slope. This work constitutes an important step in the development of an integrated and sustainable regional observing system capable of resolving physical and biological variability on timescales from days to decades. However, there are significant logistical and analytical impediments to using slow, relatively fragile autonomous platforms in a demanding operational setting. In this presentation we explore, from both scientific and engineering perspectives, the feasibility of long-term occupation of this cross-shelf transect. We will present a synthesis of more than 20 independent realizations of this section, contrast the glider observations with coincident shipboard measurements, and evaluate our computation of along-shelf baroclinic transport.

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IMPLEMENTATION OF THE NAVY COUPLED OCEAN DATA ASSIMILATION SYSTEM AT THE NAVAL OCEANOGRAPHIC OFFICE

The Navy Coupled Ocean Data Assimilation (NCODA) system is a 3D variational optimization (MVO) system developed at the Naval Research Laboratory (NRL). It can provide a 3D analysis of temperature, salinity, and geostrophic currents based on real-time observations. This system is being implemented at the Naval Oceanographic Office (NAVOCEANO) on the supercomputer configuration of the Major Shared Resource Center (MSRC). NCODA is running in both a stand-alone mode and coupled with the Navy Coastal Ocean Model (NCOM). Several case studies will show NCODA results compared with recent bathythermographic data sets acquired in the western Pacific. These studies will include the customization of NCODA to the region and input data sets by means of its adjustable input parameters.

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DEVELOPMENT OF BIOLOGICAL SEDIMENT STABILITY IN MUD/SAND MIXTURES: A LABORATORY STUDY

Natural sediments rarely consist of only mud or sand but a mixture of both. Since predictive modeling of estuarine sediment erosion and transport requires a description of the erosional properties and behavior of the bed, a number of different sediment mixtures have been investigated. The investigations were carried out using ananual laboratory C-1 miniflumes with sand-mud mixtures of 0, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90 and 100 percent mud by weight. The sediment was left to stabilize for 0, 2, 5 and 7 days before experiments were carried out to determine the bed stability. The results showed that adding 20 % mud by weight to sand gave a decrease of stability by 29 % due to...
to fact that the added mud did not fully encompass the sand grains. While adding of 20% sand to mud showed an increase of stability by 114%. The development of bio-oxidation was possible from 40 to 100% mud and can be described as a bell shaped curve with maxi-
mum around 60% mud added.

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EFFECT OF THE COUPLING BETWEEN THE UPPER AND LOWER CIRCULATIONS NEAR THE FRONT ON THE DEEP MIXING
Observations in the Sea of Japan in the winter of 2000 show evidence of convection to a depth of roughly 1000 m in the subpolar front. Numerical simulations by 3-D model show that this deep mixing is associated with both barotropic and free convection and is pre-existing larger-scale downwelling regimes. The downwelling regime appears to be a result of inter-
actions between frontal meandering and deep circulation in this basin over bottom top-
ographically defined anomalies. The coupling between the frontal dynamics and the deep circulation was explored through the semigeostrophic Sawyer-Essijian equation, solved numerically for the Sea of Japan case. Source terms due to vertical mixing and Ekman lateral buoyancy advection for ship observations were estimated from the solutions of a 1-D turbulence closure model. An analysis of the solution demonstrates that vertical coupling between the upper and lower circulation produces a localized region of downwelling that leads to buoyancy instability in deep layers and supports mixing. The applicability of this mixing mechanism in other locations in the global oceans is discussed.

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THE IMPORTANCE OF MICROBIAL DYNAMICS IN MARINE BIOGEOCHEMICAL MODELING. A TESTATIVE DATA ASSIMILATION STUDY OF OPEN OCEAN ECOSYSTEMS
DOM usage by bacteria is important in the carbon cycle especially inorganic nutrient regeneration. However, it is still controversial whether it is necessary to explicitly include bacteria-DOM processes in open ocean biogeochemical models. We constructed a 1-D biogeochemical model that simulates the carbon (C), nitrogen (N) and phosphorous (P) components in picophytoplankton, diazotrophs, bacteria, protozoa, labile and semi-labile DOM, and inorganic nutrients including ammonium, nitrate and phosphate. The C:N:P ratios in the compartments are flexible. The model includes a detailed bacteria-DOM dynamics such as control equations on DOM labilization and bacterial growth effi-
ciency. Data assimilation is applied to objectively optimize parameters so that the misfits of modeled estimates and observations (costs) are minimized. Experiments: (1) A model without microbial dynamics which assimilated chlorophyll, primary production, nitrate, micro-phytoplankton biomass and export. (2) A model with microbial dynamics which as-
similated the same data as (1). (3) Same model as (2) but assimilated more data including bacterial production and DOM stock. Our results show that although the model without microbial dynamics can be optimized to fit the available data, it does so for the wrong reasons. By including microbial dynamics and assimilating the microbial related data, the cost of the model can be significantly reduced while optimized to a reasonable pattern.

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HPIES - MEASURING WATER COLUMN CURRENTS AND PROPERTIES FROM THE SEA FLOOR
We will describe a new sea floor instrument, called HPIES, that combines three well-
tested sensors. When deployed in an array and combined with CTD data, the HPIES can provide daily estimates of sea surface to sea floor profiles of temperature, salinity, specific volume anomaly, and absolute horizontal currents across the array. The HPIES is being tested sensors. When deployed in an array and combined with CTD data, the HPIES can provide daily estimates of sea surface to sea floor profiles of temperature, salinity, specific volume anomaly, and absolute horizontal currents across the array. The HPIES is being
developed to take advantage of the emergence of flexible data gateways to the deep ocean, such as cabled observatories and modern-carrying gliders. These gateways create the opportunity for acquiring data for long durations in near-real-time, permitting exploration and data utilization in ways that traditional expeditionary data collection does not. The HPIES sensors measure the horizontal electric field, the vertical acoustic travel time from the sea floor to the sea surface (that is, an inverted echo sounder), and bottom pressure. Besides showing data from recent deep-water evaluation deployments, we will present examples of the use of these variables, from earlier experiments when the variables were measured separately, for producing such analysis tools as daily horizontal maps of meso-

d-scale variability and stream-coordinate representations of frontal jet currents.

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BIOGEOCHEMISTRY OF FE(II) OXIDATION IN A PHOTOSYNTHETIC MICROBIAL MAT: IMPLICATIONS FOR PRECAMBRIAN FE(II) OXIDATION
Early photosynthetic organisms are assumed to have played a major role in the forma-
tion of Precambrian Banded Iron Formations (BIFs) by either oxidizing Fe(II) directly or by producing O2 during photosynthesis, which in turn oxidized Fe(II). Microbial mats at Chromatium Pots Hot Springs Yellowstone National Park composed of oxygenic cya-
nobacteria and the anoxicogenic photosynthet Chelatobacteri were studied as a model to dis-
prove the role of either process. Voltammetric microelectrodes were used to measure dissolved O2, Mn(II) and Fe(II) simultaneously in situ with a 0.05 mm depth resolution. Oxygenic photosynthesis produced enough O2 to remove all Fe(II) from the mat at light intensities of ~15 W/m2. The Fe(II) oxidation rates caused by oxygenic photosynthesis was mea-
sured in this study are sufficient to explain BIF formation. Performing kinetic experiments in the dark and light at the depth of maximum O2 production indicates that the decay of Fe(II) follows a zero order rate law consistent with photosynthesis as the source of O2. These dynamic environments show how kinetic data can be obtained in situ and be used to understand the interactions between biology and chemistry.

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A COASTAL OCEAN PREDICTION SYSTEM FOR TAMPA BAY, FLORIDA
The USF College of Marine Science has developed a Coastal Ocean Prediction System for Tampa Bay based on an integrated observing system and circulation model. The model system is a real-time observation and forcing system that is designed to produce three-dimensional fields of circulation, temperature, salinity, and water level. The hydrodynamic model is fully operational in either a nowcast-forecast mode or a hindcast mode (see http://oomp.marine.usf.edu/TFMmodel). A water quality module produces fields of dissolved oxygen, nutrients, and dissolved oxygen from time-varying nutrient and fresh water loading and a wave module provides directional wave spectra and bottom stresses. The integrated observing and modeling system provides a decision support tool that is used to enhance security, safety, and efficiency of maritime transportation, to guide search and rescue efforts, and to evaluate the bay ecosystem response to environmental stresses. Such stresses include severe storms, seasonal and interannual changes in fresh water input, as well as human impacts, such as hazardous material spills, fresh water diversions, nutrient loading, changing land use patterns, and alterations in bay bathymetry.

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DIRECT ESTIMATION OF THE REYNOLDS STRESSES FROM PIV DATA
A direct challenge in modern turbulence measurements in the coastal ocean is to separate wave induced motions and turbulence when calculating the Reynolds stresses. Here we introduce a direct approach for removing the wave velocities that is suitable for particle image velocimetry (PIV) data, and compare it to the second order structure function method of Trowbridge (1998). The instantaneous wave velocities are estimated as the spatially averaged horizontal and vertical velocity over the two sample areas of 35x35cm2, that are separated horizontally by 60 cm. Subtracting this value and the overall time averaged velocity from instantaneous data provides the turbulent velocity fluctuations, which are then used to calculate Reynolds stresses. The results indicate that dissipation dissipation stresses are in good agreement with the structure function method, and discrepancies between the two approaches are discussed in the context of their underlying assumptions. Error estimates for the two approaches are presented and compared.

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ESTIMATING ANNUAL GLOBAL UPPER OCEAN HEAT CONTENT ANOMALIES DESPITE IRREGULAR IN SITU OCEAN SAMPLING
The effects of irregular in situ ocean sampling on estimates of annual globally integrated upper Ocean Heat Content Anomalies (OHCA) are investigated for sampling patterns from 1955 to 2006. An analytical method is presented for computing the effective area covered by an objective map for any given in situ sampling distribution. To evaluate the mode, appropriately scaled sea surface height (SSH)anomaly maps from Aviso are used as a proxy for OHCA from 1993 to 2006. Using these proxy data demonstrates that the simple area integral of such an objective map for sparse data sets does not agree as well with the actual integral as a representative one. From 1955 to 1966, in situ ocean sampling is inadequate to estimate accurately annual global integrals of upper OHCA. During this period, simple integrals for the sampling pattern of any given year underestimate the 13-year mean proxy OHCA from 1993 to 2006 by around 70%, and comparisons of integrals for representative integrals are often very large. From 1967 to 2003 there appear to be suffi-
cient data to estimate annual global integrals. For this time period the simple integrals for any given year’s sampling pattern still underestimate the 13-year trend by around 30%, but the representative integrals match the trend well with small confidence intervals. For 2004 through 2006 in situ sampling, with near-global in situ Argo data coverage, the 13-year trend is equally well represented by simple or representative integrals.
Goldsmith, S. T. and Lyons, W. B. have important implications for the way in which aquatic pathogens are collected, monitored and volume fraction of aggregated material varied throughout the study. These results led to exploring differences in the characteristics of aggregates found in habitats populated by (e.g., clams and oysters), including bivalve pathogens and human pathogens acquired via distribution, and fate of aggregates, few have addressed their role in the ecology of aquatic ecosystems and although many studies have focused on the composition, formation, and distribution, and fate of aggregates.

POTENTIAL SATELLITE FOR MONITORING BIO-OPTICAL PROPERTIES: QUALITY ASSESSMENT OF OCEAN COLOR MONITOR DATA IN THE COASTAL ZONE

We determined a new capability for monitoring bio-optical properties can be performed using the Ocean Color Monitor (OCM) sensor onboard the Indian remote sensing satellite IRS-P4. OCM has a spatial resolution of 360 meters which enables the fine detail of spatial variability present in the coastal zone to be resolved. A suite of automated validation tools have been developed and used to analyze the quality of OCM normalized water leaving radiance (nLw), and derived inherent optical properties by comparing these OCM data to in situ data sets (absorption, backscattering, and attenuation coefficients), co-located SeaPRISM-derived nLw’s, and the Aerosol Robotic Network (AeroNet) derived aerosol properties derived from the Martha’s Vineyard Coastal Observatory site. An automated de-striping algorithm was also applied to the OCM data to correct for instabilities in the characteristics of the benthos bream sensor. The effects of the de-striping algorithm on the match-up data are also presented. These de-striped images can be integrated with current bio-optical algorithms to produce similar MODIS products at a higher spatial resolution. The results indicate OCM can provide useful products in the coastal zone.

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PHOSPHORUS COMPOSITION OF SINKING PARTICLES FROM GUAYMAS BASIN, GULF OF CALIFORNIA

The seasonal and interannual composition and fluxes of sinking particulate phosphorus (P) in the Guaymas Basin, Gulf of California were investigated using a sediment trap deployed at 475 m from August 1990 to December 1996. Samples were analyzed using sequential extraction (SEDEX) to examine the various forms of particulate P (TPP). Particulate P(TPP) concentration averaged 40.9 ± 26.7 mg P m⁻³, with particulate P accounting for only 32.2 ± 13.7% of the total particulate N (TPN). The remaining N was comprised of loosely bound (18 ± 13%), mobile nitrogen (22 ± 12%), and nitrogenous (23 ± 12), and detrital (5.4 ± 2.8%) P forms. Annual fluxes varied widely, with significant increases during the summer, likely due to increased atmospheric input. Interannual variations in inorganic P will be discussed and compared to other sites with varying magnitudes of riverine input, upwelling, and upwelling in order to provide insights into the mechanisms that control particulate P composition and its ultimate removal from the marine water column.

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GOT SNOW? TRACKING MARINE PATHOGENS IN AQUATIC ECOSYSTEMS

Marine aggregates (i.e., marine snow, floes, and organic debris) are ubiquitous in aquatic ecosystems and although many studies have focused on the composition, fate of aggregates, few have addressed their role in the ecology of aquatic ecosystems. This research focuses on diseases associated with suspension-feeding bivalves (e.g., clams and oysters), including bivalve pathogens and human pathogens acquired via consumption of contaminated bivalves. Marine aggregates were characterized using un-derwater video surveys coupled with direct collection in modified settling cones in order to explore differences in the characteristics of aggregates found in habitats populated by clams (Mercenaria mercenaria) and oysters (Crassostrea virginica). Microaggregate (< 500 µm) concentrations were always greater than macroaggregate (> 500 µm) concentrations, but peak concentrations of microagggregates and macroaggregates, mean size of particles, and volume fraction of aggregated material varied throughout the study. These results have important implications for the way in which aquatic pathogens are collected, monitored, and quantified for risk-based surveillance in shallow-water ecosystems.

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DISSOLVED ORGANIC CARBON IN SMALL RIVERS, PANAMA

The climate of Panama is typical of the low-latitude humid tropics, characterized by near-uniform average temperature, abundant rainfall, and a distinct seasonality of precipitation with a dry December to mid-April Dry season and a wet season with near constant average monthly rainfall during the intervening months. Samples for dissolved organic carbon (DOC) analysis were collected from small rivers across Panama from along a transect from the Lake Bayano area to the Costa Rican border during both the wet and the dry season. Analyses of our data demonstrate that during the wet season the DOC concentration in all but three of the streams are higher than during the dry season. Concentrations vary greatly from river to river and from season to season, with values as low as 0.053 to high values of over 2.0 mM/L. The highest concentrations were observed in rivers draining sedimentary rocks in coastal watersheds. DOC dynamics from these rivers will be discussed in terms of what is known regarding SSMRs draining tropical forests in Puerto Rico and other Central American locations.

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KNOWLEDGING A LONG-TERM STABLE ISOTOPE RECORD DERIVED FROM NORTH ATLANTIC RIGHT WHALE BALEEN: IMPLICATIONS FOR ECOSYSTEM-LEVEL CHANGES IN THE GULF OF MAINE?

North Atlantic right whales (Eubalaena glacialis) experience high anthropogenic mortalit y rates and have not recovered from the population bottleneck induced by commercial whaling. The majority of the extant population can be found foraging seasonally in several areas within the Gulf of Maine (GoM). We collected incremental stable isotope ratios (δ¹³C, δ¹⁵N, δ³¹P, δ δ) from 25 right whale baleen plates to examine long term trends in right whale migration behavior, health, and diet. The same isotope ratios were determined for zooplankton collected in GoM right whale feeding habitats, as so to ground-truth the observed whale baleen isotope patterns. Here we present the baleen isotope time series, which spans from 1880-2006, in the context of zooplankton isotope ratios as well as biogeochemical and physical measurements from the GoM. Most interestingly, we explore potential causes of a marked decrease in whale baleen δ¹³C that occurred in all whales sampled after 1999. Our results demonstrate that in addition to recording whale diet data, baleen may record environmental data, useful for documenting ecosystem-level changes.

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INFLUENCE OF NET Ecosystem METABOLISM IN TRANSFERRING RIVERINE ORGANIC CARBON TO THE Atmosphere: C14 DIC IN A TROPICAL COASTAL LAGOON (CHILKA LAKE, INDIA)

Biogeochemical cycling of carbon in the Chilka Lake, Asia’s largest brackish lagoon on the east coast of India, was studied twice during May 2005 (premonsoon) and August 2005 (monsoon). The dissolved inorganic carbon (DIC) in the lake is higher by ~22% and dissolved organic carbon (DOC) was lower by ~36% during premonsoon than monsoon due to increased rainfall variations in the tributary rivers. Surface PCO2 values of over 2.0 mMC/L. The highest concentrations were observed in rivers draining seasonal changes in the lake seems to be governed by PCO2 levels in rivers and their discharge rates, which were several folds higher during monsoon than premonsoon. The net DOC efflux from entire lake during monsoon (2.64 Gg C·d⁻¹) was higher by 44 times than during premonsoon. 15% of DOC efflux from lake in monsoon was contributed by its supply from rivers and the rest was contributed by in situ heterotrophic activity. Based on mass balance, net ecosystem production (NEP) of lake (~377 Gg C·d⁻¹) was found to be in consistent with the total riverine carbon trapped in the lake (2.80 Gg C·d⁻¹) suggesting that strong heterotrophy in the pelagic compartment of the lake is mainly responsible for elevated fluxes of CO2 during monsoon. This suggests that Chilka lake is an important region in biogeochemical transformation of organic carbon to inorganic carbon and its export to the atmosphere.

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OBSERVATION OF INTERNAL SOLITARY WAVES IN THE NORThern SOUTh CHINA SEA

Several remote sensing techniques are employed in observing the large internal solitary waves (ISWs) in the northern South China Sea in April 2007. The surface expressions of the ISWs are monitored from the same ship-borne radars. Two frequencies of acoustic ISWs are monitored from the satellite and ship-borne radar. Two frequencies of acoustic ISWs are monitored from the satellite and ship-borne radar.
are also observed at the location with sharp topographic changes. The 3-5 kHz chirp sonar is used in these areas. Large sand dunes with cascading runout near the beach are exposed to wave action, and affecting biolabile compounds derived by photolysis of CDOM. We examined the relative importance of these effects in an experiment that separated UV-shielding from supplementation of organic matter. Heterotrophic flagellates (HNAN) exposed to UV filtered through 5.5 cm of oligotrophic lake water (1.1 ppm DOC) suffered 100% mortality. HNAN shielded by an equivalent layer of CDOM (2.4 ppm DOC) maintained a stable population for ~48 h. HNAN incubated in the dark had maximum specific growth rates of 0.5 m/s. HNAN incubated in the dark had maximum specific growth rates of 2.08 and 2.17 d⁻¹ in lake water and CDOM, respectively. DNA dosimeters indicated that DNA damage was reduced by the CDOM shielding. These data confirm the importance of CDOM as a UV shield, but suggest that the biologically available organic matter may not be transferred to higher trophic levels during periods of UV stress.

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DIRECT AND INDIRECT EFFECTS OF UV RADIATION AND CDOM ON A HETEROTROPHIC FLAGELLATE

Natural levels of UVB radiation can reduce microbial population growth. Climate change may alter the direct effects of UVB by changing input of chromophoric dissolved organic matter (CDOM), which absorbs UVB. CDOM fluctuations in oligotrophic lakes could alter the production of heterotrophic flagellates by modifying exposure to damaging radiation and affecting biolabile compounds derived from photolysis of CDOM. We examined the relative importance of these effects in an experiment that separated UV-shielding from supplementation of organic matter. Heterotrophic flagellates (HNAN) exposed to UV filtered through 5.5 cm of oligotrophic lake water (1.1 ppm DOC) suffered 100% mortality. HNAN shielded by an equivalent layer of CDOM (2.4 ppm DOC) maintained a stable population for ~48 h. HNAN incubated in the dark had maximum specific growth rates of 2.08 and 2.17 d⁻¹ in lake water and CDOM, respectively. DNA dosimeters indicated that DNA damage was reduced by the CDOM shielding. These data confirm the importance of CDOM as a UV shield, but suggest that the biologically available organic matter may not be transferred to higher trophic levels during periods of UV stress.

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DIRECT AND INDIRECT EFFECTS OF UV RADIATION AND CDOM ON A HETEROTROPHIC FLAGELLATE

The ecological importance of pteropod physiology

Pteropods have recently received attention in respect to ocean acidification because of their production of aragonite shells. Swarming in large numbers in parts of the world, pteropods can be a substantial part of the diet of seabirds, whales and fishes. Shells and direct microstructure measurements using an AUV, in addition to numerical simulations. The 2006 campaign, during a period of extremely high river flows, yielded estimates of TKE dissipation rate on the order of 10⁻³ m²s⁻¹, one to two orders of magnitude higher than observed during the more moderate flows of the 2007 campaign. These data sets provide a unique opportunity for comparisons between various measurement techniques, and indicate how the use of multiple approaches can yield valuable information about the nature of the turbulent field.

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THE MEAN WOCE-ERA PACIFIC OCEAN GENERAL CIRCULATION AS SEEN THROUGH ASSIMILATIVE AND INVERSE MODELS

A primary goal of the one-time Woce global hydrographic survey was to procure data capable of providing a basic description of the ocean's general circulation. Analysis of these data has taken a variety forms, but over the time frame of the Woce project two analysis techniques for synthesizing oceanographic data have emerged: steady-state box model inversions and OGCM observation assimilations. Recent analyses of data from spatial and temporal scale flow variations in specific regions have brought into question our ability to use hydrographic data as a basis for understanding, and quantifying, general/mean circulation patterns, and more particularly decadal time-scale changes in such patterns. The goal of this investigation was to compare the time-averaged, 3D Pacific circulation estimates provided by a box inverse analysis of Woce-era observations and a general circulation model, ECCO which assimilates many of the same (and additional) data. Results indicate that 1) surface (outcropping) circulations are often different, 2) upper layer subsurface and intermediate circulations are more often similar in both character and magnitude, 3) and deep circulations are often quite different. The details of these similarities and differences are presented.

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THE MEAN WOCE-ERA PACIFIC OCEAN GENERAL CIRCULATION AS SEEN THROUGH ASSIMILATIVE AND INVERSE MODELS

A primary goal of the one-time Woce global hydrographic survey was to procure data capable of providing a basic description of the ocean's general circulation. Analysis of these data has taken a variety forms, but over the time frame of the Woce project two analysis techniques for synthesizing oceanographic data have emerged: steady-state box model inversions and OGCM observation assimilations. Recent analyses of data from spatial and temporal scale flow variations in specific regions have brought into question our ability to use hydrographic data as a basis for understanding, and quantifying, general/mean circulation patterns, and more particularly decadal time-scale changes in such patterns. The goal of this investigation was to compare the time-averaged, 3D Pacific circulation estimates provided by a box inverse analysis of Woce-era observations and a general circulation model, ECCO which assimilates many of the same (and additional) data. Results indicate that 1) surface (outcropping) circulations are often different, 2) upper layer subsurface and intermediate circulations are more often similar in both character and magnitude, 3) and deep circulations are often quite different. The details of these similarities and differences are presented.

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from major river systems from the last glacial maximum (LGM) on into the future with emphasis on the influences of human activities and climatic change on the land-coastal margin system. As we came out of the LGM and atmospheric CO2 concentrations increased, net ecosystem metabolism (NEM) and net ecosystem carbon fixation (NEM) changed in response to climatic change and introductions of new nutrients to the ocean via rivers. The net air-sea exchange of CO2 in the coastal zone prior to extensive human influences on the land-coastal ocean system was from sea to air; soon that direction will reverse, if it has not already done so, driven by some extent by excess nutrients being added to coastal environmental from the land owing to human activities. NEM and NEC as we move into future centuries will be modified. Uptake of anthropogenic CO2 by the ocean will continue to acidify ocean waters and lead to potential changes in biogenic calcification rates and other effects on marine communities and carbonate sediment composition.

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BLOOD OR DORM: SURVIVING THE TRANSITION FROM MIXING TO STRATIFICATION

In seasonally stratified seas, the onset of stratification in spring traps nutrients and phytoplankton within the euphotic zone where photosynthetic light limitation is reversed, resulting in a phytoplankton bloom. To identify key acclimation strategies that occur in response to such a rapidly changing light environment, we simulated a stratification event to induce bloom formation in natural phytoplankton populations collected from a deep- mixed, low-nutrient water column in the Red Sea. By replicating light conditions within the surface, middle, and deep euphotic zone following stratification, our results show that acclimation responses to high and low irradiances differ substantially during a bloom. Fluorescence, cellular chlorophyll content, and photosynthesis-short term relationships suggested that photosynthetic acclimation is characterized by an initial lag, in which photo-protective mechanisms may continue to function in a circadian pattern indicative of acclimation to a previous light regime, followed by rapid acclimation to new growth irradiances. In contrast, cell growth did not require a lag period, and picoeukaryote and Synecococcus populations bloomed within several hours of exposure to new light regimes. Bloom processes are therefore rapid and dynamic, encompassing a combination of seasonal and photosynthetic acclimation processes that occur over a period of hours to days.

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INTERNAL WAVES ACROSS THE PACIFIC: THE ROLE OF SUBHARMONIC INSTABILITIES

As part of the Internal Waves Across the Pacific experiment, we conducted intensive shipboard and moored observations spanning 25-37°N (1600 km) along an internal tide emanating from the Hawaiian Ridge. Our goal was to understand the processes affecting the vertical propagation of the ocean's internal tides, and in particular their susceptibility to parametric subharmonic instability (PSI) at the critical latitude of 28.8°N. At the critical latitude, velocity and shear were observed to occur in intense vertically-standing, inertia-rotating bands of several hundred meters vertical wavelength, consistent with generation through PSI. These occurred in bursts following spring tide, and contrasted sharply with the downward-propagating, wind-generated features seen at other latitudes. Associated turbulent diffusivity is elevated by a factor of 4 or more over this latitude range, and by more than a factor of ten in what appears to be a strong tidal beam to the east. Details of the observed waves will be shown and implications for turbulent mixing in the global ocean discussed.

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ECOLOGICAL AND FUNCTIONAL RECOVERY OF SEDIMENTS ASSOCIATED WITH FINISH CAGE AQUACULTURE - DO SOME SYSTEMS COPE BETTER?

In Tasmania access to coastal water for finfish aquaculture is limited, consequently following of whole lease areas is rare and cage rotation within farms is a more common approach for managing sediment recovery. We compare and contrast the ecological and functional recovery response associated with short and long-term recovery at salmon farms in Tasmania. Although the benthic communities at the short-term (3 month) recovery locations showed a strong recovery response, the community structure did not return to that observed under reference conditions. Differences in recovery response were shown to directly reflect the background environmental conditions and indicated that sediments in some areas have a greater resilience to organic inputs. The longer-term recovery studies indicated that once the ecological function of the sediment was restored subsequent community changes were relatively minor, suggesting that restoration of system function may be a more useful indicator of generalized recovery from organic enrichment than commu-
nary equivalence. Implications for farm/environmental management will be discussed with reference to current key environmental issues and the need to understand the ecological effectiveness of current fa
ing protocols will be highlighted.

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THE INFLUENCE OF PERIMETER HABITAT ON AN ESTUARY: MODIFIED TRANSPORT IN A TIDAL CHANNEL DUE TO EXCHANGE WITH RECOVERING SALT MARSH IN SOUTH SAN FRANCISCO BAY

Exchanges between an estuary and its perimeter habitats are explored in this study by examining the impacts of salt marsh restoration on an adjacent channel. The channel restoration consists of breaching levees separating the tidal channel from subsided salt ponds for the first time in decades, effectively doubling the local tidal prism. The breaches allow mechanisms such as tidal trapping and tidal pumping to alter hydrodynamics in the channel, modifying transport of ecologically pertinent scales like salt and sediment. Field observations of velocities, salinity, temperature, depth, and suspended sediment concentrations were collected over four months at several locations in and near one levee breach in South San Francisco Bay. Analysis of these data establishes the existence of a buoyancy-driven, lateral exchange in the tidal channel induced by relatively saline waters that emerge from the breached salt pond during ebb tides. This exchange is further explored using a two-dimensional scalar transport model in an idealized domain. The results provide insight into the dynamics of estuarine transport as they are modified by exchange with perimeter habitats.

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ECOSYSTEM-BASED MANAGEMENT OF THE EVERGLADES-FLORIDA BAY ECOSYSTEMS USING INTERLINKED SIMULATION MODELS

Restoration of the Everglades and coastal Florida ecosystem complex follows an ecosystem-based management (EBM) strategy that relies on integrated, whole-system planning. The highest priority south Florida ecosystem includes Lake Okeechobee, Everglades River and Slough, Cypress Wetland, Marl Prairie, Mangrove Estuaries, Biscayne Bay and Florida Bay subsystems. This series of connected ecosystems is linked hydrologically by a slow-moving, shallow fresh water flow discharging into multiple estuaries. Relationships within the subsystems are dependent on hydrologic timing, quantity and quality, inundation schedule and connectivity. Design of the south Florida restoration plan relies on simulation modeling at all levels for evaluating strategies and predicting response to ecosystem changes. Though the ecosystem restoration plan rests largely on repairing hydrological function, models of hydrology, biogeochemistry, physiology, landscape processes, water quality, human impacts, and upper trophic levels are needed to develop a coherent restoration plan. The linkage of geochemical and biological processes models to hydrologic and hydrodynamic transport platforms creates a geospatial, landscape framework integrating bottom-up components with upper level consumers. This talk discusses the capabilities and limitations of such an ambitious simulation environment.

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CREATION OF AN INTEGRATED TOPOBATHY DEM FOR COASTAL AND OFFSHORE NORTH CAROLINA

The Renaissance Computing Institute (RENCI), at the request of the state of North Carolina Floodplain Mapping Program, and with funding from the Federal Emergency Management Agency (FEMA), is modernizing the floodplain maps of the state of North Carolina. This work is being conducted by computing a series of worst-case scenario flood models for coastal North Carolina using Octocore, RENCI’s IBM Blue Gene/L supercomputer. Over 500,000 Octocore computing hours will be needed to complete the work. As a part of this larger work, RENCI had to develop a new and more detailed integrated topo-bathymetric elevation dataset of coastal North Carolina. This paper presents the process used to create and quality control the single, integrated raster Geographic Information System (GIS) dataset that will be useful for a variety of purposes, including inundation modeling, mapping and other purposes. A single 1/3 arc-second (~10 meter) elevation grid was generated from multiple best available digital datasets in the region of different scales. It consists of 54,000 rows by 64,800 columns and 3,499,200,000 individual cells. The final raster file is as over 25Gb in size.

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REGIONAL OCEAN CLIMATE MODELING FOCUSING ON THE NORTH SEA- BALTIC SEA TRANSITION ZONE

The North Sea and the Baltic Sea form a semi-enclosed sea area, and are linked by a quite narrow and shallow transition zone. To make multi-decadal simulations of this area, it is essential to model the North Sea-Baltic Sea water exchange correctly. Hence the complex topography in the transition zone must be resolved. We use a 6-1 nautical mile two-way nested model, BSHcmod, to make climate simulations. The model has been used operationally to forecast sea level, currents, temperature, and salinity since early 1990s, and has a well-documented ability to simulate specific events in the area. Here, we present hindcast simulations and validation results, comparing our model with unique historical temperature and salinity records from lightships in the transition zone. The validation focuses on the model’s ability to simulate special events, especially inflow events to the Baltic Sea, and the model’s performance on seasonal, interannual, and longer time scales. This is the first climate simulation with this BSHcmod. In future studies we will compare the model output with simulations for the years 2070-2100.

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DEI VARIATION OF LIGHT ABSORPTION OF MARINE PHYTOPLANKTON ISOCYRIS GALBANA IN RESPONSE TO NITRATE CONCENTRATIONS

Light absorption of marine phytoplankton Isochrysis galbana in response to nitrate concentrations were examined under 12h:12h light:dark cycles. Isochrysis galbana was grown in a continuous culture with various concentrations of nitrate (800µM, 200µM, 100µM, and 50µM). Nitrate were replete in culturing vessel except 50µM experiment. At 50µM nitrate experiment, nitrate in the outflow was depleted (~1µM). In all conditions, chlorophyll a specific light absorption coefficient α(λ) had primary maximum at around 440nm throughout diel cycles. The α(440) at 440nm except for 50µM nitrate concentration exhibited diel variation with the maximum during light periods and the minimum during dark periods. Diel average of α(440) at 50µM was significantly higher than those at other nitrate concentrations. The average of α(440) for the nitrate replete experiments was highest at the highest nitrate concentration (p<0.01). This may suggest that light absorption efficiency per unit of chlorophyll a may increase with increasing nitrate concentration in the replete nitrate condition.

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CAPES AND FORM DRAG: THE ROLE OF STRATIFICATION

Capes and headlands are topographic features important for coastal circulation since they are associated with high values of mixing and dissipation. Phenomena like current separation, lee waves and generation of eddies has important biological consequences and influence the drag force being imparted on the larger scale flow. In this work, the effect of stratification on eddy generation past capes is investigated. We present a sensitivity study considering a steady barotropic current impinging on an idealized triangular headland in a rotating and linearly stratified environment. Numerical experiments are conducted using ROMS in a wide range of parameter space, consisting of the slope of the obstacle, the Burger and the Rossby numbers. The form drag exerted by the cape on the coastal current and the mixing downstream are calculated. It is found that the eddy shedding regimes depend on the Burger number. The form drag coefficient is expressed as a function of both the Burger number and the cape slope.

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SUBMESOSCALE FLUXES AND BIOLOGICAL PRODUCTION IN THE UPPER OCEAN

We explore the impact of submesoscale processes on the distribution and flux of biogeochemical tracers in the upper ocean using a numerical model. We characterize the vertical flux of nutrients for phytoplankton production in the euphotic layer in terms of stratification, wind stress, frontal strain, vorticity, and the ambient vertical gradient of the tracer. Horizontal transport across fronts is examined at frontal singularities. Vertical nutrient flux into the euphotic layer results in a phytoplankton production with a characteristic time scale for growth. The flux of nutrient and the distribution of phytoplankton are highly sensitive to the biological uptake time scale and are not necessarily coincident in time and space. Longer lived phytoplankton are found to accumulate not where fluxes are highest, but where mixing is weakest, e.g. at the centers of eddies formed by frontal meanders. We attempt to correlate the patterns in surface phytoplankton that are discernible from sea surface chlorophyll, with physical characteristics of the flow.

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PHYSIOLOGICAL AND COMMUNITY RESPONSE OF AUTOTROPHS TO SIMULATED UPWELLING OF NUTRIENT RICH DEEP WATER AT STATION ALOHA IN THE NORTH PACIFIC SUBTROPICAL GYRE

Between October 2005 and May 2007, seven mesocosms experiments (20L) were conducted in the North Pacific subtropical gyre, to examine the physiological and community
response of autotrophs to the addition of nutriment-rich deep seawater (750m, 5% vol.-vol.), the goal being to assess bloom dynamics and community structure in the oligotrophic region. Inorganic nutrients, size fractionated autotrophic biomass and rates of primary production, as well as community composition were monitored for up to 170 hours. Here, we show that although primary production increased during all experiments, community composition and size structure did not change significantly in 5 of the 7 experiments. The magnitude of autotrophic responses was water column-dependent on water column history, nutrient status and season. Parallel “nirrate only” experiments showed that up to 60% of the physiological response observed by adding deep seawater was due to the addition of inorganic nitrogen. These experiments demonstrate the unpredictable response of the autotrophic community to nutrient fertilization and emphasize our inability to predict bloom dynamics in the open ocean.

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OCEANIC GERMANIUM/SILICON FRACTIONATION: EVIDENCE FROM OCEANIC PROFILES AND DIATOM CULTURES

The cycling of inorganic germanium (Ge) in the ocean closely resembles that of silicon (Si). Here we present ten Ge and Si concentration profiles collected from the Atlantic and the Southwest Pacific Oceans. A plot of Ge concentration versus Si concentration produced a near-vertical line with a slope of 0.86±1.2 and an intercept of 1.16±0.6. When the Ge to Si ratio (Ge/Si) was plotted versus depth, higher values were observed in surface waters and the ratio declined with depth. Short-term Ge and Ge uptake experiments involving the marine diatom Minutocellulus polymorphus produced half saturation constants of 0.87±0.1 and 2.70±0.1, respectively. Azarn (1974) obtained similar results for the marine diatom Nitzschia alba. This suggests that the uptake of Ge is slower than that of Si and that the lower uptake efficiencies of Ge are related to the same fundamental mechanism leading to Ge/Si fractionation in diatoms, and ultimately the positive intercept in the Ge vs Si seawater relationship. If Ge/Si fractionation is driven by subtle differences during uptake then paleo-nutrient reconstructions utilising the Ge/Si signature of diatoms need re-examination.

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PHYTOPLANKTON COMMUNITY STRUCTURE IN THE SOUTHERN MID-ATLANTIC BIGHT: BASELINE MEASUREMENTS FOR THE WA-COOL PROJECT

Phytoplankton community structure in the southern Mid-Atlantic Bight was examined during a time-series of cross-shelf surveys from Wallops Island, Virginia, as a part of the Wallops Coastal Oceanic Observing Laboratory (Wa-COOL) program over the previous 8 years. Cruises were conducted approximately monthly on the RV Phillip N. Parker and covered a transect of five stations from 5.2 m to 21.7 m offshore. Dominant diatoms at the offshore station included Fossiulina, Saccharina, and Chaetoceros. Pseudonitzschia peaked during March 2007, with a density of 18.2x10^6 cells L^-1 at 5m depth. In the southwest section of the transect, but peaked in November 2006 to 1.5x10^7 cells L^-1 at 5m depth. Chaetoceros was most abundant in late summer, peaking at 9.6x10^6 cells L^-1 in late July 2007. Phaeocystis appeared in large numbers on the order of 6.9x10^7 cells L^-1 in surface samples in November 2006, and was typically observed in colonial form. This first year baseline study indicated the presence of harmful algal species during the spring, and also the presence of a nuisance algal species, Phaeocystis.

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ULTRAVIOLET RADIATION (UVB) EFFECT ON NATURAL PHYTOPLANKTON ASSEMBLAGES IN SAGAMI BAY, JAPAN

To assess the effect of solar ultraviolet radiation (UVB, 280-320 nm) on primary productivity and natural phytoplankton assemblages, samples were collected at coastal water off Manzuru, Sagami Bay, central Japan from August 2006 to March 2007. UVB and photo-synthetically active radiation (PAR) were determined in air. Samples were placed in acrylic aquariums and exposed to PAR+UVA+UVB and incubated with inoculation of Na_2SiO_3 at respective levels of 6.97x10^-2 and 9.60x10^-3 mol L^-1. Paramecia were present throughout the cruises, but peaked in November 2006 to 5x10^6 cells L^-1 at 5m depth. Thalassiosira was present throughout the cruises, but peaked in November 2006 to 5x10^6 cells L^-1 at 5m depth. Phaeocystis appeared in large numbers on the order of 6.9x10^7 cells L^-1 in surface samples in November 2006, and was typically observed in colonial form. This first year baseline study indicated the presence of harmful algal species during the spring, and also the presence of a nuisance algal species, Phaeocystis.

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EFFECT OF SMALL-SCALE TURBULENCE ON GRAZING AND GROWTH OF SEA URCHIN LARVAE

Small-scale turbulence may reduce food limitation in marine invertebrate larvae, with important implications for growth, dispersal, and recruitment. This study investigates whether small-scale turbulence reduces food limitation and enhances growth in larvae of the sea urchin Lytechinus variegatus. Short-term food conditions were exposed to steady laminar shear generated in simple Couette flow. Clearance and ingestion rates were determined based on changes in cell concentration of the unicellular alga Rhodomonas lens. Postlarval (PO), midline body (M), and stomach (S) lengths were measured as indices of growth. Clearance and ingestion rates were significantly different and increased nearly two times greater larval exposure to shear compared to still controls. But the effects of shear treatment on growth were more complex and may reflect age-specific differences in flow sensitivity. Biochemical analyses indicated that sheared larva had advanced to later stages of development compared to still controls. These results support predictions that turbulence, which increases encounters with prey, leads to increased grazing and growth. But biochemical markers may be more useful indicators of growth compared to morphological indices of development.

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PARALLEL NITROGEN CYCLES IN SOUTHWEST FLORIDAS TIDAL RIVERS: SELECTIVE REMINERALIZATION OF ALGAL MATERIAL SUPPORTS RECYCLING OF Bioassayable and recalcitrant nitrogen pathways and the flow of nitrogen from autotrophic production to fish biomass was investigated in naturally and anthropogenically influenced tidal rivers and tributaries in Southwest Florida. d15N composition of water column and sedimentary components were used to identify 1) the primary producers (plankton, benthic microalgae, vascular plants) that contribute to bulk sedimentary organic matter, 2) the types of organic nitrogen that support foodwebs via remineralization, and 3) the primary producers that support fish biomass. Strong isotopic linkages were found between 1) microalgae and sediment porewater ammonium, 2) living vascular plants and bulk sedimentary organic matter, and 3) microalgae and fish. These results suggest that of two distinct but parallel nitrogen cycles co-occur in these systems. The labile nitrogen cycle contributes to the fish trophic base either directly or indirectly via remineralization, while the recalcitrant cycle involves burial of low-nutrition vascular plant detritus. To safeguard processes that support valued fish production, resource managers must identify 1) the types of primary producers that support higher trophic levels and 2) the contribution of nutrient recycling and burial to the total nutrient load.

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INUNDATION ALONG SOUTH EAST COAST OF INDIA FOR 26TH DECEMBER 2004 TSUNAMI : FIELD MEASUREMENTS VS NUMERICAL MODEL

The tsunami generated by the 26th December, 2004 at Sumatra Mw = 9.3 earthquake inundated many countries along Indian Ocean and worst tsunami-related death toll in this decade. Field measured data have indicated the run-up levels varying from 1.5m to 5m in Andaman Islands and 3m to 7m in Nicobar Islands. In the case of south coast of India (Tamilnadu), it was between 2.8m and 6.0 m. Locations with gentle land slope showed penetration of seawater to long distances compared to steeper slopes. Inundation along south east coast of India (450 km) and Andaman Nicobar groups are among the highest ever documented for non-landslide generated tsunamis by us, where the high magnitude of runup and run up heights were measured in a short period using Real Time Global Positioning System without loosing the signatures. We model this event to confirm the estimated inundation, and we find that current state-of-the-art shallow-water wave models can predict tsunami inundation correctly including extreme runup. Results suggest that the predicted extreme inundation is more sensitive to land elevation and nearshore bathymetry. We used the Airborne Lidar Terrain Mapper (ALTM) data with an accuracy of 0.35m for land elevation and model results compared for three sites indicated good agreement. Also, analysis of bathymetry collected pre and post Tsunami indicated that the tsunami wave caused changes in the seabed morphology, sediments removed from offshore long shoals are deposited in nearshore.

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NEW INSIGHTS INTO QUATERNARY SEA LEVELS AND ISOSTASY BASED ON OPTICAL DATING OF SILICICLASTIC PALEO-SHORELINE FEATURES ON THE U.S. ATLANTIC COASTAL PLAIN

Improvements in geochronological techniques now allow for more precise dating of siliciclastic coastal lithosomes that have the potential to provide many more sea-level index
points (SLIPs) for the Quaternary Period. These techniques include optically stimulated luminescence (OSL) and electron spin resonance dating (ESR). This investigation uses these new dating tools in conjunction with ground penetrating radar (GPR) and sedimentological data to establish the age and relative sea level (RSL) as recorded by stranded coastal lithosomes (Holocene and Pleistocene beach ridges) in North Carolina and Florida. Sites have been cored using vibracore and geoprobe techniques, sampled for granulometric and radiometric analysis, and surveyed using GPR. These coastal deposits consist of silicilastic or mixed carbonate silicilastic sands. However, due to intense subaerial weathering, the carbonate sediments are typically too badly altered, or too scarce to acquire meaningful U-series dates. Granulometric and GPR data are being used to indicate the elevation of the beach ridges - surf zone transition, which provides a datum for determining RSL. These data are being used to refine the Quaternary relative sea-level record of the SEUS Atlantic Plain and, by comparison to other Quaternary sea-level data and isotopic models, will help to refine models of mantle and lithosphere rheology and isostasy.

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SOUTHERN PUGET SOUND DISSOLVED OXYGEN STUDY - AN OVERVIEW

The Washington State Department of Ecology has embarked on a comprehensive study of South Puget Sound to understand the relative influence of various natural and anthropogenic sources of nitrogen near bottom dissolved oxygen levels. This fjord-type estuary has low DO levels that occur in late summer and that violate state water quality standards. The first phase of the study indicated that both point sources from wastewater treatment plants and nonpoint sources from both uplands and downlands contribute significant nitrogen loads. The current project further refines those loads of nitrogen and other parameters. Data collection includes marine water column data collected monthly from 80 marine stations, watershed and wastewater treatment plant inputs, boundary conditions, current fields, and benthic fluxes. A three-dimensional circulation and water quality model will enhance understanding of how nitrogen moves around South Puget Sound and the relationships with dissolved oxygen levels. The calibrated model will be applied to a variety of management actions to determine how much point and nonpoint source nitrogen loads must be reduced to meet water quality standards.

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DEVELOPING A EUROPEAN OCEAN COLOUR SERVICE SUPPORTING WATER QUALITY ASSESSMENT AND OPERATIONAL OCEANOGRAPHY

The Water Framework Directive (WFD), started to be implemented in Europe in 2000. As the European directive that provides guidelines on the management of water resources, it clearly defines environmental objectives in terms of water quality for lake, river, underground and characteristic coastal waters (so-called water masses). Several initiatives have been performed, under ESA support and in the context of GMES, to apply Ocean colour techniques from space to operational management of coastal water quality with relevant results obtained at local, regional and European scales by using such techniques. These experiments have opened the door to reliable services for water quality monitoring and their extension at global level through Ocean colour data merging. This will be the basic component of the global Ocean colour Thematic Assembly Centre that is presently put in place by EU to support operational oceanography and shall have a significant role in the building of the Global Earth Observing System of Systems.

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TOWARDS MODELING THE CARBON CYCLE OF THE ARCTIC OCEAN

We use a numerical model to examine the fate of riverine fluxes of dissolved organic carbon (DOC) in the Arctic Ocean. The model is based on the Arctic sector of an eddy-permitting ocean model (MITgcm), where spherical geometry is projected onto a cube to avoid polar a singularity in the Arctic region. The physical model is forced by time-varying NCEP re-analysis products and an explicit representation of fresh water run-off in the Arctic region. Passive tracers and idealized
estimated with satellite-derived products from OCTS, SeaWiFS, AVHRR, and the VGPM primary productivity algorithm. These results were compared with the distribution and abundance of three pelagic species within the California Current System, Humboldt jumbo squid (Dosidicus gigas), sardine (Sardina pilchardus), and yellowfin tuna (Thunnus albacares). Fronts and primary productivity are key ocean process linked with a variety of biological processes that may directly or indirectly enhance population success. Our analysis, conducted in the last few years, suggests different responses of these three species to interannual ocean-climate variability. Humboldt jumbo squid and sardine have progressively expanded poleward, which is most likely explained by latitudinal change of favorable conditions, which are discussed in this presentation.

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PARTICULATE AND SEDIMENT ORGANIC MATTER IN TWO CANADIAN ESTUARIES INVESTIGATED BY SOLID-STATE NMR: VARIATIONS OF CHEMICAL STRUCTURES WITH LOCATION AND DEPTH

We used advanced solid-state NMR, especially new spectral-editing techniques, to investigate chemical structures of five humic acids (HAs) from particular organic matter at different depths and sediment organic matter in the Saguenay Fjord and St. Lawrence Estuary, Canada. Despite different locations and depths, the five HAs were found to have a common structure: peptides, aliphatic chains, aromatics, and sugar rings. Advanced NMR presented structural information such as a small proportion of N-heterocycles, and very mobile aliphatic chains in close proximity to the other structural components. A major bacterial contribution to these samples could explain why the samples, which had different dominant organic matter sources (terrestrial vs. marine), were similar. Nevertheless, some significant structural differences were observed for HAs from the same depth and those from sediments at two locations: HAs in the Saguenay Fjord had more aromatic/olefinic carbons and lower aliphatics than corresponding HAs in the St. Lawrence Estuary, suggesting more lignin input for organic matter in the Saguenay Fjord. With increasing depth, aliphatics decreased while aromatics and aromatic C-O groups increased, suggesting that diagenetic alterations occur with depth.

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MULTIPLE EQUILIBRIUM STATES AND ABORTED TRANSITIONS IN TIDAL ECO-MORPHOLOGY

Changes in relative sea level, sediment loading, and ecological characteristics expose tidal landforms and ecosystems to responses which may or may not be reversible. Here we present a point model of the joint evolution of tidal landforms and biota, including the dynamics of intertidal vegetation, benthic microbial assemblies, erosional and depositional processes, local and general hydrodynamics, and relative sea-level changes. Alternative stable states and abrupt transitions among them emerge, governed by vegetation type, disturbances of the benthic biofilm, sediment availability and marine transgressions or regressions. Multiple equilibria are the result of the interplay of erosion, deposition and biostabilization, highlighting the importance of the coupling between biological and sediment transport processes in determining the evolution of a tidal system as a whole.

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LONGITUDINAL CHANGES IN THE QUALITY OF DISSOLVED ORGANIC CARBON IN THREE TROPICAL WATERSHEDS

Dissolved organic carbon (DOC) is considered the most important source of energy of river ecosystems, including tropical rivers. The source of allochthonous organic matter inputs to rivers can be either natural or anthropogenic. It is hypothesized that the source can also affect the quality or biodegradability of the DO. This research pretends to perform nutrient amendment experiments in the eastern (140°W) and western (165°E) equatorial Pacific with a particular emphasis on measuring the changes in C, N, and Si incorporation during the enhanced phytoplankton growth. Iron and silicic acid additions at 140°W caused the greatest growth response (10-fold increase in 122-fold increase in 14C uptake rates) with the resulting biomass composed primarily of diatom diatoms. Combined iron, nitrogen and phosphate concentrations at 165°E caused the greatest growth response (3-fold increase chla and 16-fold increase in 14C uptake rates) with the resulting biomass composed primarily of photosynthetic picophytoplankton. We will compare between the regions, the changes in (1) phytoplankton biomass and composition—assayed by size-fractionated chla and particulate organic matter, biogenic silica, flow cytometry and diatom enumerations and (2) productivity—assessed by C, N (nitrate, ammonium and dinitrogen gas) and Si uptake rates and maximum photochemical yields—before and after nutrient amendments.

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CHARACTERIZATION OF SEABED GEOMETRY IN A FREE SURFACE WAVE ENVIRONMENT

The goal of this effort is to increase our understanding of seabed geometry induced by free surface gravity waves. Observations of seabed geometry and wave characteristics were obtained at two water depths (1.723 m and 1.625 m) during the collaborative 2005 CROshShore Sediment Transport EXperiment (CROSTEX) at Oregon State University. Seabed elevation and beach slope observations were obtained with a two-axis scanning acoustic backscatter sensor. More detailed ripple geometry observations were measured with a submersible PIV system. The free stream velocity time series was measured with an Acoustic Doppler Velocimeter (ADV) located 60 cm above the bed. In this effort, we examine the impact of offshore wave characteristics (wave height and period) and local beach slope on ripple geometry and migration. Offshore wave heights ranged from 20 to 60 cm and peak periods ranged from 4 to 8 seconds. The observed ripples are of the anisotropically type and are consistent with the field observations of Crawford and Hay. The observations show that increasing wave energy results in a general flattening of the seabed.

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ACROSS-SHORE EDDY TRANSPORT OFF CENTRAL CALIFORNIA

The mesoscale and submesoscale eddies on the across-shore transport observed off Central California was studied using 65 isobaric RAFOS float launched in the California Undercurrent between 150 and 600 m in 1992-2004. The floats typically move poleward for some period of time, perhaps reversing direction for short periods, but eventually escape the undercurrent and move to the west where they enter a region dominated by mesoscale and submesoscale motion. The kinematics of this eddy-dominated region are studied here. About 50 loops, i.e. floats which demonstrated two or more consecutive rotations of the same sign, have been identified from the data, most of them (>75%) trapped in anti-cyclonic eddies travelling roughly westward. Assuming that the looping floats were translated by nonlinear eddies, their geographic distribution, mean period of rotation, characteristic swirl velocity, size, and eddy kinetic energy were estimated. Trajectories are also compared with the motion of persistent depressions of the sea surface as measured by satellite altimeter.

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AN EDUCATIONAL WEB-BASED OCEAN CURRENT REFERENCE SITE

An educational web-based ocean current reference site is being constructed. Each major ocean current has a listing of important links, text and data plots. The text provides a detailed summary of observed velocities, transport, salinity, temperature, water mass characteristics, and seasonal variability for each current. Data plots include average and seasonal surface summary of observed velocities, transport, salinity, temperature, water mass characteristics, and seasonal variability for each current. These results were compared with the distribution and abundance of three pelagic species within the California Current System, Humboldt jumbo squid (Dosidicus gigas), sardine (Sardina pilchardus), and yellowfin tuna (Thunnus albacares).
Johnson, R. Marshall, H. G. corroborate other USGS cores from the freshwater Everglades. The pre-drainage salinity reduced more than Shark River Slough. The hydroperiod estimates from model output reduced significantly over pre-drainage estimates, with the Taylor Slough hydroperiod season. Stage values in both Shark and Taylor Sloughs are about 0.15 meters lower on flow into the Everglades is about 2-2.5 times lower than it was during the pre-drainage to estimate pre-drainage stage and flow conditions in Shark River Slough and Taylor used to develop an estimate of the salinity regime in Whipray Basin prior to about 1900. Paleoecological data from were collected and interpreted by the USGS and US Fish and Smith, D. T. Marshall, F. E. an explicit eddy energy budget following the above procedure. Extensions of this approach circulation model in which the Gent and McWilliams eddy closure is modified to include parameterized eddies. Preliminary results will also be presented from an ocean general calculation and freely decaying turbulence in ocean basins, with both explicitly resolved and parameterized some necessary ingredients to parameterize the gross effects of eddies in both forced-dissipative and freely-decaying turbulence. An important issue concerns parameterization of the dispersion and dissipation of the eddy energy, for which some simple schemes are suggested. These ideas are illustrated through applications to wind-driven circulation and freely decaying turbulence in ocean basins, with both explicitly resolved and parameterized eddies. Preliminary results will also be presented from an ocean general circulation model in which the Gent and Williams eddy closure is modified to include an explicit eddy energy budget following the above procedure. Extensions of this approach to include angular momentum constraints will also be discussed.

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THE USE OF STATISTICAL MODELS WITH PALEOSALINITY DATA TO SIMULATE THE PRE-DRAINAGE HYDROLOGY IN THE GREATER EVERGLADES ECOSYSTEM
Paleocological data from were collected and interpreted by the USGS and US Fish and Wildlife Service from Whipray Basin in Florida Bay. After interpretation, these data were used to develop an estimate of the salinity regime in Whipray Basin prior to about 1900. Statistical models coupled salinity in Whipray Basin and the hydrology in the Everglades to estimate pre-drainage stage and flow conditions in Shark River Slough and Taylor Slough. The overall mean values produced by the models indicate that existing freshwater flow into the Everglades is about 2-2.5 times lower than it was during the pre-drainage period. The deficit in Taylor Slough is much greater than Shark River Slough in the dry season. Stage values in both Shark and Taylor Sloughs are about 0.15 meters lower on average now than during the pre-drainage period. The average hydroperiod has also been reduced significantly over pre-drainage estimates, with the Taylor Slough hydroperiod reduced more than Shark River Slough. The hydroperiod estimates from model output corroborate other USGS cores from the freshwater Everglades. The pre-drainage salinity regime throughout Florida Bay was also estimated.

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RE-OCCURRING HARMFUL ALGAL BLOOMS IN THE TIDAL RIVERS OF VIRGINIA, U.S.A.

A total of 37 potentially harmful algal have been identified for the Chesapeake Bay estuary transect. (Marshall 2007). Of note, is the increased occurrence of Cochlodinium polykrikoides in the James and Elizabeth rivers following a 1992 Chesapeake Bay bloom that entered these sub-estuaries. This intrusion established fertile seed beds containing C. polykrikoides cysts; the source of subsequent blooms that annually have perpetuated this pattern, resulting in an increased occurrence of its blooms in these waters. Highest local pre-1992 abundance recorded was 5-6 cells ml⁻¹, today bloom levels reach 1-15 x10⁶ cells ml⁻¹. Also a 2007 York River C. polykrikoides bloom (1,170 cells ml⁻¹), included as a co-dominant Alexandrium monilatum at 1,200 cells ml⁻¹. PCR analysis of Karlodinium venenatum has indicated this taxon is widely distributed in Virginia tidal waters, including numerous rivers and streams. This species produces an extensive and long lasting bloom and estuaries bordering the Potomac River in 2007 from mid-June into August. Concentrations reached 337 x10⁶ cells ml⁻¹. These blooms were also frequently accompanied by high concentrations of Akashiwo sanguinea, Heterocapsa rotundata, and/or Prorocentrum minimum.

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RECENT DEVELOPMENTS IN THE STUDY OF EDDY STIRRING AND MIXING IN THE SOUTHERN OCEAN
We review recent progress in the understanding and mapping of mesoscale eddy stirring in the southern ocean placing emphasis on the interplay of observations and theory. In particular we discuss: (i) the spatial distribution of mixing zones and barriers and their relation to the geography of the oceans potential vorticity field and steering levels in the southern ocean. (ii) the vertical variation of the eddy stresses and its interplay with the applied surface wind stress in setting the meridional overturning circulation of the ocean. (iii) Implications of the above for the forthcoming DIMES southern ocean mixing experiment.

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IN SITU MEASUREMENTS OF DIEL VARIATIONS IN BARREL SPONGE RESPIRATION FROM NOAAS AQUARIUS UNDERWATER OBSERVATORY ON CONCH REEF, FLORIDA KEYS (USA)
The barrel sponge Xestospongia muta accounts for approximately 60% of sponge biomass in a 660m2 area on Conch Reef off Key Largo, Florida Keys. Respiration by X. muta generally results in a 5-15% oxygen drawdown in the huge volumes of ambient water pumped through the sponge and released as excurrent flow and thus can significantly lower concentrations in the overlying water column. Excurrent DIN fluxes resulting from organic matter consumption during respiration far exceed those from coral substrate and sediments. During 2005 and 2007 missions using the Aquarius underwater observatory, chemical transformations and fluxes resulting from X. muta respiration were quantified for periods of hours to several days by coupling dissolved gas measurements with acoustic Doppler velocimetry measurements. Three different instrument arrays, including Clark sensors and an in situ mass spectrometer, were utilized to continuously measure dissolved gases including O2 (mass 32), N2 (28), Ar (40) and CO2 (44, 45). The stoichiometries of CO2 consumption, CO2 production and DIN release are utilized to quantify the role of barrel sponges in total respiration and C and N cycling on the reef.

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NUMERICAL MODELLING OF THE INTERACTION OF INTERMEDIATE WAVES WITH BATHYMETRY USING ADAPTIVE MESH TECHNIQUES
Internal gravity waves can provide a sufficient source of energy to activate strong diapycnal mixing in the near-surface of open ocean. Our model is motivated by the desire to study wave breaking and subsequent mixing; and the effect of the depths of the thermocline and shelf-break on the transport of colder nutrient rich water up onto continental shelves, with important implications for bioproductivity. We present two- and three-dimensional results of numerical investigations of internal wave breaking using the Imperial College Ocean Model (ICOM), a non-hydrostatic, finite-element model that includes anisotropic mesh adaptivity. The ability of the model to focus resolution where it is most needed in response to the evolving flow makes ICOM an ideal tool to study the small-scale processes that result from the interaction of internal gravity waves with bathymetry. We examine: (1) the interaction of internal waves with idealised and realistic bathymetry, in particular wave-breaking and subsequent mixing; and (2) the effect of the depths of the thermocline and shelf-break on the transport of colder nutrient rich water up onto the continental shelf.
Fish assemblages in urban areas are commonly characterized by a dominance of non-native species over time. This life history strategy might benefit native species by providing different environments thus reducing the negative impacts of urbanization. In this study we characterized fish assemblages in the Río Piedras Basin, one of the most urbanized watersheds in Puerto Rico. Ten sites were sampled using backpack electrofishing. All individuals were counted and identified on site. We found a mixture of native and non-native species at all sites. A total of 9 species were found. Half of them were native. Results indicate that streams within this highly urbanized watershed support a diverse assemblage of fishes and that native species are still abundant, potentially due to their catadromous life history.

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IMPACT OF SAHARAN DUST ON THE CIRCULATION OF THE NORTH ATLANTIC

Satellite images regularly show dust clouds entering the eastern tropical North Atlantic from the Sahara. Generally, Sahara dust can impact the ocean through two processes: (1) by reducing the solar insolation with associated cooling of the surface water and (2) by enhancing primary productivity and thereby altering the absorption of solar radiation in the upper ocean. Knowing the importance of either of these processes is important for understanding the feedback mechanism between dust and the physical and biogeochemical ocean. In this talk we present an analysis of the dynamical response of the ocean due to dust forcing. The problem is studied by forcing the MITgcm with perturbations in solar radiation observed from observed dust concentrations. The response can be rationalized in terms of fast propagating to the trade winds, and also Kelvin waves that are triggered by dust-induced cooling. Associated sea surface high anomalies propagate first northward and then around the entire basin within 1 month of simulation. Atlantic heat transport anomalies at different latitudes and the perturbations in the Atlantic MOC stream function react to the dust forcing through this propagating density anomaly

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INTEROPERABILITY BETWEEN SEA-SONDE AND WELLEN HF RADARS IN THE FLORIDA CURRENT

A dual-station high frequency (HF) Wellen Radar (WERA) transmitting at 16 MHz have been observing near-real time surface currents over a range of 100 km in the Florida Straits since July 2004. A pair of 25 MHz Sea-Sonde HF radar were deployed by the NOAAs Center for Operational Oceanographic Products and Services south of WERA sites during a period of 10 days in April 2005. The Sea-Sonde grid produced overlapped the southern portion of the WERA domain. During the same period of time, a moored acoustic Doppler current profiler (ADCP) obtained subsurface current measurements within these HF radar grids starting at 14-m. To examine this question of interoperability between beam-forming and direction-finding technologies, comparisons of radial and vector currents for an 8-day concurrent time series were made suggesting good agreement in direction in both domains where maximum surface currents of about 1.4 m s⁻¹. In the core of the radar domains, hourly vector currents were obtained by combining radials from these radars and compared and will be discussed relative to the ADCP measurements.

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INVESTIGATING HISTORICAL LAND USE WITHIN THE MANATEE RIVER WATERSHED

The Tampa Bay estuary has become severely altered by anthropogenic activities. There are few studies that link changes in the Manatee River Watershed to changes in land use. The objective of this project is to examine historical land use in Southeast Tampa Bay.
Sediments, water samples, and water quality measurements were collected near Native American middens located in Emerson Point Park to provide insight regarding historical land use of the Manatee River Watershed. Sediments were analyzed using gamma spectrometry techniques as well as lithologic characteristics including grain size, total organic content and carbonate content. Standard Inductively Coupled Plasma and Optical Emissions Spectrometry methods have been used to determine concentrations of trace, minor and major elements in the sediments related to land disturbances. The geochemical record will reflect the impact of land use prior to the industrial age through modern day. This project is part of a larger on-going investigation. If successful, this investigation will ultimately yield a tool for determining the effect of anthropogenic activity on the watersheds of Southeastern Tampa Bay over the last one hundred years.

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FISH HEALTH IN A TROPICAL URBAN WATERSHED
Urban land use impacts streams by altering their hydrology and geomorphology resulting in reductions in biodiversity. Riparian deforestation, sewage discharges, and increased nutrient loading are some of the factors driving ecological degradation. The fish community reflects these impacts. In this study, we evaluated fish health in an urban watershed in Puerto Rico, which is characterized by having a migratory native fish fauna that closely connects with the ocean. The objective was to evaluate fish community health and condition in the Rio Piedras basin. We sampled fish in ten streams reaches and recorded external abnormalities (deformities, lesions and ulcers, tumors) and parasite infections. Native fishes did not present morphological damages. In contrast, exotic fishes showed external abnormalities, like tumors in anal fins. The migratory behavior of native fishes and the constant recruitment of juveniles from estuaries provide native fishes with a strategy to potentially reduce the negative impacts of urbanization on their populations. Alternatively, native fishes could be tolerant to the impacts of urbanization. Overall, our study indicates that native fishes are healthy suggesting a large potential for management and restoration of urban river ecosystems in Puerto Rico.

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LOCAL AND REMOTELY-GENERATED INTERNAL WAVES ON THE OREGON CONTINENTAL SLOPE
Turbulence observed on the Oregon continental slope, which is strong enough to be of potential importance to global mixing budgets, is hypothesized to result from the breaking of locally- and/or remotely-generated internal waves. To determine which, a moored and shipboard field program was conducted in full 2005. Semidiurnal energy fluxes are obtained from harmonic fits to horizontal velocity and vertical displacement profiles from McLane Moorled Profilers on 5 moorings, deployed for 40 days in a zonal line across the continental slope at 43.215° N. The direction and magnitude of zonal energy fluxes are temporally- and spatially-variable. At times, onshore semidiurnal fluxes converge as internal waves generated at remote sites shoal onto the continental slope. At other times, fluxes diverge between the shallowest moorings indicating a local source. Refraction and/or scattering of the internal wave field to higher wavenumbers on ‘rough’ or near-critical slopes is thought to be the cause of enhanced dissipation. Observations are presented and implications for the observed mixing are discussed. Observations are presented and implications for the observed mixing are discussed. More, recently, there are few studies directly related to this topic. The study site was used to investigate a historical record of contaminants at the study site. This information will also be used to provide information regarding historical regional climate and terrestrial land use changes.

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INTERCOMPARISON OF VARIOUS GLOBAL EVAPORATION PRODUCTS
Fresh water flux consists of two components, i.e. precipitation and evaporation. Since ocean reserves huge amount of water, the evaporation over the ocean is expected to play an important role in global water cycle. However, studies related to evaporation are not so many compared with those related to precipitation. Recently there are several products of global latent heat flux over the ocean. The products include reanalysis data (e.g., NRA, ERA and IRA), in situ data (e.g., NODC and ICOADS), satellite-derived data (IOHAPS, GSTST and J-OFURO) and hybrid data (OAIfux). We can obtain evaporation using latent heat flux data. While there are some studies of intercomparison of global latent heat flux data over the ocean, for example, Kubota et al. (2003). However, their analysis covered only several years. Moreover, there are few recent studies directly related to evaporation over the ocean. In this study, we compare various global evaporation products. The analysis period is from 1988-2000. The temporal and spatial resolutions are monthly and 1 degree, respectively.

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ACOUSTIC SIGNATURES IN A FORECASTING OCEAN MODEL
Global and regional ocean models run operationally at the Naval Oceanographic Office (NAVO), such as a suite of Navy Coastal Ocean Models (NCOM), provide a wealth of nowcast and forecast information of ocean features on varying resolutions. Recently, efforts have been made to translate the ocean physics contained in these models into products that provide horizontal and temporal variability of the acoustic signature of an area. Variables such as Mixed Layer Depth (MLD), Sonic Layer Depth (SLD), Below Layer Gradient (BLG), and In-Depth Gradient (ILG) have been used to provide a basic understanding of ocean feature location, structure, and acoustical significance. In particular, the western Philippine Sea and East China Sea regions will be discussed using model results validated against recent observations. These regions allow for assessments of variations in acoustic signatures caused by boundary currents, eddies, and internal tides, plus the effect of temporal variations due to atmospheric forcing.

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ACCELERATED ARCTIC WARMING - A WORKABLE INTERPRETATION AND FUTURE PROJECTION
Despite of the recent Arctic sea ice melt, its causes and effects are not fully understood and require improved knowledge of interactions and feedbacks in the Arctic system. To address some of these outstanding issues, results from a high resolution coupled ice-ocean model of the pan-Arctic region are analyzed to investigate causes and variability trends of Arctic sea ice cover and the regional climate system. Our model results, validated against submarine
and satellite observations, suggest that the rate of melt represented by sea ice thickness and volume might be faster than that of ice extent/concentration. We find that the recent decrease of sea ice cover is partially due to an anomalous sea ice export through Fram Strait in the mid-1990s. This has been followed by the increased advection of warm Atlantic and summer Pacific waters into the upper Arctic Ocean, which acts to increase thermodynamic interactions at the ice-ocean interface as well as feedbacks to the atmosphere. We conclude that sustained high resolution modeling studies of regional Arctic climate are necessary and critical to advance understanding and prediction of Arctic environmental change.

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THE ASSESSMENT OF DISSOLVED ORGANIC MATTER BIOLABILITY IN LOTIC SYSTEMS

The “River Continuum Concept” suggests that the nature of DOC can vary in lotic systems as a function of flow and load in a watershed. Headwater sites can be dominated by humic DOC mainly of terrestrial origin. Downstream sites usually have DOC derived from more autochthonous sources. The biolability of DOC can be expected to vary along a river system in accordance with its source. In this study we use a batch culture technique to assess the biolability and metabolic growth efficiency for DOC along a continuum of the Lehigh and Delaware Rivers, Pennsylvania, USA. DOC consumption rates varied significantly between the headwater sites in the upper Lehigh watershed (0.17 % / week) and a site along the lower Delaware River (2.84 % / week). Bacterial growth efficiency also varied. DOC consumption rates and RGE both decreased with increasing stream order. This is likely due to differences in DOC quality, which have been observed using spectral absorbance and fluorescence techniques. Comparisons will be made between DOC consumption rates obtained using batch cultures and those made using plug-flow bioreactors, which were performed simultaneously.

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A HIGH-RESOLUTION NUMERICAL MODEL STUDY AT THE CANARY ISLANDS

The Canary Islands off the northwest African coast perturb the southwestern flowing Canary Current. The complex island circulation is revealed in studies based on satellite imagery and in situ data. Island-generated eddies interact with filaments of cold upwelling water that extend from the coast. Understanding of these mesoscale features is limited by the sparsity of data available. Few modelling studies exist for the region, none specifically to address the island circulation. At ULPGC/UCLA a high-resolution regional ocean model (ROMS) configuration has been developed to study the dynamics in this region. A large domain (10-km resolution) covers the NE Atlantic, feeding two successively finer domains (ROMS) configuration has been developed to study the dynamics in this region. A large domain (10-km resolution) covers the NE Atlantic, feeding two successively finer domains

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GREATER ORGANIC PHOSPHORUS UTILISATION IN THE NORTHERN SUBTROPICAL GYRE

The northern and southern subtropical gyres of the Atlantic Ocean have distinct biochemical regimes, with depleted phosphate in the North Atlantic subtropical gyre (NASG). Our observational surveys reveal that within the gyres dissolved organic phosphorus (DOP) provides the dominant surface pool of available P, accounting for 94±4% of total dissolved phosphorus in the NASG and 49±12% in the Southern subtropical gyre (SASG). In order to assess the utilisation of DOP we investigate the kinetics of the enzyme alkaline phosphatase (APA), which releases inorganic phosphorus from DOP for uptake. There is a reduction in the bioavailability of DOP from late spring to autumn, in both gyres. Enhanced production in spring releases fresh labile DOP which is subsequently removed via plankton uptake. APA activities show that utilisation of DOP in the NASG is significantly higher than in the SASG, and increases 3-fold in late spring from 1.15 to 3.43 nmol P L⁻¹ h⁻¹. Concurrently we observe a seasonal NASG decrease in DOP of 60%. We invoke nitrogen fixation in the NASG to deplete phosphorus and drive the utilisation of DOP, maintaining production.

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NET COMMUNITY PRODUCTION AND THE BIOLOGICAL PUMP IN THE WESTERN ARCTIC OCEAN

The Chukchi shelf is the site of some of the highest rates of primary production in the global ocean. In late summer and spring of 2002, rates of net community production over the shelf were as high as 2,000 mg C m⁻² d⁻¹, and averaged 800 mg C m⁻² d⁻¹ across the entire shelf. Using conservative tracers to construct a carbon mass balance, we found that 10% of the DIC consumed during net community production was converted to DOC and 15% was converted to suspended POC. The remaining 75% was exported from the mixed layer as sinking organic particles. At the termination of the bloom, nutrient concentrations had been reduced to near zero and most of the organic matter had been exported from the mixed layer, leaving surface waters undersaturated with respect to atmospheric CO₂. Presently, these shelf surface waters are transported offshore beneath the permanent ice cover before any significant re-equilibration with atmospheric CO₂ can occur. As such, the biological pump on the Chukchi shelf plays an important role in conditioning the highly oligotrophic waters of the Canada Basin. If the forecasted reduction in Arctic sea ice occurs then this basin will initially act as strong sink for atmospheric CO₂ by allowing the re-equilibration. However, the depletion of nutrients from shelf processes will continue to limit any significant biological activity prohibiting the deep central Arctic Ocean from being a long term sink of that CO₂.

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NOAA NESDIS MULTI-SEA SURFACE TEMPERATURE ANALYSIS

NOAA NESDIS has been in the process of developing a new high-resolution (0.1° x 0.1°) global SST analysis to replace the previous 100-km, 50-km and 14-km (regional) products. The new scheme, which uses a recursive estimator to emulate the Kalman filter, also provides continuously updated uncertainty estimates for each analysis grid point. Since the analysis is entirely satellite-based, there is no explicit attempt to correct regional

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biases to an in situ standard. However, biases between individual datasets are corrected in a statistical manner, with certain assumptions of persistence and correlation length scale. The operational polar-orbiting satellite’s Advanced Very High Resolution Radiometer (AVHRR) and the Geostationary Operational Environmental Satellite (GOES) imager are the current satellite SST datasets used in the analysis, although there are plans to incorporate data from other geostationary sensors (MT-SAT and Meteosat-9) and microwave instruments. We show the results in situ data and other analysis products. This product is running pre-operational at NESDIS and is planned to be transitioned to operations in January 2008.

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ANTHROPOGENIC CARBON UPTAKE IN A NEWLY CONFIGURED INTERMEDIATE COMPLEXITY CARBON-CYCLE CLIMATE MODEL

Reliable quantification of the anthropogenic carbon budget is an important goal in the carbon cycle modeling community. The usual trade-off between computational efficiency and spatial resolution provides a niche for intermediate complexity models that high resolution models cannot fill. Here we use a modified version of GENIE (Edwards and Marsh, 2005; Ridgwell et al., 2007), a global carbon-climate model of intermediate complexity, to investigate the mechanisms of the oceanic uptake of anthropogenic carbon. Our modifications include changes in the vertical resolution and depth-dependent vertical diffusivities in the physical model as well as a more prognostic representation of ocean biology. One of our foci is the effect on carbon uptake of riverine flux of anthropogenic nitrogen, carbon, and alkalinity.

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OCEAN CLIMATE VARIABILITY AND WATER MASS VARIABILITY IN THE REANALYSES OF THE MERRA MULTIVARIATE OCEAN VARIATIONAL ESTIMATION (MOVE) SYSTEM

Salinity field estimation is a key issue for reproducing realistic ocean state by data assimilation. For practical implementation of a multivariate analysis scheme we adopted a coupled temperature-salinity empirical orthogonal function model decomposition for the background error covariance matrix in a Meteorological Research Institute ocean data assimilation system. Salinity field is reproduced well by using information of temperature and remote-sensed sea level observation through the multivariate analysis scheme. We conducted reanalysis experiments for global ocean and the North Pacific. Periods of the reanalyses are 1948-2006 for global ocean and 1955-2005 for the North Pacific. Using these reanalyses, we investigated climate variability in the South Pacific ocean and trends in the water mass variability (e.g., North Pacific Tropical Water) have been investigated. Interannual variability of oceanic heat content in the North Pacific subtropical gyre is connected with variability of wind stress curl. Distribution of the salinity maximum, which characterizes North Pacific Tropical Water (NPTW), is controlled by variability of the shape of the subtropical gyre, and variability of the salinity maximum is concerned with freshwater influx in the NPTW formation region.

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TOPOGRAPHIC EFFECTS ON DENSE GRAVITY CURRENTS

Around Antarctica, cold and saline waters created at coastal polynyas descend on coastal slope and exported to deep ocean as Antarctic Bottom Water, the densest water in the world ocean. The direction of downslope gravity current tends to be parallel to isobaths due to Coriolis force, so the dense water is hard to descend after the front of the dense water is geostrophically balanced. Observations suggest that topographic barriers break such balance and control where and how much of the dense water descend to the bottom. Using a high resolution nonhydrostatic model, we study the topographic effects on dense gravity currents. Under an idealized setup, sensitivity of the down-sloping water to topography and depth-dependent vertical diffusivity in the physical model as well as a more prognostic representation of ocean biology. One of our foci is the effect on carbon uptake of riverine flux of anthropogenic nitrogen, carbon, and alkalinity.

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CALIFORNIA CURRENT

The California Current is a unique oceanic system that exhibits a complex balance of physical and biological components and plays a key role in the global climate system. The current is characterized by cold, nutrient-rich water that flows southward along the west coast of North America, with significant upwelling of deep, cold water. The current is an important source of productivity and plays a key role in the global carbon cycle and climate system. The current is also important for the fisheries of the region, with significant catches of anchovies, sardines, and other species.

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OCEANOGRAPHIC AND CLIMATE CHANGE RESEARCH: A COMPREHENSIVE APPROACH TO ENSURE SUSTAINABILITY

The ocean plays a key role in regulating the Earth’s climate and supports a diverse array of marine life. The ocean’s temperature, salinity, and currents are influenced by continental runoff, ocean currents, and solar radiation. These conditions are crucial for the survival of many marine species, including fish, whales, and other oceanic species. The ocean also plays a role in the global carbon cycle, with the ocean absorbing a significant portion of the carbon dioxide released by human activities.

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three-dimensional, gridded fields of temperature, salinity, and absolute geostrophic velocities in the global upper and intermediate-depth ocean. The advanced technique developed in this study effectively triples the number of independent observations available from the Argo floats array and allows efficient quality control of the original data. Obtained three-dimensional structure of the mean geostrophic ocean circulation is shown to improve previous products, such as the one based on the World Ocean Atlas. Temporal variability of the circulation, temperature, and salinity is discussed along with the effects of the large-scale advection of heat, salt, and momentum. In the upper ocean the dataset is supplemented by the gridded maps of the mixed layer and barrier layer depths. The release of the near-real-time product for the public use will be announced at the meeting.

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IMPROVED FINE SCALE MODEL PERFORMANCE USING AUV FEEDBACKS IN A TIDALLY DOMINATED SYSTEM.

A challenge for model prediction and validation is providing the models with data of appropriate spatial and temporal resolution. Use of autonomous underwater vehicles allows data collection on these scales. The goal was to apply a model and an AUV system for improving model performance and AUV mission planning. A dye release was conducted in a tidally dominated bay. The initial experiment was to simulate the dye plume based on the best available data. This was used for a baseline evaluation and for AUV mission planning for plume following. The model correctly predicted the general shape and direction of the dye and allowed for successful mission planning. Bathymetry data collected by the AUV was incorporated into the model and re-run and dye measurements were used to re-evaluate the model. Field data comparisons indicate that the model effectively predicted the plume edge and the propagation characteristics. The location of the evolving plume was confirmed by remote sensing. Stratification was the dominant controlling factor for improving model performance. Modeling results coupled with the field information present a quantitative improvement to the understanding of the circulation and demonstrate the integration of observational datasets into model evaluation for applications related to short, short duration surface contaminant releases. This study highlights the strength of this approach with AUVs and may serve as a guide towards improving the model performance.

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EVALUATION OF COASTAL SIMULATIONS IN THE WESTERN PACIFIC

We deploy and evaluate a flexible globally-relocatable ocean-atmosphere simulation capability (COAMPS & NCOM), linked to initial and lateral boundary conditions from data-assimilating global HYCOM and global NCOM. We focus on several coastal regions in the Western Pacific in order to compare and contrast relatively data-poor (Philippines) and data-rich (Japan) areas. Atmospheric simulations for Japan and the Philippines achieve resolution greater than 15 km while the accompanying ocean simulations are run at greater than 5 km resolution. Error statistics for the two global models are presented for the two regions using available observations, along with an analysis of the regional coastal models.

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PHOTODISSOLUTION OF PARTICULATE ORGANIC MATTER CAN SHUNT ITS DECAY TO MICROBIAL COMMUNITIES

Particulate organic matter (POM) is efficiently utilized by metazoans, while dissolved organic matter (DOM) is more efficiently utilized by unicellular organisms. We examined the potential for light-induced dissolution of POM to make photodissolved DOM (FotDOM) available to microbes. POM from fresh and aged phytoplankton membrane debris and sediments each photodissolved strongly after dozens of hours under simulated sunlight. Photodissolution selectively removed polysaccharides from sediments, implying greater photochemical lability of fresher components of the heterogeneous, sedimentary POM. FotDOM had high C:N ratios, but simultaneous photoammonification converted particulate N to a form that favors its use by microbes, perhaps in combination with utilization of the high C:N FotDOM. Microbial inocula metabolized significant fractions of FotDOM on timescales down to minutes. The net effect is enhanced production of smaller oligomers by Photodissolution of POM, which may serve as an additional food source for many microorganisms.

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ASSESSING RADIODEECHOICHEMICAL TECHNIQUES AS A TOOL FOR MANAGEMENT OF TWO MARINE PROTECTED AREAS IN PUERTO RICO: A CASE STUDY

Baseline studies provide data that can help identify and develop management strategies for impacted marine ecosystems. This study intends to provide radiogeochemical baseline data of mangrove sediments for monitoring purposes at two marine protected areas. Prior to becoming a reserve, the Jobos Bay National Estuarine Research Reserve (JBNEER) received contaminated sediments (e.g. heavy metals, pesticides, and other hazardous substances) from nearby agricultural and industrial activities. Preceding its designation by the US Fish and Wildlife Service (FWS), the Vieques National Wildlife Refuge (VNWR) was the site of various military activities that introduced toxic waste, explosive compounds, and depleted uranium to the local environment. Radionuclide concentrations, distributions and behaviors have been determined for sediment samples collected throughout the two study sites. Clay mineralogy, organic matter content, elemental composition, and particle grain-size distributions of the samples have also been determined. An educational and outreach component has been specifically designed for this project to promote basic environmental awareness and literacy within the surrounding communities of both study sites. Specific educational and outreach activities include the development of teacher workshop materials, teacher workshops and development of curriculum-based environmental education activities.

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DIURNAL CURRENTS, SEA BREEZE AND TIDES ON THE INNER SHELF OFF CARTAGENA DE INDIAS, CARIBBEAN COAST OF COLOMBIA

Inner shelf current variability from the inner shelf and nearshore off the Colombian coast, near Cartagena de Indias, is examined from data collected during the period 2000-2002. This presentation focuses on diurnal oscillations present in the records which are surface intensified, with amplitudes of up to 8 cm/s in the nearshore. In all the sites the main axes are parallel to the predominant direction of the isobaths. The currents appear to be correlated with the oscillating wind forcing associated with sea breeze which has an amplitude of up to 1.21 m/s and a rotational clockwise pattern. Harmonic analysis, spectral, complex correlation, complex demodulation and analytical modeling are used to verify this correlation with the wind. The results indicate a significant contribution from the sea breeze winds and a lesser contribution from the tides in the generation of the observed diurnal currents.

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IDENTIFYING THE LOCATION AND TIMING OF GLOBAL MODE WATER FORMATION PROCESSES

Mode water formation processes are often quantified in the theoretical framework developed by Walin, 1982, who precisely expressed diapycnal volume fluxes through the sides of a chosen control volume - based on, for example, temperature - in terms of non-advective (mixing) supply of heat to that control volume. However, it is an integral statement and therefore necessarily integrates over space and so blurs regional details that may be indicative of mechanism. We have developed a diagnostic approach, consistent with the integral Walin budget, to precisely localize the underlying formation/destruction process through air-sea buoyancy interaction and mixing processes. We apply the approach to study tropical mode waters in the global ocean using a model-data synthesis and air-sea flux data sets. We draw out both similarities and differences between the model water cycle in the Kuroshio extension, the Gulf Stream and the Southern Ocean. We also use our approach to discuss the relative importance of formation in vs away from regions of intense jets.

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OBSERVATIONAL AND NUMERICAL MODEL ANALYSIS OF NEAR-FIELD COLUMBIA RIVER PLUME ENTRAINMENT AND WIND EFFECTS

We present an analysis of both observational surface drifter measurements and 3D numerical model simulations of the Columbia River plume. River water exits the estuary mouth during ebb tides forming a pulsed plume. As plume water transits offshore it expands laterally and entrains underlying ambient fluid. A control-volume analysis of surface drifter data is used to estimate the plume depth and entrainment rate as the flow evolves seaward. Entrainment is largest near the river mouth O(10^4 m/s) and decreases seaward, but remains significant between the mouth and the ocean-plume boundary. Beyond ~20 km our entrainment analysis breaks down as the surface drifters begin a return loop shoreward at slack tide. Numerical 3D model fields are used to examine the ebb-cycle plume momentum balance and relate it to the observed entrainment analysis. Our findings are similar in quality to previous 1-layer model attempts in vs away from regions of intense jets.

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development of curriculum-based environmental education activities.
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A MULTI PROXY APPROACH TO ASSESS TROPICAL CLIMATE VARIABILITY DURING MARINE ISOTOPE STAGE 3: RESULTS FROM THE CARIBIAO BASIN

With the growing interest in using Caribio Basin sediments to reconstruct climatic and hydrologic conditions, it is necessary that we understand the 818O/salinity relationship in this region and assess the implications for paleosalinity reconstructions. Our results show that this relationship varies significantly over the course of the year primarily due to an increase in freshwater input from the local rivers into the Caribio Basin. Additionally the freshwater data reveal two distinct trends that represent the upwelling and run-up welling seasons. We further use a multi-proxy approach, combining detailed oxygen iso- trope and Mg/Ca records for G. ruber from MD03-2621, to evaluate the magnitude of sea surface temperature, 818Ow, and sea surface salinity variations associated with 10 stadial/interstadial oscillations during marine isotope stage 3. The variability in the 818Oc of G. ruber correlates very well with the color reflectance data, which is considered a proxy for marine productivity. The Mg/Ca results for G. ruber across several of these stadial/inter- stadial oscillations tend to co vary with the 818O data. Interestingly the Mg/Ca and 818O records for G. ruber diverge shortly after IS9 and 6 suggesting warmer, saltier conditions during these stadial periods. We compare this record with Greenland and Antarctic ice cores to evaluate the role that the tropics play in millennial scale climate change.

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OCCURRENCE OF PHAGE INTEGRASE-LIKE GENE EXPRESSION IN TAMPA BAY

Phage integrase genes often play a role in the establishment of lysogeny in temperate phage. To investigate temperate gene expression, an induced viral metagenome from Tampa Bay was sequenced by the 454/R sequencing method. The sequencing yielded 294,068 reads with 6.6% identifiable. There were 103 Integrase hits, yet only 4 significantly significant ones. Real-time PCR primers and probes were designed for each of these four integrases. Initial testing of the assay with microbial viral DNA from Tampa Bay revealed 1.9 x 10^4 copies and 1,300 gene copies of Vibrio-like integrase and Oceanicola-like integrase (gene) respectively. The other two integrases we not detected. The integrase assay was then tested on the microbial RNA fraction extracted from 200 ml of Tampa Bay water over an annual cycle. Vibrio-like integrase gene expression was detected in three samples, with estimated copy numbers of 2.4-1280 gene copies per liter. Clostridiun-like integrase gene expression was detected in 6 samples, with estimated copy numbers of 37 to 260 copies per liter. In all cases, detection of integrase gene expression corresponded to statistically significant phage induction events.

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CIRCULATION AND FLUXES OF HEAT AND FRESHWATER IN THE SUBTROPICAL NORTH ATLANTIC

We present the circulation from a new atlantic hydrographic section at 36°N made in 2005. This cruise included two crossings of the western boundary at 35.5°N and 37.5°N. Between these two western boundary crossings the southwestern flowing Deep Western Boundary Current decreased in strength from 33.65° to 22.5°, and the northeastern flowing Gulf Stream increased in strength from 66.75° to 112.15° in the top 200m. An

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WHAT DO YOU WANT TO BE?

Many students do not consider science as a career because they have no contact with anyone who works as or with a scientist. In K-12 science classes, students study scientific concepts, but not how they were researched and who participated in the work of supporting ideas for theory. In an eGyF program, high school students to consider careers in science, this exploration-based learning exercise is designed to help them realize that many opportunities in science are open to them. In this project students are encouraged to discover the similarities between themselves and workers described on the Joint Oceanographic Institutions webpage: http://www.joicos.org/careers_flash.html. It requires students to explore the career of a scientific ocean driller working, including education, training, certifications, daily routine, and the drilling projects in which they participate, sharing information with classmates via classroom presentation. The outcome of this class project is that students see that their backgrounds are not very different from these professionals, and realize that they can join the working world of science and contribute to its ongoing discoveries.

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DEPICTIONS OF LABRADOR SEA WATER FROM THE IPCC MODELS AND A FINE RESOLUTION POP SIMULATION DURING HIGH AND LOW NAO INDEX PERIODS

The oceanic uptake of properties such as heat and freshwater result from mode water formation. We examine the representation of mode waters in the one-degree class oceans of the IPCC global coupled simulations. Initially we examine two present day green house gas forcings control runs of high school students into the Great Oceanographic Expedition (GOE) that differ only in their dynamical atmospheric cores in the Community Atmospheric Model 3 (CAM3) that differ only in terms of their dynamical atmospheric cores in the Community Atmospheric Model 3 (CAM3). We examine formation rates and trace mode waters into the ocean interior using their potential vorticity (PV) signature. Particularly we consider Labrador Sea Water (LSW) and examine its PV interior signature in composites of high and low North Atlantic Oscillation (NAO) index periods. We also calculate formation rates and the interior PV distributions using output from a fine resolution (0.1-degree, 40-level) North Atlantic basin simulation of the Parallel Ocean Program (POP) forced with synoptic forcing only in terms of their dynamical atmospheric cores in the Community Atmospheric Model 3 (CAM3). We examine formation rates and trace mode waters into the ocean interior using their potential vorticity (PV) signature. Particularly we consider Labrador Sea Water (LSW) and examine its PV interior signature in composites of high and low North Atlantic Oscillation (NAO) index periods. We also calculate formation rates and the interior PV distributions using output from a fine resolution (0.1-degree, 40-level) North Atlantic basin simulation of the Parallel Ocean Program (POP) forced with synoptic forcing.

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PARTNERS: A PERSPECTIVE FROM THE STUDENT STANDPOINT

A pan-arctic field sampling effort was conducted from 2003 through 2006 to improve understanding of river export to the Arctic Ocean. Sampling focused on the Yukon and Mackenzie Rivers in Northern America and the Ob, Yenisei, Lena, and Kolyma in Siberia. The success of the project, apny named Pan-Arctic River Transport of Nutrients, organic matter and Suspended Sediments (PARTNERS), required an extraordinary degree of international cooperation. In addition to the parameters identified in the project title, many others were measured including major ions, trace elements, and isotopic tracers. While a variety of previous studies have focused on the chemistry of large arctic rivers, differences in methods and objectives have hampered river inter-comparisons and understanding at the pan-arctic scale. Furthermore, a majority of the previous studies were conducted only after peak flow during summer months. This presentation will emphasize comparisons among the major rivers and highlight insights that have emerged as a result of the PARTNERS project. More comprehensive knowledge of seasonal and inter-annual dynamics in arctic rivers is essential for detecting changes in constituent runoff to the Arctic Ocean.

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WHAT DO YOU WANT TO BE?

Many students do not consider science as a career because they have no contact with anyone who works as or with a scientist. In K-12 science classes, students study scientific concepts, but not how they were researched and who participated in the work of supporting ideas for theory. In an eGyF program, high school students to consider careers in science, this exploration-based learning exercise is designed to help them realize that many opportunities in science are open to them. In this project students are encouraged to discover the similarities between themselves and workers described on the Joint Oceanographic Institutions webpage: http://www.joicos.org/careers_flash.html. It requires students to explore the career of a scientific ocean driller working, including education, training, certifications, daily routine, and the drilling projects in which they participate, sharing information with classmates via classroom presentation. The outcome of this class project is that students see that their backgrounds are not very different from these professionals, and realize that they can join the working world of science and contribute to its ongoing discoveries.
inverse analysis of the 36N section with boundary current, bottom water and net volume and silicate constrained a northeastward flux of 1.25PW ± 0.62PW across 36N and a freshwater divergence of 0.8 Sv ± 0.1 Sv between 36N and Bering Strait (implying a fresh water flux into the ocean). At 36N the overturning strength is 195 ± 15S at 117°N ± 40°. We combine the 36N section with a section across the Gulf of Cadiz made in 2005 and a section across 24N made in 2004. There is a heat divergence of <0.1PW between the sections and a freshwater convergence of 0.35S (implying a freshwater flux out of the ocean).

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USING INFORMATION THEORY TO DETERMINE OPTIMAL MODEL COMPLEXITY IN AQUATIC BIOGEOCHEMICAL MODELING

The complexity of aquatic biogeochemical models (e.g. plankton functional types) is increasing in an attempt to capture the real complexity of nature. The data sets available for model calibration and validation, however, are often relatively small. This situation creates the danger of models containing unjustifiably large degrees of freedom and can result in 'overfitting' the data. In such cases, the usefulness of the model (especially for prediction) may be compromised. We present a strategy to use the principles of information theory to rank the performance of a set of models incorporating varying degrees of complexity against a single calibration data set, in order to determine the 'optimal' level of complexity. The models are evaluated using a metric based on Akaike's Information Criterion (AIC), which takes into account not only the model's ability to replicate the data, but also the number of estimated parameters in the model relative to the number of data points. Preliminary application of this method shows that even modest levels of complexity in aquatic biogeochemical models are often unjustified, and reinforces the importance of parsimony in modeling.

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BUILDING PARTNERSHIPS BETWEEN SCIENTISTS AND EDUCATORS: A PERSPECTIVE FROM THE CENTERS FOR OCEAN SCIENCE EDUCATION EXCELLENCE - MID ATLANTIC (COSEE MA)

In five years, the National Science Foundation’s Centers for Ocean Science Education Excellence (COSEE) network has grown from infancy through a phase of intense development. The COSEE network has explored new territory, learned to cooperate, and shared learning experiences. One of the main goals of the COSEE program is to engage scientists and educators in meaningful partnerships that translate into improved Ocean Science Literacy outreach and broad reach of ocean issues including students, teachers, and the general public. In this presentation, we will explore the successes and challenges of engaging scientists and educators in partnerships and discuss what we have learned about differences and similarities between scientists and educators in their approach to the pedagogy of science education. We will share our lesson learned with engaging scientists, educators, and the public in ocean science education and discuss how we have applied our lessons learned in the new COSEE Networked Ocean World (COSEE NOW).

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NOAA’S EFFORTS IN SUPPORTING FORMAL AND INFORMAL EDUCATION USE OF STREAMING DATA: CHALLENGES IN ADDRESSING THE NEEDS OF THESE AUDIENCES WITH EVER-CHANGING DATA

NOAA has developed several programs and pilot projects aimed at facilitating the use of earth system science data, streaming ocean observing data, and data visualizations by formal and informal educators. One program, Science On A Sphere, a large visualization system that uses networked LCD projectors to display animated global datasets onto the outside of a 1.7-meter diameter opaque sphere, enables science centers and museums to display real-time and current earth system science data. NOAA’s Ocean Data Education Portal is a pilot K-12 teacher-focused integrated data portal for several of NOAA’s streaming ocean data. Additionally, NOAA has begun to explore the creation of educational gaming and web interfaces for ocean data sets. Results of needs assessments and formative evaluations for these projects will be presented. Initial results indicate that not only are simple-to-use data interfaces necessary, but also a large amount of contextual informational and updated scientific interpretation needs to be available. There is a clear need for both ongoing technical developments to support educators’ access to data, but also continuous scientific support to explain the significance of the data.

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TEMPORAL AND SPATIAL PATTERNS OF CARBONATE AND SILICICLASTIC SEDIMENTATION ACROSS A TROPICAL CONTINENTAL MARGIN

The Gulf of Papua (GoP) is a tropical continental margin where significant amounts of both river derived silicates and neritic/pelagic carbonates accumulate. The goal of the MARGINS Source-to-Sink (S2S) study in the Papua New Guinea (PNG) focus area is to develop an understanding of sediment production, transport, and accumulation across the GoP. The flux of carbonate and siliciclastic sediments reaching the most distal part of the PNG focus area, including the slope, troughs, and Eastern Plateau, will be presented from a number of cores. Sediment fluxes are based on oxygen isotope stratigraphies and elemental data collected using an X-Ray Fluorescence core scanner. Spatial and temporal changes in carbonate and siliciclastic sedimentation will be described based on changes in percent carbonate source elements (Ca, Sr) and terrestrially derived elements (Fe, Al, K). Results from the deep Gulf of Papua do not show a simple glacial/interglacial pattern of siliciclastic or carbonate sedimentation. Spatial and temporal patterns of siliciclastic and carbonate sedimentation change throughout the Quaternary as a result of changes in sea level, production, transport pathways, climatic and environmental conditions.

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AUTOMATED DECISION MAKING FOR A NEW CLASS OF AUV SCIENCE

Autonomous Underwater Vehicles (AUVs) are an increasingly important tool for oceanographic research. However, control of these platforms has relied on fixed sequences for execution of pre-planned actions limiting their effectiveness for measuring dynamic and episodic ocean phenomena. At MBARI, we are developing an advanced Artificial Intelligence based control system to enable our AUV’s to dynamically adapt to the environment by deliberating in-situ about mission plans while tracking onboard resource consumption, dealing with mission failures by allowing dynamic re-planning and being cognizant of vehicle health and safety in the course of executing science plans. Existing pre-scripted behavior-based approaches offer limited flexibility in dealing with opportunistic science needs, are unable to deal with uncertainty in the oceanic environment and put undue burden on the mission operators to manage complex interactions between behaviors. Our system the Tele- Reactive Executive (TREX http://www.mbari.org/autonomy/TREX/index.htm) has been tested on an MBARI Dorado 21’ vehicle with a range of scientific instruments for water-column surveys in Monterey Bay. Our year-end goals revolve on mapping unstructured phenomenon such as Ocean Fronts and Thin Layers.

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HINDCASTING THE HISTORIC 2005 NEW ENGLAND RED TIDE: FORCING MECHANISMS AND FUTURE IMPLICATIONS

In 2005, a massive bloom (red tide) of the toxic dinoflagellate Alexandrium fundyense closed shellfish harvesting along the coastlines of Maine, New Hampshire and Massachusetts, as well as a 40,000 km² area of offshore, federal waters. Blooms of this organism are common in the Gulf of Maine (GOM) region, but outbreaks of this magnitude are rare - the most recent similar event being in 1972. Three factors have been identified to explain the massive 2005 bloom: high cyst abundance, heavy rainfall and runoff, and major storm events (northeasters that pushed surface waters and cells to the shore and down the coast. We combine field observations with numerical model simulations to demonstrate that a major cyst deposition or accumulation event was the dominant factor leading to the historic 2005 New England red tide, and provide additional evidence that the persistence of that cyst deposit is likely to result in sustained and significant blooms in the coming years. Monitoring of the regional abundance of cysts may thus hold the key to interannual forecasts of A. fundyense bloom severity.

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ALOHA-MARS MOORING SENSOR NETWORK FOR OCEAN OBSERVATORIES

The ALOHA-MARS Mooring Sensor Network combines adaptive sampling methods with a moored deep ocean sensor network. A test version of the mooring system was installed 26 June 2007 and connected to the Seaburst Observatory in Puget Sound in a water depth of 30 m. The ocean deployment of the mooring system on the MARS Observatory in Monterey Bay in a water depth of 900 m is currently scheduled for spring 2008. This project will demonstrate the scientific potential of combining adaptive sampling methods
with a moored deep-ocean sensor network at the MARS Observatory. We will directly address the challenge of sampling along the ocean with both high temporal resolution and high vertical resolution. With the moored sensor network consisting of a profiler moving between near-surface and abyssal fixed sensors under program control, we will be able to focus the sampling and measurement capabilities on the scientific features of most interest. The long term goal is to deploy similar moorings at the Aloha Cabled Observatory and the Hawaii Ocean Time-Series (HOT) station, near Oahu, and on the cabled nodes of the Ocean Observatories Initiative (OOI) of the Ocean Research Interactive Observatory Networks (ORION). This project is funded by the National Science Foundation (NSF) and managed by NSF and the Joint Oceanographic Institutions (JOI).

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STABLE ISOTOPE PROBING USING 13C AND 15N IN THE ORINOCO RIVER PLUME

Understanding carbon and nitrogen cycling in topical river plumes will help delineate the effect of terrestrial ecosystems on the coastal environment. In this study, the Orinoco River Plume was sampled at 12 stations and 4 depths along the plume axis and screened by stable isotope probing using 13C-amino acids and 15N-nitrate. Two-liter samples were amended with 200-2000 nM substrate and incubated for 3 hours. Isotopically labeled DNA was recovered with carrier DNA methods using halophile DNA. For the carbon analysis, approximately 2/3 of the peaks detectable in the 13C fraction (average=30 ± 5.2 peaks for all stations) were observed to incorporate 13C (average=21 ± 4.8 peaks). Furthermore, the samples treated with amino acids showed clustering more strongly with depth than by station. The transect is dominated by a different pattern with significantly smaller peak numbers in the 15N fraction and clustering along station rather than depth. Additional effort in cloning/sequencing of specific peaks from these analyses is underway. Similar SIP studies, in both marine and terrestrial environments, should help to relate microbial community structure to function.

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UP THE TIDAL RIVER: IN SEARCH OF ANOTHER MISSING LINK

Particle-bound materials that originate within the watershed and are transported via rivers to the ocean undergo many transformations en route. Knowledge of what transformations take place (and where) is crucial to our understanding of river-ocean systems and their response to global change. A major limitation is that traditional “river endmember” measurements have been made above the tidal freshwater zone — in many cases is 100s of kilometers upriver of the river mouth. Our understanding of residence times and transformations within the tidal (fresh) lower river represents a critical missing link. Direct examination of the lower Mississippi River reveals that the tidal (fresh) zone is much more important than the adjacent margin in terms of loss of particulate organic carbon, iron, manganese and associate constituents such as uranium. Indirect examinations (comparing “river endmember” and margin values) suggest that net gains in bulk particulate organic carbon, iron, manganese and uranium within the tidal river zone are also possible in other RioMar systems. The use of isotopic tracers (stable and radioactive) will be discussed as a possible approach for future studies.

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IDENTIFICATION OF PREVIOUSLY UNCHARACTERISED NATURAL SEDIMENT ORGANIC MATTER USING ULTRA-HIGH RESOLUTION MASS SPECTROMETRY AND NUCLEAR RESONANCE SPECTROSCOPY

Using a new analytical strategy for characterizing the unidentified portion of sedimentary organic matter (combined use of some new NMR techniques and Fourier transform ion cyclotron resonance mass spectrometry-FTICR-MS), we examine diagnosis of organic matter in two cores of organic-rich deposits from Mud Lake, Florida, and Mangrove Lake, Bermuda. The sediment is extracted with pyridine, is verified as being representative of the whole sediment by matching its NMR peaks with high resolution magic angle spinning (HR-MAS) NMR spectrum of the solid, and then analyzed using ultra-high resolution FTICR-MS. Preliminary mass spectra data for Mud Lake suggest an increase in aromatic type structures, accompanied by a decrease in lignin as depth increases, consistent with solid state NMR data. Combining NMR and MS techniques, whole sediment samples of a terrestrial or marine source can be analyzed at the molecular level which characterizes the previously uncharacterizable organic matter.

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OPERATIONAL METOP SEA SURFACE TEMPERATURE PROCESSING AT THE NAVAL OCEANOGRAPHIC OFFICE

The Naval Oceanographic Office (NAVOCEANO), Stennis Space Center, Mississippi, is operationally producing Multi-Channel Sea Surface Temperature (MC SST) retrievals from Meteorological Operational Satellite (METOP) Advanced Very High Resolution Radiometer (AVHRR) data. This new EUMETSAT polar orbiter is the first to provide global 1km AVHRR data. NAVOCEANO modified its existing operational SST processing software to generate retrievals within 1000 km of coastlines globally and in areas significant to the Navy. NAVOCEANO also processes METOP global area coverage 4km AVHRR data provided by the NOAA/NESDIS Office of Satellite Data Processing and Distribution (OSDPD). The MC SST data are distributed in near real time to thermal analyses and circulation models at NAVOCEANO, to other oceanographic and weather centers in the United States, and to the GODAE High Resolution Sea Surface Temperature (GHR SST) pilot project. This paper will provide details on the SST processing steps, validation results from buoy matchups, and examples of the SST product.

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CARBON CYCLE VARIABILITY AT BERMUDA AND IN THE NORTH ATLANTIC: SUBTROPICAL GYRE

Progress in understanding the carbon cycle and its variability require us to take full advantage of both imperfect numerical models and limited data. Timeseries observations are crucial because they reveal carbon cycle variability in time, but do not directly allow study of spatial variations. Coupled physical-biogeochemical models estimate both spatial and temporal variability, but are imperfect representations of the real world. In this paper, we report on a new physical-biogeochemical model that is able to capture much of the observed carbon cycle variability from 1983 to 2005 at Bermuda (Bates, 2007). Preliminary results suggest that sea surface temperature at Bermuda has been stable since 1984 due to horizonal advection balancing decadal timescale warming and cooling trends in the local atmospheric forcing. The result is that temperature-driven pCO2 trends have been negligible. There is an increasing trend in surface ocean pCO2 driven by increasing atmospheric pCO2, and DIC anomalies due to changing vertical mixing also strongly influence surface ocean pCO2. Following detailed model-data comparisons, we use the model to construct a physically and biogeochemically predictive power of time series observations at Bermuda for the rest of the subtropical gyre.

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CHARACTERISTICS OF A MICROBIOLOGICALLY DERIVED IHS REFERENCE FULVIC ACID FROM A SALINE COASTAL POND IN ANTARCTICA

The study of the biogeochemistry of dissolved organic matter (DOM) has been advanced by the availability of a reference material from a terrestrial source, i.e., the IHSS Suwannee River fulvic acid, but has been limited by the lack of a reference from a purely microbially based aquatic ecosystem. The chemistry of fulvic acid from Pony Lake, a eutrophic, subtropical gyre.

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Large-scale physical and geochemical surveys of the southern Canada Basin conducted in the 2000’s show that changes observed during the 1990s have progressed further into the basin. Temperature of the Bering Sea summer water has increased, the volume of Bering Sea Winter Water has decreased and temperatures of the Fram Strait Branch have
increased. Distributions of increased ventilation together with the above data are used to infer circulation and show that the boundary current is not the sole mechanism for the delivery of change in the southern Canada Basin.

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COMPARING FINGERPRINTING AND PHYSICS: MULTIPLE APPROACHES TO LARVAL CONNECTIVITY OF MYTILID MUSSELS

Connectivity patterns of mytilid mussel species, Mytilus californianus, Mytilus galloprovincialis and Musculista senhousia were studied in San Diego County using trace elemental fingerprinting of retained larval shell to assess recruitment and connectivity and by simulating transport with open coast (ROMS) and bay (ADICIRC) numerical simulations. Location-specific chemical signatures needed to interpret recruit origins were determined from outplanted mussel larvae at bay and open-coast sites spanning 100 km of shoreline. Using this regional ‘reference map’ of chemical signals, we assigned settler origins by compared the expected larval chemistry for each region to the larval shell chemistry of newly settled recruits collected 2 wk after outplanting. Within species we observed temporal and spatial variation in patterns of connectivity and self seeding. We also observed species differ-
ences related to adult distributions and larval supply. Metrics are developed for quantify-
ing connectivity across space and time, and for drawing comparisons between results of fingerprinting and larval supply simulations for the same time period. These fingerprinting/modeling approaches offers insight into key determinants of species-specific connectivity patterns, and interannual variability, with potential benefits for conservation and management.

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THE IMPACT OF LARGE SCALE COASTAL DYNAMICS ON THE OPTIMIZATION OF BEACH REPLENISHMENT DECISIONS

Human alterations to the coast in the form of beach replenishment depend upon the state of the beach, which itself is related to past alterations; the human occupied coastline thus forms a dynamical system with strong coupling between human and natural processes. Within this coupled human-natural system replenishment decisions are driven by coastal management and localized in space. Previous work has shown that an instability in plan-view coastline shape, and subsequent self organization, has likely given rise to the large-scale cuspate shape of the North Carolina coastline. These emergent behaviors operate over time and space scales considerably greater than considered for localized replenishment decisions. How does the context set by large-scale dynamics affect net benefits from replenishment? To explore this question, we present a numerical model featuring coupled human and coastline interactions. The physical model incorporates coastline changes associated with alongshore sediment transport. The economic model represents replenishment decisions. The combination of potential benefits from enhanced beach width minus costs of replenishing. We present results that illustrate the degree to which localized dynamic optimization fails to maximize net benefits of replenishment. We also explore how net benefits change due to changing storm behaviors. Finally, we present a heuristic optimiza-
tion procedure that adapts to the context of large-scale coastal change.

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RECONSTRUCTING THE OCEAN 13C SUSS EFFECT

We applied a multi-parameter mixing approach to quantify anthropogenic changes in the delta-13C of dissolved inorganic carbon (D13IC) (Sonnerup et al. 2007) to WOCE D13IC sections in the Pacific (P11, P13, P18 and P06), Indian (I2, I3 and I85/95) and Atlantic (A20 and A22) Oceans. Central to analysis is the proper selection of endmember water masses for the analyzed sections. For each ocean basin, we chose four endmembers using potential temperature/salinity diagrams. Additional constraints were imposed based on the physical and chemical properties of the individual basins. In the South Pacific Ocean, the calculated surface and depth-integrated delta-13C changes are largest in the subpolar and decrease towards the south. In the South Indian Ocean, a similar pattern in depth-in-
tegrated changes was observed. Also, the greatest surface changes were observed north of 20S, and decreased to the limit of detection south of 50S. The North Atlantic reconstruc-
tions indicate that the maximum delta13C changes are fully equilibrated with respect to 20S, and decreased to the limit of detection south of 50S. The North Atlantic reconstruc-
tions were also be presented.

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EVOLUTION OF THE 2006-07 EL NIÑO: THE ROLE OF INTRASEASONAL TO INTERANNUAL TIME SCALE DYNAMICS

This presentation describes the development of the 2006-07 El Niño, which started late, ended early and was below average strength. Emphasis is on the interplay between large scale (intraseasonal and interannual) time scales, to illustrate the evolution of the event. Efforts to forecast the El Niño are reviewed, with discussion of factors affecting its predictability. Perspectives on possible influences of global warming on the ENSO cycle, which exhibited unusual behavior in the first decade of the 21st century, will also be presented.

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MIXING ASYMMETRY IN TURBULENT FLOWS WITH LARGE HORIZONTAL SCALAR GRADIENTS

On several occasions, measurements made from sea ice of flow with horizontal gradients in salinity and temperature have shown significant modification in the character of turbulence compared with regimes without horizontal gradients. If density at the measurement site increases (decreases) with time, turbulence is suppressed (enhanced) by shear induced vertical gradients in the underice boundary layer, in a manner analogous to what Rippeth et al. (J. Phys. Oceanog., 31, 2001) have termed strain induced periodic stratification. An example from tidal flow near the mouth of Van Mijen Fjord, Svalbard, during June, 2004, illustrates the phenomenon. We observed periodic variation in salinity in a tidally modulated flow generally directed into the fjord. During times when salinity decreased there was large downward salt flux and increased turbulent drag, 1 m below the surface, despite upward heat flux and evidence of rapid basal melting (which would typically result in upward salt flux). A simple heuristic model suggests that this originated from a positive vertical salinity gradient as fresh water advected faster at depth. Examples from other locations are also shown.

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INTEGRATING MULTIPLE COASTAL OBSERVING EFFORTS TO DESCRIBE THE CIRCULATION FEATURES OF A SOUTHERN CALIFORNIA TOXIC BLOOM EVENT

A suite of separate interdisciplinary coastal observing systems were drawn from to de-
scribe the dynamics surrounding a highly productive, toxic bloom event in the Santa Barbara Channel (SBC). Measurements from an outer-shelf SBC mooring maintained as part of the Southern California Coastal Ocean Observing System (SCCOOS) program show that the September 2005 event was characterized by the highest Chlorophyll levels of the surrounding years. Using data from a variety of other ongoing observing efforts, including an array of inner-shelf moorings, monthly profiling, HF-radar surface current fields, satellite images, and Channel-wide hydrographic surveys, we determined that the bloom was advected into the basin and then transported shoreward by a convergent jet associated with the eddy field that commonly characterizes SBC circulation. HF-radar surface currents combined with moored subsurface data provide a unique understanding of event dynamics, and suggest that a relaxation shift in SBC synoptic circulation states was responsible for the demise of the bloom. These findings emphasize the importance of understanding both local, mesoscale dynamics and offshore, coast-wide scales in under-
standing the evolution of coastal bloom events.

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THE OPTICAL PROPERTIES OF FLORIDA BAY: IMPACTS FOR SEAGRASS PRODUCTIVITY

Sediment dispersal and capture across the land-sea interface plays a critical role in defin-
ing the sensitivity of continental margin stratigraphy to fluctuations in the terrestrial sediment signal. A process-based understanding of this dynamic interface that bridges the gap between event and stratigraphic time scales is an important first-order requirement towards a seamless, source-to-sink model. To this end, geophysical data (interferometric swath bathymetry and EdgeTech sub-bottom) were collected across Poverty Bay, the land-sea interface of the Waipaoa Sedimentary System, in August 2005 and April 2006 along with thirty surface sediment grabbs, thirty gravity cores, and nine vibracores. Seismic profiles groundtruthed by vibracores and coastal plain well logs suggest very efficient segregation processes over the past 7 K, capturing sand within the rapidly prograding beach and bypassing fine-grained sediment to the shelf. "Be and excess" activities from surface grab samples as well as the lithology of the 30-cm gravity cores also indicate substantial reworking and rapid dispersal of fine-grained sediment to the shelf over short time scales.

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This study investigated the relationship between seagrass productivity and water column optical properties in Florida Bay. The region adjacent to the Everglades National Park encompasses areas of high seagrass density close to the Keys, with small seagrass further north towards Cape Sable. The vertical attenuation coefficient KPAR was low in the south and increased towards Cape Sable. Approximately 86% of variance in KPAR was explained by absorption. Along the Keys, phytoplankton contributed 9% to total absorption compared to 8% by colored dissolved organic material. The average cosine of the submarine light field was 0.7 to 0.9 in the south. Towards Cape Sable values decreased to 0.6 due to higher suspended material, indicating a more diffuse light field. Seagrasses were excluded from high turbidity areas where incident irradiance reaching the plants was less than 10% of surface irradiance. Although eutrophication processes have contributed to historic die-offs of seagrasses in Florida Bay, high suspended sediment loads currently prevent sufficient light from reaching the seabed. Therefore, nutrient load reductions may be necessary, but insufficient to promote seagrass growth in North Florida Bay.

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**CLIMATE EXACERBATES EUTROPHICATION IN THE NORTH SEA**

During the 1980s, a rapid increase in the Phytoplankton Colour Index (PCI), a semiquantitative visual estimate of algal biomass, was observed in the North Sea as part of a regional-wide regime shift. Two new datasets created from the relationship between the PCI and SeaWiFS Chlorophyll a (Chl a) quantity differences in the previous and current regimes for both the anthropogenically affected coastal North Sea and the comparatively unaffected open North Sea. The new regime maintains a 13% higher Chl a concentration in the North Open Sea, 21% higher concentration in coastal North Sea waters. However, the current regime has lower total nitrogen and total phosphorus concentrations than the previous regime. Besides becoming warmer, North Sea waters are also becoming clearer (i.e., less turbid), thereby allowing the normally light-limited coastal phytoplankton to more effectively utilize lower concentrations of nutrients. Linear regression analyses indicate that winter Secchi depth and sea surface temperature (SST) are the most important predictors of coastal Chl a while Atlantic inflows is the best predictor of open Chl a; nutrient concentrations are not a significant predictor in either model. Thus, despite decreasing nutrient concentrations, Chl a continues to increase, suggesting that climatic variability and water transparency may be more important than nutrient concentrations to phytoplankton production at the scale of this study.

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**DYNAMICS OF OCEANIC SURFACE FRONTS: DEFORMATION AND INSTABILITY**

In some regions (e.g., the California Current), the submesoscale regime is full of near-surface temperature fronts created by mesoscale-eddies straining ambient temperature variation. This frontogenesis is the primary mechanism for transfer of energy from the mesoscale to submesoscale en route to dissipation at microscales. The transfer is initiated as a forward cascade of available potential energy accompanied by conversion to kinetic energy, and it is carried forward on smaller scales by a forward cascade of kinetic energy; none of these behaviors are consistent with geostrophic turbulence. The frontogenesis effects a restratification of the upper ocean, in competition with the mixing by boundary-layer turbulence. The fronts themselves become unstable, even in the midst of active frontogenesis, giving rise to frontal breakdown and emergence of submesoscale vortices.

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**SUBMESOSCALE PROCESSES EVIDENT IN NEAR-SURFACE HORIZONTAL SPECTRA**

Horizontal wavenumber spectra of temperature, velocity, and tracers near the ocean surface in the scale range from 100 m – 100 km are an indication of the sub-inertial, rotating stratified, forward cascades of variance from mesoscale eddies into and through the submesoscale range en route to even finer scales. The variance distributions within this scale range are also indicative of the lateral dispersion rates (i.e., mixing). Although diagnosing processes from spectrum shapes is a notoriously non-unique method of inference, a discussion will be presented for relevant dynamical models for the spectrum shape, including geostrophic turbulence, surface quasi-geostrophy, frontogenesis by mesoscale straining, Stratified turbulence, and inertia-gravity waves.

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**DECADAL CHANGE IN OCEANIC WIND SPEED AND WATER VAPOR**

The Special Sensor Microwave Imager series of satellite-borne microwave radiometers is capable of making measurements of windspeed, water vapor, cloud water and rain over the world's oceans. At least one of these satellites has been operating for the past 20 years, long enough to begin to examine the measurement evidence for global climate change. We will discuss SSM/I measurements of decadal-scale changes in wind speed and total water vapor, and compare these results to the predictions of climate models. We have succeeded in detecting a fingerprint of human-induced climate change in the water vapor measurements. Detecting and attributing anthropogenic change in wind speed measurements has been more difficult, primarily due to the large interannual fluctuations in atmospheric circulation.

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**CHANGES IN NATURAL SOURCE INPUTS TO SEDIMENTARY ORGANIC CARBON ALONG THE MULLICA RIVER AND ESTUARY, NJ: A MULTI-BIOMARKER AND STABLE ISOTOPE CHARACTERIZATION**

The Mullica River, NJ (watershed ~ 1700 km²) drains two distinct land cover vegetations, predominantly pine-oak forests in the Pinelands, changing progressively to salt marshes towards the estuarine source. Sources and potential transformation processes of dissolved organic carbon (DOC) and particulate organic carbon (POC) were assessed using a detailed molecular identification of several biomarker classes, ranging from arap to polar compounds. That was accomplished by the extraction of sediment samples with DCM:MeOH (2:1) and the consequent analysis of their 5ylated total extractions by GC-MS. Overall, sediment biomarker compositions reflected changes in the catchment vegetation along the river; however, dipterocarps (e.g., eucalyptic, debbyroahetic acid (a biomarker for conifers)) were detected predominantly up river, the latter triterpenoid taxarol occurred in downstream sediments, mainly from the salt marsh vegetation. Significant levels of low MW fatty acids (C28-C3) and saccharides (e.g., glucose, mycoste) were observed in the estuarine sediments and are likely derived from marine microorganisms. 6°Abundances of individual fatty acids add specificity in understanding C3 versus C4 vegetation inputs to the system and terrestrial versus marine OC processing in the estuary.

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**EFFECTS OF CHEMICAL CUES ON VISUAL ORIENTATION OF EARLY LIFE STAGES OF THE AMERICAN HORSESHOE CRAB (LIMULUS POLYPHEMUS)**

Although adult horseshoe crabs (Limulus polyphemus) have long served as models for the study of vision in marine arthropods, little is known about the visual responses of early life history stages. We examined the visually directed movements and orientation of first stage juveniles to horizons containing dark areas of different sizes. The study tested the hypotheses that (1) early life history stages use visual cues to avoid predators or locate potential refuge areas and (2) responses to visual targets depend on the presence or absence of chemical cues from potential nursery habitats. Visual orientation of crabs to horizontal rectangles subtending angles from 30-300 degrees was tested in a circular arena containing water that either lacked estuarine chemical cues (offshore water) or contained odors from aquatic vegetation or predators. In offshore water, juveniles oriented away from dark horizons. Yet, in water containing chemical cues, including odor from manate grass Syringodium filiforme and blue crab Callinectes sapidus, they swam toward the solid targets. Results support the hypothesis that the visual orientation of juvenile horseshoe crabs changes dramatically upon exposure to estuarine chemicals.

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**USING PARTNERSHIPS TO IMPROVE EDUCATIONAL USE OF SCIENTIFIC DATA**

The use of authentic scientific data in effective learning materials for students, educators, and adults in classrooms and in informal learning venues has been a significant aspect of NASA's education efforts for about the last 15 years. Although much of the technology has changed, there has been a vast increase in the technical challenges that existed 10-15 years ago still remain. However, the magnitude of those technical challenges has decreased significantly. As a consequence, today's biggest challenges are not technical but rather limitations of expertise, organizational infrastructure, and sustainability and continuity of data streams. These human and information challenges have existed all along but were masked by the technical challenges. One way to address these human and information challenges is through partnerships with individuals or organizations that already serve the target educational audience. Specific examples of such partnerships will be examined to highlight key features of successful partnerships and the challenges they face.

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**SIMULATION OF PRIMARY AND SECONDARY PRODUCTIONS OF GULF OF ST. LAWRENCE (CANADA): IMPORTANCE OF TEMPERATURE REGULATION**

Primary production in the NPZD models is usually formulated as either light- or nutrient limited, and zooplankton growth, as prey limited. However, the importance of temperature regulation of phytoplankton and zooplankton growth re-emerged during early and
flow. Also, for the first time, we report here the jets signature detected in satellite SST and resemble a stationary Rossby wake induced by a force in the California Current (possibly, coherent in vertical from the sea surface throughout at least 700 m depth, and correlates scales, and to extract it a special filter is developed. The thermal signal is found to be ocean topography data. We use historical XBT profiles providing satisfactory coverage of Ubiquitous nearly-zonal jets have recently been found in the 1992-2002 mean dynamic structures.

VARIATIONS OF THE FLORIDA CURRENT TRANSPORT FROM 1964 TO 2007 AND THE RELATIONSHIP TO FORCING

Flowing through the Straits of Florida at 27°N, the Florida Current carries most of both the western boundary circulation of the North Atlantic Subtropical Gyre and the upper limb of the Atlantic Meridional Overturning Circulation. Variations in the Florida Current volume transport can result from changes in either horizontal or vertical gyres. Given the breadth of observation data that have been collected within the Florida Current over the past 44 years (more than 300 ship sections, and more than 25 years of continuous submarine cable observations), one might hope that it would be possible to determine the various forcing mechanisms behind the observed variations. A careful analysis of these different data sets demonstrates that at some times and at some times-scale there are possible links between Florida Current transport fluctuations and indices monitoring changes to the forcing fields (e.g. the North Atlantic Oscillation), however no simple relationship seems to hold over the full time period of the record. Statistical analyses using the continuous time series records illustrate the difficulties in extracting meaningful annual and interannual signals from this time series given the high degree of short-period variability observed in the Florida Current. Nevertheless, the Florida Current represents one of the best locations to search for meaningful ‘climate scale’ ocean fluctuations due to the exceptional length of the observational record.

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IN SITU DEPTH PROFILES AND BENTHIC FLUX MEASUREMENTS TO DETERMINE SEASONAL VARIATIONS OF BIOGEOCHEMICAL PROCESSES IN ESTUARINE AND CONTINENTAL SHELF SEDIMENTS

Estuarine and continental shelf sediments are areas where rates of natural organic matter respiration are extreme, yet very few studies have thoroughly investigated variations in biogeochemical processes and elemental fluxes in such environments. The Satilla River in the South Atlantic Bight, (Georgia, USA) is an example of a relatively pristine estuary that experiences pronounced seasonal variations. An autonomous benthic lander equipped with a benthic chamber for monitoring oxygen fluxes across the sediment water interface, and a micromanipulator for volumetric profiling of the main redox species in sediment porewaters (O₂, Mn⁴⁺, Fe⁴⁺, S²⁻ and other iron and sulfur complexes) discovered strongly for more than two years at multiple stations along the river and the nearby bay. Benthic chamber data indicate increased respiration during the late summer and early fall months. The in situ sediment profiles garnered clearly illustrate seasonal variability between times of high and low oxygen saturation along the river. A correlation to river discharge and salinity is also apparent. This study demonstrates that heterotrophy in continental shelf sediments is controlled by a combination of temperature, supply of inorganic and organic substrates, and hydrological processes.

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VALIDATION AND PHYSICS OF QUASI-STATIONARY OCEANIC JET-LIKE STRUCTURES

Ubiquitous near-zonal jets have recently been found in the 1992-2002 mean dynamic ocean topography data. We use historical XBT profiles providing satisfactory coverage of the eastern North Pacific to successfully validate these structures. The mesoscale jet-like signal is overwhelmed by both horizontal heterogeneity and temporal variability at larger scales, and to extract it a special filter is developed. The thermal signal is found to be coherent in vertical from the sea surface throughout at least 700 m depth, and correlates with SSH at about 0.7. Consistent with the high-resolution OFES model, dynamics of jets resemble a stationary Rossby wave induced by a force in the California Current (possibly, by secondary circulation in the California Current meanders). The wakes are Rossby waves with their crests tilted in the meandering direction and propagating against geostrophic flow. Also, for the first time, we report here the jets signature detected in satellite SST and ocean color data and discuss physical mechanisms sustaining these structures.

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UNDERSTANDING FLORIDA BAY HYPSOSALINITY AND WATER EXCHANGE

Florida Bay is made up of a collection of shallow basins separated by mud banks and mangrove islands situated between the Florida mainland and the Florida Keys. The bay is located downstream of the Everglades discharge that has been altered over the past century by human activities. Florida land use practices, leading to reduced water delivery to Florida Bay and subsequently elevated salinities. The reduced water flow has had the strongest impacts in the north-central region of the bay where extreme hypersalinity can develop along with degradation of water quality and sea grass die-off. Hypersalinity development was found to be caused by the combination of reduced fresh water inputs during the dry season and with weak basin water renewal rates. Using direct measurements of the volume transports through connecting channels, indirect estimates of the total transport to the subregions from mean sea level variability and a computer-generated animation model of observed sub-tidal sea level anomaly fields combined with wind vectors in the region, we show that interior basin water exchanges are weak and are controlled by local wind forcing.

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QUANTIFYING BIOLOGICAL MECHANISMS OF PLANKTON LAYER FORMATION IN EAST SOUND, ORCAS ISLAND, WASHINGTON

Small boat surveys were combined with laboratory experiments to quantify the importance of biological mechanisms in plume patch formation. Four stations along the longitudinal axis of East Sound, a shallow foray in the northeast Pacific were sampled on 15-day cruises in summer 2007. At each station, water column physical properties and phytoplankton fluorescence were recorded with a SeaBird CTD 19+. Using a horizontally-mounted Niskin bottle, water samples were collected to quantify species assemblage, phytoplankton standing stock and dissolved inorganic nutrients. Plankton growth- and mortality rates were determined experimentally. Over 5-weeks, multiple phytoplankton layer formation and dissipation events were observed, including surface and sub-surface layers. Species assemblages shifted between large diatoms and the smaller, toxic alga Heterosigma akashiwo. Heterosigma formed layers at the surface, whereas diatoms formed deeper layers. Intense, size-specific grazing on only larger phytoplankton may be an important structuring mechanism in shaping species composition and subsequently layer type. There was no deterministic relationship between physical properties of the water column and layer presence. These results demonstrate that several biological mechanisms can lead to or prevent layer formation and influence layer characteristics.

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ANALYSIS AND DETECTION OF BREVETOXIN ANALOGS IN MARINE SEDIMENTS: A NEW BIOMARKER?

Harmful algal blooms of Karenia brevis (K. brevis) produce a suite of lipid soluble polyether brevetoxins known to cause environmental, health and economic ill effects. Recently there has been an increase in the magnitude and duration of these blooms along the Florida west coast in the Gulf of Mexico. However, it remains unclear if the cause of these blooms is anthropogenically influenced or is the result of natural variability. The objective of this research was to analyze sediment from an area that have had known K. brevis blooms and to investigate if these compounds are being recorded in the underlying sediment, thus, potentially be used in paleo-reconstruction studies of these blooms and relate back to forcing mechanisms. Preliminary data indicates PB7-2 and PB7-3 are incorporated into recent marine sediments collected from the southwest coast of Florida with values ranging from 0.17-1.65 ng g⁻¹.

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THE ECCO2 HIGH RESOLUTION GLOBAL-OCEAN AND SEA-ICE DATA SYNTHESIS

The Estimating the Circulation and Climate of the Ocean, Phase II (ECCO2) project aims to produce increasingly accurate global-ocean and sea-ice data syntheses at resolutions that start to resolve ocean eddies and other narrow current systems, which transport
heat, carbon, and other properties within the ocean. ECCO2 data syntheses are obt-
tained from a global state-of-the-art deep ocean and sea ice configuration of the Massa-
thusetts Institute of Technology general circulation model (MITgcm) to the avail-
able satellite and in-situ data. A first ECCO2 data synthesis has been obtained using a
Green's Function approach. This presentation provides a brief overview of this ocean and
sea ice data synthesis, of the estimation methodology, of the solution characteristics, and
of some first science applications.

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INTERMITTENT MIXING IN EQUATORIAL DEEP JETS

The closure of the mass budget in the global ocean circulation is a fundamental and
still open problem. In particular, the dynamics of the resupply to the abyssal oceans with poten-
tial energy lost through polar deep water formation is poorly understood. Equatorial de-
ephenal jets are a significant reservoir of kinetic energy, and their transport reaches about 2/3
of the thermohaline circulation. For these reasons, the equatorial regions could be prefer-
ential places for abyssal mixing. Observations in the equatorial Atlantic show two distinct
vertical scales. On the deep jets, of scale 500-800m, is superimposed a smaller scale signal
of thin layers (50m) of well-mixed tracer fields. The thin layers coincide spatially with lati-
tudinal plateaus of zero potential vorticity within the deep jets and as such are interpreted
as due to inertial (and/or parametric inertial) instability mixing. In very high resolution
numerical simulations, equatorial deep jets of 500-800m vertical scale are produced by an
oscillating forcing in the western boundary of an ocean-scale basin. In such a flow, the
time-evolution of a passive tracer field shows a characteristic depth of mixing of about 50m.
A statistical analysis shows that the well-mixed layers are located in latitudinal plateaus of
zero potential vorticity. As an alternative to the breaking of internal waves, which appears
to be less significant at the equator, inertial instability can be a source of

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LOCAL TO GLOBAL - SCALE BIODIVERSITY PATTERNS ON CONTINENTAL
MARGINS: FIRST OUTPUTS FROM COML/COMARGE SYNTHESSES

Of all ocean habitats, the seafloor biota of the continental slopes experiences the narrow-
est vertical gradients of temperature, salinity, pressure, and food availability. These global-
uearly scales interact with local and regional phenomena to control the composition and
processes of an ecosystem distinct from continental shelves and abyssal plains. The syn-
theses, undertaken by COMARGE, aim at providing an estimate of the relative impor-
tance of local versus global-scale variations in habitat. At the larger scale, the concepts
of zonation and diversity maximum at mid-slope depth are revisited. Repetitions of pat-
tterns are sought in the Gulf of Mexico, on Brazilian and European margins. Comparisons
are made with Arabian Sea margins, influenced by an oxygen minimum zone. These
depth-related patterns are discussed in relation with their potential environmental drivers.
At a local scale, the concepts of COMARGE classification of habitats are introduced. The
merits of higher resolution imaging and bathymetric charting of the seafloor in mapping
habitats and quantifying habitat heterogeneity are underlined. The outcomes of these
ongoing syntheses are discussed in relation with the Known, Unknown and Unknowable
on continental margin ecology.

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EVOLUTION OF THE DEEP AND BOTTOM WATERS OF THE SOUTHERN OCEAN, DURING 1995-2005

Repeat hydrographic section data from the eastern Scotia Sea are used to investigate vari-
ability in deep and bottom waters of Southern Ocean origin. U.K. sections in 1995 and
1999 are combined with the 2005 occupation conducted via the U.S. CLIVAR/CO2 repeat
hydrography program (section A165). Significant changes in the Warm Deep Water (a region
of the previously observed warming) and Weddell Sea Deep Water (WSDW) are observed.
Changes in the abyssal circulation of WSDW are also observed. The WSDW changes are best explained by interannual varia-
tions in the density of the deepest waters exiting the Weddell Sea, superimposed on a
longer-term (decadal) warming trend. The interannual variations are related to changes in
the strength of the Weddell Gyre, reflecting large-scale atmospheric variability that poss-
ibly includes the El Niño / Southern Oscillation phenomenon. The Scotia Sea is the most
direct pathway for WSDW to penetrate northward and fill much of the world ocean abyss
as the densest component of Antarctic Bottom Water; thus the regional changes observed
potentially have globally climatic implications.

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DIURNAL INTERNAL TIDES OBSERVED DURING THE HAWAII OCEAN MIXING
EXPERIMENT

The Kaena Ridge, one of the main semidiurnal internal tide generation sites along the
Hawaiian Archipelago, is also a site of diurnal internal tide generation. The barotropic to
baroclinic conversion of diurnal tidal energy is simulated using a primitive equation model
and compared with mooring and shipboard observations collected during the Hawaii
Ocean Mixing Experiment. The generation of low trajectory diurnal internal tide beams
from the ridge crest is captured in the model and validated with the in-situ measurements.
The diurnal internal tide appears to feel the Earth’s rotation more than the semidiurnal
tide, which radiates directly away from the ridge, leading to a quasi-trapped diurnal
internal tide component that propagates around the island of Oahu. The trapped wave
encounters other areas of strong barotropic forcing, however, because of phase delays,
the barotropic forcing does work against the baroclinic wave, leading to a decrease in energy
levels that are independent of turbulent dissipation. Implications for the spatial variation
in tidal currents around the island are considered.

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PROBING THE NEPTUNE EFFECT: EDDY-TOPOGRAPHIC INTERACTION IN AN
ULTRA-HIGH-RESOLUTION PRIMITIVE EQUATION MODEL

Eddies interacting with sloping bottom topography tend to drive along-slope currents in
the direction of topographic Rossby wave propagation, with shallower water to the right of
the current vector in the Northern Hemisphere. This effect is well-established theoretical-
ly and in idealized (e.g. quasi-geostrophic) flow simulations. Here we apply a more realistic
primitive equation model, MOM4, to simulate wind-driven circulation in an idealized,
mid-latitude basin with varied bathymetry. Forcing is via a steady, meridionally varying
zonal wind stress, and horizontal resolutions ranging from O(1°) to 1/48° are considered.
Questions addressed include (i) how is the strength and direction of abyssal mean flows
affected by model resolution/eddy intensity; (ii) at what resolution (if any) do eddy inten-
sity and the mean flow field become insensitive to further refinements. A prescription for
adjusting viscous dissipation coefficients when model resolution changes is also suggested.

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EVOLVING TECHNOLOGICAL IMPROVEMENTS OF THE USF/CMS HF RADIAR
NETWORK

In an effort to improve our understandings on the workings of the coastal ocean for a
variety of environmental applications and to improve upon forecasts of storm surge for resi-
dents along the West Coast of Florida, the University of South Florida’s College of Marine
Science (USF/CMS) established a real-time Coastal Ocean Monitoring Prediction System
(COMPS) for the West Florida Shelf region. COMPS program observing assets consist
of arrays of offshore buoys and coastal tidal stations for surface meteorology and in-water
measurment (AIRC, standing for salinity, and currents; along with several High Frequency
(HF) Radar sites for offshore surface-current velocity field measurement. Commerically
available CODAR Seasonde long range HF Radar systems have been in operation for over
3 years in this challenging region of limited beach availability/access, low wave energy,
severe weather, and frequent lightning activity. The intent of this presentation is to pre-
sent the ongoing technological improvements that have occurred within our evolving HF

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Radar network, present and discuss achieved historical performance, and discuss possible system enhancements/modifications and their effect on overall system performance.

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INTERANNUAL VARIABILITY AND LONG TERM TRENDS IN EASTERN PACIFIC UPWELLING ECOSYSTEMS

Time series of in situ biogeochemical and physical data from Peru, California and the eastern equatorial Pacific have been compiled. These time series have been analyzed using the same techniques to extract the interannual variations and trends of the time series, to highlight different regime shifts and to examine changes in the seasonal cycle. The impact of the 1982-83 and 1997-98 ENSO events are also very clear. The techniques used are standard time series analysis as well as newer spectral methods. We look at surface and subsurface temperature, salinity, oxygen, chlorophyll, nitrate, nitrite, phosphate and silicate as well as some derived parameters such as N/P ratios and N*. The presentation highlights the similarities and differences among the regions.

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TRACER-DERIVED TRANSIT TIME DISTRIBUTIONS IN THE NORTH ATLANTIC ALONG 36ºN AND INFERRING ANTROPOGENIC CARBON CONCENTRATIONS

We present Transit Time Distributions (TTDs) derived from the transient tracers data set of chlorofluorocarbons (CFC-11, CFC-12) and sulfur hexafluoride (SF₆) measured along 36ºN in the North Atlantic during the May-June 2005 Charles Darwin cruise. The CFCs and SF₆ tracers complement each other, since their atmospheric source functions are different. In particular, SF₆/CFC ratios is a good dating tool of post-1970s water because, unlike the CFC-11/CFC-12 ratios, which have not changed consistently for the last 3 decades, the SF₆/CFC continues to increase. Using the concept of Transit Time Distributions (TTDs) makes no assumptions about the magnitude of mixing in comparison to the common tracer ages or tracer ratio ages. The TTDs from the surface to the interior are characterized by a mean transit time (τ) associated with a width (Δ) that implicitly includes the effects of mixing on transport. The derived TTDs are used to estimate the distribution of Anthropogenic Carbon along 36ºN and we corroborate our results to the inventory of Brown et al., who applied the Δ* and TrOCA method to the same data set.

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A POSSIBLE ROLE FOR AGGREGATING FORAMINIFERANS IN THE GROWTH OF DEEP-WATER CORAL BIOHERMS

Exploration of deep-water bioherms dominated by the scleractinian corals Lophelia pertusa and its role in the feedback of the ocean carbon cycle is a priority for climate research. The CLIVAR/GOOS Indian Ocean Panel—a consortium of scientists from major oceanographic agencies around the world—prepared a prepared a plan for Indian Ocean observations. The key initial step in coordinating the implementation (NCODA) system is scheduled for transition to the Naval Oceanographic Office (NOVAOCENO) by the end of 2007. With ~7 km mid-latitude resolution, the system will 1) depict the location of mesoscale features such as oceanic eddies and fronts, 2) provide the 3 dimensional ocean temperature, salinity and current structure, and 3) provide ice concentration and thickness along with a capability to predict areas of lead opening and closings. The system (minus PIPS) has been running in real-time since December 2006. A series of phased validations/evaluations for the system began in 2007 and will continue this and next year. These will be performed relative to the existing operational global ocean nowcast/forecast system running at NOVAOCENO. First year evaluations include examination of mixed layer depth, sonic layer depth, vertical profiles of eddy kinetic energy, bottom pressure, and sea surface height at tide gauge stations. Second year evaluations will look at HYCOM as a provider of boundary conditions to nested models, comparisons with drifting buoys, current cross-sections, eddy tracking and ice performance. Validations have been performed on both nowcast and forecast fields. A subset of these results will be presented.

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INDOOS—A SUSTAINED OCEAN OBSERVING SYSTEM IN THE INDIAN OCEAN FOR CLIMATE RESEARCH

The CLIVAR/GOOS Indian Ocean Panel—a consortium of scientists from major oceanographic agencies around the world—prepared a prepared a plan for Indian Ocean observations. The key initial step in coordinating the implementation (NCODA) system is scheduled for transition to the Naval Oceanographic Office (NOVAOCENO) by the end of 2007. With ~7 km mid-latitude resolution, the system will 1) depict the location of mesoscale features such as oceanic eddies and fronts, 2) provide the 3 dimensional ocean temperature, salinity and current structure, and 3) provide ice concentration and thickness along with a capability to predict areas of lead opening and closings. The system (minus PIPS) has been running in real-time since December 2006. A series of phased validations/evaluations for the system began in 2007 and will continue this and next year. These will be performed relative to the existing operational global ocean nowcast/forecast system running at NOVAOCENO. First year evaluations include examination of mixed layer depth, sonic layer depth, vertical profiles of eddy kinetic energy, bottom pressure, and sea surface height at tide gauge stations. Second year evaluations will look at HYCOM as a provider of boundary conditions to nested models, comparisons with drifting buoys, current cross-sections, eddy tracking and ice performance. Validations have been performed on both nowcast and forecast fields. A subset of these results will be presented.

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Residence time in Tampa Bay and its variation with natural and anthropogenic influences

The non-tidal (residual) circulation in Tampa Bay strongly influences the transport of suspended biological and chemical quantities within the bay. Residence time, essentially the time for a substance or volume to be removed from the bay, is expected to vary with environmental conditions and bathymetry. A realistic ECOM-based ocean model is used to examine changes in residence time within Tampa Bay. The model is first forced with
WHAT CONTROLS THE RATE OF ORGANIC MATTER PROCESSING IN MARINE SEDIMENTS: GEOCHEMISTRY, PHYSICS OR ECOLOGY?

About a quarter of the organic matter that is exported from the surface of the ocean eventually arrives at the ocean floor, and within the sediment, another 90% of this flux is further degraded. There is great interest in the processes controlling the processing of organic matter within marine sediments, because decomposition fuels the benthic ecosystem and burial depletes the ocean’s carbon cycle. However, explaining why some organic matter in marine sediments is mineralized, and what controls the mineralization rate, has proven to be a real challenge. Past explanations favour either a “chemical” view (organic matter consists of a mix of different compounds, and the chemical structure of each compound determines the kinetic rate by which it succumbs to microbial enzyme attack) or a “physicochemical” view (the sediment redox gradient entrains the dominance control, through oxygen exposure or physical exclusion of the digestive enzymes). However, organic matter decomposition results from the metabolic activity of the benthic food web, and so, one can ask whether and how food web ecology matters. To examine this, we constructed a database of decay coefficients of organic matter across a wide range of oceanic sediments, and parameterized it at a function of the flux of organic matter to the sediment. This provides a novel and intriguing “ecological” perspective on organic matter decomposition: the more food the sediment ecosystem receives, the faster the food web processes the incoming food.

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POTENTIAL EFFECTS OF EXOPOLYMERIC SUBSTANCES ON ENGINEERED SILVER NANO Particles (ESNs) BIOAVAILABILITY AND TOXICITY TO A COASTAL MARINE PHYTOPLANKTON

The production of extra-cellular polysaccharides, the main components of exopolymeric substances (EPS), by the coastal marine diatom Thalassiosira weissflogii was examined after exposure to different concentrations of engineered silver nanoparticles (ESNs), under different nutrient conditions (nutrient enriched, and nitrogen- or phosphorus- starved conditions). ESNs were toxic at sub-µg/L concentrations, as determined by the significance of the results from the metabolic activity of the benthic food web, and so, one can ask whether and how food web ecology matters. To examine this, we constructed a database of decay coefficients of organic matter across a wide range of oceanic sediments, and parameterized it at a function of the flux of organic matter to the sediment. This provides a novel and intriguing “ecological” perspective on organic matter decomposition: the more food the sediment ecosystem receives, the faster the food web processes the incoming food.

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WORKFORCE SHORTAGES IN THE OFFSHORE INDUSTRY: CAN OOS COMPETE?

Employers in the offshore oil and gas industry are experiencing a perfect human resource storm. The growing global demand for oil, fueled largely by the rise of wealth and industrialization in China and India, is pushing oil prices to record highs. These prices make it economically feasible not only to extract oil from the deeper waters of areas like the Gulf of Mexico, but also to rework older shallow fields. Scores of new drill rigs, dynamically positioned multi-capability service vessels, and remotely operated vehicle (ROV) systems are being built to meet the demands noted above, and to meet the anticipated continuing and growing demand for oil. All of this, coupled with an aging and retiring experienced workforce has resulted in shortages of engineers, vessel officers and crews, ROV pilots, electronics and hydraulics technicians, welders; and employees in many other occupations. This presentation will describe the state of the offshore industry, explain how the industry is coping, and explore how the industry’s workforce issues will impact other industries, including the ocean observing system industry, that are competing for human resources.

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DATA AS SIMILATION ON THE NW EUROPEAN SHELF

The 3-D baroclinic hydrodynamic coastal ocean model POLCOMS of the Proudmound Oceanographic Laboratory in Liverpool has been used to describe and hindcast the on-shelf ocean behavior for the year 2004. For the same time span several satellite missions like TOPEX, POSEIDON and ENVISAT provide sea surface height measurements. These data are used in an Ensemble Interpolation assimilation scheme to update the ocean model. In addition to the error statistics of the satellite, the correlation structure of the model is necessary for successful integration of real measurements. This talk will follow the building blocks of data assimilation: introducing the North West European Shelf as area of interest, presenting the ocean model and the corresponding background information, introducing the realization of the assimilation code and focusing then on the impact of the satellite data. Here it is especially interesting to investigate the model’s comparison with tide gauge reference data with the aim of assessing the value of assimilating alimetry data in shelf seas with strong tidal signals.

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OBSERVATIONS OF STRONG, PERSISTENT, 4–10 DAY-PE RIOD INTERNAL WAVES IN HOOD CANAL, WASHINGTON

Recent observations from moorings within Hood Canal, a fjord reach of Puget Sound, Washington, have led to the discovery of persistent, full-depth waves with periods of 4–10 days and velocity magnitudes comparable to the barotropic tide at ~0.07 m/s. With the local inertial period 16 hours, these waves are significantly sub-inertial, or well below the lower frequency limit for freely-propagating oceanic internal waves. Observations suggest that in the along-channel direction these waves behave as linear internal waves without rotation, with the narrow-channel (~2 km) likely suppressing the Coriolis term. Observations at Hood Canal’s southern end show predominantly upward phase propagation indicating downward energy fluxes. Horizontal energy flux calculations give primarily northward (up-channel) fluxes with typical values of 50 kW. The downward energy flux and a strong correlation of the horizontal energy flux with wind stress suggests the waves are wind-generated, explain ing a strong seasonal cycle in wave energy. Theoretical ray paths indicate that these waves may reflect critically at the bottom, potentially elevating near-bottom mixing and influencing nutrient and oxygen fluxes in Hood Canal’s frequently-hypoxic southern end.

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A 13C LABELING STUDY TO TRACE CARBON FLOWS WITHIN NATURAL PLANKTON COMMUNITIES AT ELEVATED CO2

We will present the results of a deliberate 13C DIC tracer addition experiment during the Pelagic Ecosystem CO2 enrichment study (PeECE III). Following nutrient additions at day 0 and 13C DIC additions at day 1, bloom development of a natural plankton community was studied in triplicate at 750, 1050 and 1500 ppm CO2 for a period of 25 days. The transfer of 13C from the DIC pool to phytoplankton and heterotrophic bacteria in the suspension was monitored. The increase in 13C uptake by phytoplankton and heterotrophic bacteria indicates the achievement of the 13C DIC tracer addition experiment. These data will be combined with a simple model that allows identification and quantification of apparent differences in carbon processing in natural phytoplankton communities at different CO2 levels.

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OCEAN CIRCULATION WITHIN A MID-SIZED BAY OR GULF TO WIND AND REMOTE FORCING

We consider the barotropic, wind-forced ocean circulation within gulfs or bays that are of order the external deformation radius in extent, with specific application to Spencer Gulf, South Australia.
Australia. Surprisingly, this problem seems to have attracted little attention. Rectangular
hull geometries are adopted so that analytical and numerical solutions can be compared.
For the low-frequency wind forcing, these solutions show that the fundamental balance is
between the wind stress and sea level gradient whereby water is raised or lowered at the
head of the gulf or along the sides of the gulf. Even with strong winds (0.1Pa), the currents
within the gulf are weak due to side-wall effects. The interaction with the shelf circulation
and coastal trapped wave generation and scattering are discussed.

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EVOLUTION OF LEAD CONCENTRATIONS IN THE WESTERN MEDITERRANEAN ATMOSPHERIC AEROSOL DURING THE LAST TWENTY YEARS

Temporal and spatial variations in Sea Surface Temperature (SST) and Ocean-color
fields in the Southern Atlantic and Gulf of Mexico (SAOGOM) are examined for 2004
February to December 2007. Temperature and Ocean-color data are optimally interpolated
daily cloud-free SST and daily cloud-free Chlorophyll. a . We also use 10m winds to characterize
surface wind variability which affects ocean circulation, surface temperature and color
distributions. Three sub-regions in SAOGOM are analyzed: the South Atlantic Bight
(SAB) near the Charleston Bump, central Gulf of Mexico (GOM), and the Louisiana-
Texas (LATEX) shelf. The SAB outer shelf and slope is predominantly forced by the Gulf
Stream, meso-scale eddy shedding, and topographically forced meanders. The central
GOM is governed by wind shedding and frontal variations of the Loop Current. The
LATEX coast is affected by local winds, Mississippi river discharge, and tropical cyclones
during summer months. Case studies on characteristic hydrographic conditions during
extra-tropical and tropical cyclone passage, large anoxic river runoff, and strong deep-
sea ocean forcing events will be presented to quantify covariations between SST and Ocean-
color, and their respective temporal and spatial decleration scales.

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PARAMETERIZING THE MIXING DUE TO SALT FINGERS

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or comparisons must be between several times (warmer). We have mostly worked with the former situation and usually find low, implied mortality rates, with zero falling within an approximate confidence limits. Is very high mortality of early nauplii implausible? The report covers more data and more advanced modeling than presented at ASLO in 2005.

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QUANTITATIVE EVALUATION OF A MULTI-TROPHIC LEVEL ECOSYSTEM MODEL FOR POPULATION DYNAMICS OF THE INVASIVE SPECIES BYTHOTREPHES LONGIMANUS IN LAKE MICHIGAN

The LM-Eco model constitutes a first step toward a comprehensive Lake Michigan ecosystem productivity model to investigate dynamics among multiple trophic levels within the lower water food web of the lake. The effect of the invasive species Bythotrephes longimanus on individual zooplankton species was investigated quantitatively based upon extensive field data collected at multiple locations in Lake Michigan during the 1994-1995 Lake Michigan Mass Balance Project (LMBBP). In addition, more recent field data collected for zooplankton and Bythotrephes longimanus in Lake Michigan beyond the 1994-1995 time period was analyzed for population level trends. Further, the LM-Eco model was utilized in conjunction with this field data to forecast population dynamics of Bythotrephes longimanus and zooplankton in Lake Michigan throughout a 15 year period beyond the 1994-1995 LMBBP. This abstract does not necessarily reflect EPA policy.

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FUTURE REGIME SHIFT IN FEEDBACKS DURING ARCTIC WINTER

The Arctic is among the regions where climate is changing most rapidly today. Climate change is amplified by a variety of positive feedbacks, many of which are linked with changes in water vapor, cloud cover, and other cloud properties. In this study we use a global climate model to examine several of these feedbacks, with a particular emphasis on determining whether there are significant temporal trends in these feedbacks that would make them stronger or weaker during the 21st century. The model results indicate that one of the most significant feedbacks on Arctic surface air temperature is related to increasing water vapor, cloud cover, and cloud optical depth. The results also indicate that the enhanced Arctic wintertime warming slows toward the end of the 21st century. This appears to occur, in part, because of a regime shift during Arctic winter in which the positive feedback involving downward longwave radiation, water vapor, and cloud cover weakens substantially.

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DIRECT AND INDIRECT EFFECTS OF UV RADIATION ON BACTERIAL ABUNDANCE AND COMMUNITY STRUCTURE IN PONY LAKE, ANTARCTICA

Pony Lake, a saline, hypersaline trophic pond located on Cape Royds, Antarctica, supports a rich microbial community. Although nutrients are not limited, Pony Lake is an extreme environment for life, specifically due to a high level of ultraviolet radiation in the summer, 6 months of darkness and extreme cold temperatures. Monitoring Pony Lake through two field seasons revealed temporal and seasonal changes in bacterial abundance and community structure. The results from season one suggest changes in bacterial abundance were linked to two factors: 1) direct damage to bacteria from sunlight and 2) indirect inhibition from decreased DOM bioavailability due to photobleaching. In the second season, under diminished UV intensity, the results show no evidence for decreased DOM bioavailability or bacterial damage. While photobleaching decreased the overall UV/Vi absorbance and fluorescence intensity in Pony Lake water from both seasons, only in season one, did photobleaching reduce the quantity of redox-active functional groups. Taken together these results suggest UV light influences bacterial community composition both directly by damaging non-UV resistant cells, and indirectly, by rendering changes in the bioavailability of DOM.

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DIAGNOSTIC STUDY OF A BAROCLINIC QUASIGEOSTROPHIC MODEL OF THE KURSHIO OFF JAPAN

We examine the properties of a baroclinic quasigeostrophic regional model of the Kurashio off the coast of Japan. This model has been used successfully in data assimilation experiments, and demonstrated the capability of predicting the formation of the large meander a year in advance, initialized by assimilating satellite altimetric data for 18 days prior to the start of the experiment. The first guess was a steady state in which the meander was absent. Posterior velocity time series showed that the underlying hypothesis of Fey 1972 could be rejected. Here we examine in detail the qualitative properties of the model, i.e., the structure of its attracting sets, and begin to relate this qualitative structure to the Kurashio as observed, through comparisons to observations. We also compare the output to that of a finely-resolved primitive equation model, in order to discern the importance of ageostrophic effects, and the errors incurred through the assumptions underlying quasigeostrophy.

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PHOTOBIOGEOCHEMISTRY OF CARBON MONOXIDE (CO) IN THE COASTAL OCEAN: FROM GENES TO SPACE

Studies of CO in marine waters have confirmed its source (photochemistry) and sinks (bacterial consumption, air-sea exchange). Recent field studies have concluded that most CO in surface waters is recycled by CO-oxidizing marine bacteria, limiting atmospheric ventilation, consistent with studies showing that they are not a novelty; estimated at 1 in every 14 cells in the Sargasso Sea, with similarly high frequencies in US coastal waters. Our model on the model was implemented on the 10-yr SEWONS ocean-color record to esimate monthly averaged UV attenuation and CDOM absorbance for the Middle and South Atlantic Bights. Underwater scalar solar irradiance (STAR model), and published CO quantum yield spectra were used to generate depth-resolved CO production rates in the mixed layer. Assuming 80 percent of CO is consumed by bacteria, this model indicates that only a small fraction of the total bacterial production in the study area could be supported by CO oxidation (a maximum of only 0.2 percent in July and considerably less in colder months), an interesting paradox considering the apparently large number of marine bacterioplankton that maintain genes for CO oxidation.

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QUANTIFICATION OF FUNCTIONAL GENE EXPRESSION OF FE(III) AND SULFATE REDUCING PROKARYOTES IN SALT MARSH SEDIMENTS

This study quantified the gene expression of functional targets for Fe(III)- and sulfate-reduction to investigate the competition between these terminal-electron-accepting processes in marine sediments. Citrate synthase (glaA) and dissimilatory sulfite reductase (dsrA) genes were examined as molecular proxies for iron and sulfur reducing prokaryotes, respectively. Sediment core samples with varying levels of reactive Fe(III) were used to construct microcosms with treatments that were unamended, amended with acetate, or amended with acetate plus molybdate (a specific inhibitor of sulfide reduction). In agreement with published work, rate measurements showed that the coupling of Fe(III) reduction to reorganize anaerobic respiration was dependent upon the abundance of Fe(III)-reducing communities. Quantitative transcription real time PCR of glaA and dsrA genes indicated copy numbers were positively correlated with Fe(III) and sulfate reduction rates, respectively. Site-specific variations in gene copy number supported rate measurements to indicate differences in microbial community structure/function. To our knowledge, we are the first to demonstrate that quantification of the in situ metabolism of known Fe(III)- and sulfate-reducers is possible in marine sediments using molecular proxies in conjunction with rate measurements.

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GROWTH AND PRODUCTIVITY OF PHAEOCYSTIS ANTARCTICA AND FRAGILARIA CYPRIUS UNDER SIMULATED MIXED LAYER IRRADIANCE

The pyrmenophyete Phaeocystis antarctica dominates deep mixed environments in the Ross Sea while diatoms dominate shallow mixed layers. Understanding what controls the dynamics of these groups is essential because they utilize nutrients differently and support dissimilar food webs. We cultured P. antarctica and the diatom Fragilariopsis cylindrus under dynamic irradiances that simulated different mixed layer depths and measured their productivity in relation to irradiance (P vs. E). In both species, chlorophyll-a-normalized maximum CO$_2$ uptake ($P_{max}$) and growth were highest in the deeply mixed treatment that had a dark period. In all irradiance treatments, $P_{max}$ and the initial slope of the P vs. E curve
As the Quasi-renewable resource for nourishing the updrift barrier system, sediment composition around the Crozet Plateau reflects the dual control on input from the elevated export production and the proximity to the volcanic islands. The major lithogenic input is identified from bulk sediment geochemistry as Crozet island basalts. Significant heterogeneity in the distribution of biogenic and lithogenic phases occurs downslope. The sediments are characterised by a significant biogenic base sedimentary record and a mixed titanium-iron oxide of volcanic origin and there are multiple mass flow or turbidite events at the base. Meridional trends in $\delta^{18}O$-corrected Holocene mass accumulation rates of calcium carbonate, biogenic silica, lithogenic material, organic carbon, authigenic U, Ba$_{soil}$, and $^{210}$Pb/$^{234}$Th ratios are compared with published data for the Indian sector of the Southern Ocean. The core-top proxy records indicate that there is a significant enhancement of biogenic silica and organic carbon export both north and south of the Plateau and lower values east of the Plateau. The presence of the Crozet Plateau in the significant impact on organic carbon production and export throughout the Holocene corroborating shipboard and remote observations of enhanced productivity in this region.

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CAPTURING AN EPISODIC FRESHWATER DISCHARGE EVENT BY COASTAL OCEAN MONITORING AT THE ARANAS PASS TIDAL INLET, SOUTH TEXAS

The coastal environment is a challenging place for oceanographic observations due to its dynamic nature and rapid response to external forcing. It is critical to conduct a continuous observation at strategic locations to detect episodic climate events and their impacts on the ecosystem. Multi-parameter observations were made throughout the water column at the U.S. Marine Science Pier at the Aransas Pass inlet during the July 2007 flood. The inlet is a major exchange pathway between the Gulf of Mexico and several bays in South Texas. Over several tidal cycles during the peak of the discharge event the upper water column was mostly occupied by colder and fresher water with higher oxygen and chlorophyll a content than offshore waters occurring near the bottom. These currents were stronger at the inlet than at the surface with occasional opposite flow, inducing strong vertical shear and mixing. More recent data from the automated profiling at the pier will also be presented. Continuous water column measurements at a local inlet show a potential to detect episodic events in the coastal environment.

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Sediment Transport Trends Along the Chandeleur Islands, Louisiana: Implications for Island Sustainability and Barrier Island Management

Bathyetric analyses (1880-2006) for the Chandeleur Islands reveal long-term trends of barrier extension and retreat and recently, barrier disintegration, shoreface erosion (vertically 1-2 m), and mixed erosion and accretion on the backbarrier platform (0-4 m). Volume calculations indicate $\sim150\times10^6$ m$^3$ of sediment has been deposited downdrift (northward) and seaward of the northern terminal spit, whereas the southern end of the barrier has undergone long-term erosion. Bathyetric and shoreline analyses suggest that the islands are impacted primarily during major hurricanes, resulting in shoreline retreat in some sectors and shor development and in-place drowning in others. Katrina removed $>$90% of sand comprising the barriers exposing backbarrier marshes to wave attack. During the following year, $>$50% of the length of the northern Chandeleurs shoreline continued to erode $>(200$ m). However, during year two of recovery, marsh islands served as nucleation sites for sand accumulation along the northern arc. Incipient barrier islands now protect marshes. Contrastingly, southern segments of the chain, where marsh islands were absent, have undergone transgressive submergence. Downdrift sand reservoirs may provide a quasi-renewable resource for nourishing the updrift barrier system.
will be validated using quantitative real-time PCR (qRT-PCR). Results from qRT-PCR will be compared to the microarray data. Development of the protocols used will be presented and insights derived from preliminary results will be discussed.

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A PARAMETER TO DESCRIBE INTERNAL GRAVITY WAVE SHOALING

We propose the use of an acceleration-based nondimensional number, γ, for parameterizing the shoaling behavior of internal gravity waves. It expresses the acceleration of wave excursion on the bottom slope relative to the gravitational acceleration projected onto the slope. Unlike the commonly used Iribarren number, which is based on wave geometry, γ may be calculated easily from velocity profiler data. The utilities of the two parameters are explored by examining the reflectance of three types of shoaling waves: sinusoidal surface waves, solitary internal waves, and coastal internal wave groups. We show that γ collapses reflection values of the different wave types. This result, combined with the ease of calculation from oceanographic measurements, suggests that γ may be useful in a wide range of applications.

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LATERAL AND VERTICAL SEDIMENT HETEROGENEITY AND ITS RELATIONSHIP TO NEARSHORE MORPHOLOGY

Nearshore sediment heterogeneity enhances the already complex nature of the nearshore, defined here as the swash, surf, and breaker zones. In sediment-winged systems, the source of shoreline heterogeneity is often shallow, subtidal strata, which can become exposed/buried over relatively short time scales. Quantifying vertical heterogeneity of the nearshore may help us better predict sediment variability at the nearshore surface (or the lateral variability) and in turn, better understand the relationship between coastal morphology, stratigraphy, and lithology. To this end, eighteen vibracores were collected from the nearshore of the Outer Banks, North Carolina from within and outside a previously identified shore-parallel bar field. Cores from shore-parallel bars/troughs show greater variability in median grain size than those taken from a convex shoreline. Geophysical data show a coarser underlying stratum is exposed from the axis of the trough and on flanks of shore-parallel bar. Changes in the cross-sectional morphology of bars through time indicate a possible feedback between bar-associated sand and coarser, trough sediment. Observed lithologic heterogeneity is related to recent coastal stratigraphy and has implications for genetic analysis of shelf morphologies.

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LARVAL DISPERSAL AND POPULATION DYNAMICS IN A TURBULENT COASTAL OCEAN

Larval dispersal occurs within a turbulent coastal ocean, where coastal eddies are ubiquitous and driving the stirring of water parcels. Hence, larval dispersal is strongly controlled by coastal eddying motions. In contemporary marine ecology however, a vast majority of models oversimplify larval dispersal by ignoring coastal eddying motions and describing it as a simple deterministic diffusion process. We assess the role of coastal eddying motions in larval dispersal and their consequences on nearshore marine population dynamics. The role of coastal eddying motions in larval dispersal is assessed using idealized simulations of time-evolving coastal circulations of the California Current and also using a simple scaling theory. It is found larval connectivity is stochastic on annual time scales, reflecting coastal eddying motions regardless of topographic, demographic, and climate variability. Eddy-induced stochasticity in larval dispersal can have important consequences in stock dynamics and community structures of nearshore marine populations. As an example, we demonstrate that coastal eddying motions can be a dominant mechanism enabling marine species co-existence in the nearshore turbulent environment.

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PHOTOPROTECTION AGAINST UV-B RADIATION IN FRESHWATER PLANKTON: A COMPARATIVE APPROACH ACROSS A BROAD TROPHIC SPECTRUM

The ability to mitigate the amount of ultraviolet-B radiation absorbed by individual organisms was quantified in a broad spectrum of planktonic species commonly found in temperate fresh water lakes. Photoprotection was determined experimentally as the amount of DNA damage induced in different species compared with that induced in purified DNA donors exposed at the same time and under the same conditions. A total of fourteen species was examined and included various bacterioplankton, phytoplankton, protozoa, Daphnia and fish, both larval and adult. Damage was determined as the frequency of cyclobutane pyrimidine dimers per megabase DNA using a radioimmunoassay that specifically detects this lesion. We found that all of the organisms showed a high level of photoprotection, with reductions in potential CPD frequencies from ~80 to ~98%. Within this range, however, we found significant variation both between and within the major groups examined.

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DMS & DMS LYSE LEVELS IN THE CORAL ALGAL SYMBIONTS, SYMBIODINIUM SP.

Dimethylsulfiniopropionate (DMS) is the precursor of DMS, a significant compound in the global sulfur cycle. Dinoflagellates are large producers of dimethylsulfiniopropionate and dinoflagellate symbionts produce among the highest levels. Various coral species contain DMS produced by resident symbiotic dinoflagellates (Symbiodinium sp.) and when under stress, release the odor of DMS. DMS is formed from DMS via the enzyme, DMS lyase, which some, though not all algae contain. Functions of DMS as an osmolyte, grazing deterrent, nitrogen storage molecule and antioxidant are proposed in algae other than Symbiodinium sp. It is unknown if the coral symbiotic algae (Symbiodinium sp.) or host tissues themselves contain DMS lyase. Current research is focusing on baseline DMSP in a variety of Symbiodinium sp. clades. These studies determine levels over a growth cycle, as DMS varies with growth cycle conditions in other species. DMSP levels varied among Symbiodinium sp. strains; maximal levels in all strains were in exponential growth phase Day 14. Symbiodinium algal strain 830 with antibiotic addition displayed DMS lyase.

Future work focuses on DMS lyase host involvement in tropical sea anemone, Aiptasia sp.

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WEB ACCESS TO SATELLITE ALTIMETER CALIBRATIONS VIA THE GLOBAL TIDE GAUGE NETWORK

The methods for time-dependent errors in satellite altimetric data via comparisons with sea level time series from the global tide network have been described in multiple publications and presentations. These methods have been recently updated and extended and this work has been submitted for publication. More recently, with support from the NOAA and NASA we have created a web-based system to make these comparisons easily available to the wider community. Multiple versions of nearly all currently available altimeter datasets are currently available. The emphasis of this presentation is to illustrate what is available, how it can be accessed and used, and how other altimeter datasets could be added to the list of products.

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REFRACTORY BLACK CARBON IN THE CHESAPEAKE BAY AND LOWER GANGES-BRAHMAPUTRA

The Chesapeake Bay (C. Bay) and Ganges-Brahmaputra River (G-B) complex represent two important coastal zones for carbon cycling. We isolated refractory BC in a core from the mainstem of C. Bay and in surface sediment of the lower G-B and Bay of Bengal using a chromic acid oxidation procedure. In the lower G-B and the Bay of Bengal, BC constituted 17-32% of the TOC and appears to have been derived from a mixture of sources including petrogenesis. In contrast, throughout the late Holocene, BC in C. Bay sediments represented 69-82% of the TOC and appears to have been derived from a mixture of sources including petrogenesis. In contrast, throughout the late Holocene, BC in C. Bay sediments represented 17-32% of the TOC and appears to have been derived from a mixture of sources including petrogenesis.
NUMERICAL MODELING AND PARAMETERIZATION OF DENSE SHELTER WATER FORMATION DUE TO BRINE REJECTION OVER A GENTLE SLOPE, WITH AN APPLICATION TO THE SEA OF OKhotsk

Eddy resolving simulation of dense shelter water formation over a gentle slope, due to brine rejection, is presented. The model configuration consists of a 200 m deep, 330 km by 330 km grid, centered on the northwestern shelf in the Sea of Okhotsk, where the heaviest water in the North Pacific region forms. The shelf water density is determined by a balance between surface salt flux and baroclinic-eddy flux offshore. It is found that the shelf water density varies sensitively with the slope inclination. If the inclination is smaller than 0.01, the density decreases with depth; the inclination becomes larger; however, the density is nearly invariant, or even increases slightly. This sensitivity comes from competing effects of the sloping bottom on baroclinic stability; one is a destabilizing effect due to increase of the density-interface inclination with the bottom slope, while the other is a stabilizing effect via potential vorticity distribution in the upper and lower layers. The destabilizing effect is important for the gentler slope. Eddy flux is parameterized including the effect of the slope, which evaluates the density of the shelf water very well.

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A RECALIBRATION OF AVHRR: TOWARDS A HIGHER QUALITY AND ACCURATE DATASET FOR SST RETRIEVAL

Fundamental to accurate sea surface temperature measurements from space–borne observations is a proper understanding of the instrument calibration, particularly with the move towards physically based retrieval algorithms where absolute radiance accuracy is required. Perhaps the most widely used instrument is the AVHRR, which provides the longest continuous record of space–based observations of the SST currently available. However, while the instrument itself can be shown to be very stable, previous and current calibrations can only provide radiances accurate to 0.2-0.5K. We have derived a new physically based calibration based on the pre-launch data for the AVHRR instruments which addresses many of the problems with the previous calibration and can reduce the errors to ~0.05K. We also show that the old calibration is likely to have introduced both temporal and spatial (including latitudinal) biases into the AVHRR data, many of which cannot be fully accounted for by using Pathfinder–like running means to derive the SST retrieval coefficients. Finally, we discuss problems with the in–orbit calibration such as Earth shine and solar contamination which can be corrected for with our new calibration.

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MOSO SCALE VARIATIONS REPRODUCED BY THE JCOP2 REANALYSIS

We have created the high-resolution reanalysis data in Japanese coastal ocean by using the 4th JCOP2 ocean forecast system, which has been developed to fully utilize the potential of various types of observations, as a part of a cooperative study between FRA and JAMSTEC (FRA-JCOP2). The reanalysis skill is evaluated by regional metrics defined by the in-situ temperature/salinity profiles and the surface velocity calculated from both the satellite altimetry and drifter buoy data. The intensive use of the various kinds of metrics is quite useful to determine unknown parameters built in the three-dimensional variational assimilation (3DVAR) system implemented in JCOP2. It is found that some parameters: 1) mean sea surface height (SSH) field required for derivation of the model SSH anomaly, 2) horizontal scales of background error covariance in the 3DVAR cost function, and 3) EOF modes representing waters property of the temperature/salinity in the 3DVAR system, significantly affect the reanalysis skill. Meso-scale events reproduced by the JCOP2 reanalysis path variations of the Kuroshio-Kuroshio Extension, southward intrusion of the Oyashio coastal branch, life histories of cyclonic/anticyclonic eddies east of the JCOPE2 reanalysis: path variations of the Kuroshio-Kuroshio Extension, southward intrusion of various types of observations, as a part of a cooperative study between FRA and JCOPE2 ocean forecast system, which has been developed to fully utilize the potential of various types of observations, as a part of a cooperative study between FRA and JCOPE2 reanalysis system, which has been developed to fully utilize the potential of various types of observations, as a part of a cooperative study between FRA and JCOPE2.
ably large potential dust sources, but recent models of Jerry Wiggert, using both GISS and GOCART-derived simulations to estimate dust fluxes, suggest that there is insufficient aeolian Fe to sustain high levels of monsoon-driven primary production and C export. A critical issue is how much interannual variability there is in air mass trajectories and Fe supply, and how the decade-scale increase in monsoon intensity reported elsewhere may be influencing these fluxes.

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3D GRANULAR LANDSLIDE TSUNAMI EXPERIMENTS

Tsunamis are commonly associated with submarine earthquakes. However more than 10% of all tsunamis are generated by landslides or landslide like volcano collapses with subaerial, partially submersed or submarine origins. Landslide generated tsunamis were investigated in the easternmost circulation basin of the Baltic Sea on the basis of the geological similarity. The landslide emplacement characteristics were controlled by means of a novel pneumatic landslide generator. Deformable landslides of subaerial and submarine origin were modeled with granular materials. Measurement techniques such as particle image velocimetry (PIV), multiple above and underwater video cameras, multiple acoustic transducer arrays, as well as resistance wave and runup gauges were applied. The wave generation was characterized by an extremely unsteady three phase flow consisting of the slide granulate, water and air entrained into the flow. PIV provided instantaneous surface velocity vector fields, which gave insight into the kinematics of the wave generation process. At high impact velocities flow separation occurred on the slide shoulder resulting in a hydrodynamic impact crater. The recorded wave profiles were extremely directional, unsteady, non-linear and located in the intermediate water depth wave regime.

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THE INTERCONNECTION BETWEEN THE FLINDERS CURRENT AND LEEUWIN UNDERCURRENT

The interconnection of the subsurface currents of the west and south coasts of Western Australia was documented through analysis of the water mass characteristics and vertical and horizontal velocity fields. Located around 250 m depth, the Flinders current (FC) and Leeuwin undercurrent (LU) are the two currents in this region—the Flinders current on the south coast and the Leeuwin undercurrent on the east coast of Australia (OSU) based on the generalised Froude similarity. The landslide emplacement characteristics were controlled by means of a novel pneumatic landslide generator. Deformable landslides of subaerial and submarine origin were modeled with granular materials. Measurement techniques such as particle image velocimetry (PIV), multiple above and underwater video cameras, multiple acoustic transducer arrays, as well as resistance wave and runup gauges were applied. The wave generation was characterized by an extremely unsteady three phase flow consisting of the slide granulate, water and air entrained into the flow. PIV provided instantaneous surface velocity vector fields, which gave insight into the kinematics of the wave generation process. At high impact velocities flow separation occurred on the slide shoulder resulting in a hydrodynamic impact crater. The recorded wave profiles were extremely directional, unsteady, non-linear and located in the intermediate water depth wave regime.

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MOLECULAR APPROACH TO DETERMINE CONTRIBUTIONS OF EUKARYOTIC PROTISTS TO DOWNWARD PARTICLE FLUX

Under present conditions of increasing atmospheric CO2 and global ocean temperatures, a better understanding of the biological community involved in organic carbon flux, including the relative contributions of key taxonomic groups of eukaryotic phytoplankton as contributors to export production at a station in the eastern subtropical North Atlantic. Communities from various depths in the water column and from surface tethered particle traps below the water mixed layer were analyzed using a combination of molecular (18S rDNA clone libraries, DGGE) and traditional (epifluorescence and inverted microscopy) techniques. The application of molecular techniques to this question allows us to identify otherwise indistinguishable taxonomic groups (including the relative contributions of key taxa to particle export, will greatly contribute to this question allows us to identify otherwise indistinguishable taxonomic groups (including the relative contributions of key taxa to particle export, will greatly contribute to this question allows us to identify otherwise indistinguishable taxonomic groups (including the relative contributions of key taxa to particle export, will greatly contribute to this question allows us to identify otherwise indistinguishable taxonomic groups (including the relative contributions of key taxa to particle export, will greatly contribute to this question allows us to identify otherwise indistinguishable taxonomic groups (including the relative contributions of key taxa to particle export, will greatly contribute to this question allows us to identify otherwise indistinguishable 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one of an uncultivated eubacterium that clustered with a alpha-Proteobacterium previ-
ously isolated from the North Pacific. Rarefaction analysis suggested that the major-
ity of the diversity was covered with 384 nIhU clones. Two new qPCR primer probe sets
were applied for dominant Proteobacterial sequence groups. Trichodesmium spp. was by far
the most abundant diazotroph, with up to 6x*10^6 gene copies L^-1. Cyanoabacteria Group
A, Group B, and symbionts were detected at low abundances. The microarray data mir-
rored trends in the clone libraries. qPCR results reproduced the microarray data for
Trichodesmium but not for the alpha-Proteobacteria that dominated the clone library.
Diazotroph community in South China Sea consists of both oceanic and estuarine compo-
nents with overall low diversity.

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SPATIAL AND TEMPORAL COHERENCE OF PLANKTONIC LAYERS

The layering of planktonic organisms are a common occurrence in coastal systems.
These layers are formed by a combination of physical and biological forcing mechanisms
and depend largely on the characteristics of the organisms themselves. The coherence
of these layers and their duration at a given location are also dependent on many of the
same mechanisms, however it has only recently gained attention. As part of the Layered
Organization of the Coastal Ocean project, an autonomous underwater vehicle (AUV)
occupied the northeastern portion of Monterey Bay during 2006. Repeated missions over
the same location allowed for quantification of plankton layers and their coherence in
space and time. In addition to the AUV mission, recent data from a time series station in
San Luis Obispo Bay, CA will be shown to address these same questions from a temporal
perspective. These data highlight the potential to address the vertical interactions be-
tween planktonic groups and differential formation of layers between groups.

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CHARACTERIZATION OF KA-BAND SWATH ALTIMETRY PERFORMANCE FOR SURFACE WATER HYDROLOGY

Traditional radar altimetry has demonstrated the ability to retrieve surface water heights
with decimeter accuracies along the nadir path. However, a profiling sensor is insufficient
to provide global monitoring of fresh water bodies. In response, the Water Vapor mission
proposes a swath-based imaging altimeter to provide the key hydrologic variables needed
for comprehensive river discharge and storage observations, specifically temporal height
count, slope and spatial extent. In addition, key imaging capabilities provide classification
and data for topographic corrections. Initially, we identify the error sources that a near-nadir synthetic aperture radar interferometer, such as the KaRIn instrument
proposed to meet the Water Vapor requirements, would incur. We then demonstrate that
with appropriate calibration techniques, measurements of river stage with an accuracy of ap-
proximately 5 cm and river slope with an accuracy of 1 cm/km are achievable. Finally, we
focus on methodologies for land/water and layover classification and limitations imposed
by temporal decorrelation of the water and local topography respectively.

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THE ROLE OF BREAKING WAVES IN ENHANCING THE RATE OF CHEMICAL REACTIONS IN OCEANIC SURFACE WATERS: DEDUCTIONS FROM A TIPPING BUCKET EXPERIMENT

When ocean waves break a portion of their energy is converted to the production of new
bubble surfaces. These surfaces are sites at which naturally occurring dissolved organic
matter can collect. The energetic environments at the bubble–water boundary have been
postulated to be favored sites for chemical transformations to occur. A series of tipping
bucket experiments were conducted to test this hypothesis. Tryptophan was used as a
representative DOM compound. Within an enclosed space, a microprocessor-controlled
bucket of sea water was tipped into a tank of sea water every minute for days to generate
a bubble plume. Water samples were periodically taken through a port in the tank lid, and
the concentration of target chemical species were determined. In a number of experi-
ments the rate of specific transformations during tipping runs was seen to significantly
exceed the rate in control. The average bubble, or whitecap, coverage of the surface
in the water in the tank was determined so that the observed laboratory transformation rates
could be associated with a particular sea state, inferring rates for other whitecap cov-
erages.

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ASSIMILATION OF AIRBORNE IMAGER WITH LIDAR FOR BATHYMETRIC ESTIMATION

One of the challenges to understanding coastal processes is overcoming the limitations of
methods for quantifying large scale coastal behavior. A particularly adaptive survey meth-
ood for use in regional nearshore studies is airborne Lidar (Light Detecting and Ranging),
which is able to densely sample both topographical and shallow bathymetric elevation
data over large geographical regions. Bathymetric Lidar is dependent on water clarity, and
in the surf zone sediment and air bubbles entrained in the water column by wave breaking
Photosynthesis produces biomass within the euphotic zone, which eventually sinks to the upper sedimentary layers of the ocean. This process is critical for the export of organic carbon from the surface waters to the deep ocean, contributing to the formation of the oceanic carbon reservoir. The study of benthic grazing and its role in the carbon cycle is essential for understanding marine productivity and the fate of organic matter at the sediment-water interface.

Benthic grazing is the process by which marine invertebrates consume organic material from the sediment surface. This includes pelagic organisms such as foraminifera and bivalves, as well as benthic filter feeders like amphipods and polychaetes. Benthic grazing is a fundamental process in marine ecosystems, influencing the flux of organic carbon from the sediment to the water column and affecting the structure of the benthic community.

The study of benthic grazing is crucial for understanding the role of the ocean in the carbon cycle and the fate of organic matter. This research can have implications for climate change, as changes in benthic grazing can affect the uptake and release of carbon dioxide from the ocean to the atmosphere. Additionally, understanding benthic grazing can help in the management of marine resources and the conservation of marine ecosystems.

Coastal sediments are source of dissolved organic carbon (DOC) to the overlying oceanic water column. Changes in coastal sedimentation, which are driven by physical processes such as tidal currents and wave action, can influence the amount of DOC exported to the ocean. This process is critical for understanding the carbon cycle and the budget of organic matter in coastal ecosystems.

The study of DOC export and its role in the carbon cycle is crucial for understanding the carbon budget of coastal ecosystems. This research can have implications for climate change, as changes in DOC export can affect the uptake and release of carbon dioxide from the ocean to the atmosphere. Additionally, understanding DOC export can help in the management of coastal ecosystems and the conservation of marine resources.
Dissolved hydrogen and of the potential of these measurements to aid the quantification of nitratation levels will be reported together with their relationship with isotopic measurements over the latitudinal surface ocean. Evidence of a correlation between hydrogen concentrations (or net degradation) and increased their APA in response to ATP but not inorganic P additions. However, whether Prochlorococcus populations (or some ecotypes) are P-limited or have become P-limited is a regular occurrence. It is not clear, how variations in iron inputs from the atmosphere. The BEC model includes multiple potential sources and in alkaline phosphatase activity (APA), and these differences are reflected in the typically assumed low, constant solubility of 1-2%) on phytoplankton community structure, nutrient limitation patterns, and the rates of nitrogen fixation, export production, and air-sea CO2 exchange.

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PHYSIOLOGICAL RESPONSE OF PROCHLOROCOCCUS IN P-LIMITED CHEMOSTATS AND ON-DECK NUTRIENT ENRICHMENT EXPERIMENTS

In some regions of the world's oceans where marine cyanobacterium Prochlorococcus dominate, phosphorus (P)-limitation is a regular occurrence. It is not clear, however, whether Prochlorococcus populations (or some ecotypes) are P-limited or have a competitive advantage under P limitation. Studies on P stress response of various Prochlorococcus ecotypes revealed differences in their ability to utilize organic P sources and in alkaline phosphatase activity (APA), and these differences are reflected in genome content. This raises the question of what differentiates the P physiology of Prochlorococcus ecotypes and whether natural populations experience P limitation. To begin exploring these questions, P-limited chemostats of Prochlorococcus MED4 (HLI) were established and uptake kinetic experiments carried out. These results indicate that MED4 has a rapid uptake rate for P when grown under P-limiting conditions but is not more efficient at P uptake than other marine picophytoplankton ecotypes. Rates do not occur at the same time as increases in APA. On-deck nutrient enrichment studies in oligotrophic western Pacific indicate that Prochlorococcus populations grew and increased their APA in response to ATP but not inorganic P additions.

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DISSOLVED HYDROGEN MEASUREMENTS AND THEIR RELATIONSHIP TO NITROGEN FIXATION IN THE EQUATORIAL PACIFIC: RESULTS FROM THE CMORE-BULA CRUISE

Dissolved hydrogen was measured in surface waters samples and vertical profiles during the CMORE-BULA cruise between Fiji and Hawaii in April 2007. The primary objective of this study was to determine whether nitrogen fixation is the main process responsible for the supersaturated levels of dissolved hydrogen that have been observed in the low-latitude surface ocean. Evidence of a correlation between hydrogen concentrations (or net production rates) and rates of nitrogen fixation as measured by NIF assimilation could offer the possibility of a near real-time measurement that would have value in mapping oceanic nitrogen fixation. Hydrogen proxy could assist in guiding isotopic measurements or in interpolating between such measurements. Hydrogen concentrations and isotope levels will be reported together with their relationship with isotopic measurements of nitrogen fixation rates. Assessments will be made of the sampling requirements for dissolved hydrogen and of the potential of these measurements to aid the quantification of nitrogen fixation.
We present a new approach for parameterizing dissolved organic matter (DOM) absorbance spectra. Two distinct spectral slope regions (275-295 nm and 350-400 nm) within log-linearized absorbance spectra were used to compare DOM from contrasting water types, ranging from wetlands (Great Dismal swamp and Swanneree River) to photobleached oceanic water (Sargasso Sea). Based on DOM size-fractionation studies (ultraltrafiltration and size exclusion chromatography), we found that the slope of the 275-295 nm region and the ratio of these slopes (Rs = 275-295 nm slope:350-400 nm slope) were related to DOM molecular weight (MW) and to photochemically-induced shifts in MW. Along an axial transect in the Delaware Estuary, large variations in Rs were measured, probably due to photo-degradation and microbial alteration of chromophoric DOM (CDOM) as terminally-dead DOM transits through the estuary. Further, Rs varied by over a factor of 14 between DOM-rich wetland waters and Sargasso Sea surface waters. Currently, there is no consensus on a wavelength range for log-linearized absorbance spectra. Based on our results, we suggest that the 275-295 nm slope be routinely reported in future DOM studies.

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M., UPRM - Department of Marine Sciences, Mayaguez, Puerto Rico, jmorell@uprm.edu; Corredor, J.L., UPRM - Department of Marine Sciences, Mayaguez, Puerto Rico, jcorredor@uprm.edu; Lopez, J. M., UPRM - Department of Marine Sciences, Mayaguez, Puerto Rico, jlopez@uprm.edu; Brosco, R., UPRM - Department of Marine Sciences, Mayaguez, Puerto Rico, rbrosco@gmail.com; Fuentes, D., UPRM - Department of Marine Sciences, Mayaguez, Puerto Rico, pirul-india@yahoo.com; Antoun, H., UPRM - Department of Marine Sciences, Mayaguez, Puerto Rico, antounoma@gmail.com; Lopez, R., UPRM - Department of Marine Sciences, Mayaguez, Puerto Rico, rojpez18@gmail.com; Cabrera, A., Colombia, alvazo.cabera@gmail.com; Mendoza, M., UPRM - Department of Marine Sciences, Mayaguez, Puerto Rico, alram80@gmail.com; Major River Plumes in the Tropical Ocean: Physical and Biogeochemical Expression. The Caribbean and Western Tropical Atlantic receive massive inputs of Orinoco and Amazon River water carrying a load of organic and inorganic materials into waters characteristically devoid of these. The magnitude of riverine impact became evident as remote sensing became an ocean color monitoring tool. These observations depict riverine plumes, containing dissolved organic matter and phytoplankton well above background concentrations, being advected into the oligotrophic ocean. Subsequent research revealed that riverine intrusions radically modulate trophic balance and activity through changes in plankton abundance, composition and size distribution and last but not least: availability of solar irradiance. Moreover, riverine influence responds to climate processes and oceanic mesoscale processes without significant spatial and temporal variability at annual and interannual scales. We discuss observations of physical and biogeochemical gradients in the Orinoco River Plume in the above context. Moret-Ferguson, S. E., Sea Education Association, Woods Hole, USA, s Ferguson@sea.edu; Sidla, A. N., Sea Education Association, Woods Hole, USA, asidla@sea.edu; Schell, J. M., Sea Education Association, Woods Hole, USA, jschell@sea.edu; Spatial and Temporal Variability in Zooplankton Density of East Pacific Surface Waters Zooplankton provide fundamental links in marine food webs, and their distributions have long been used to define biogeographic boundaries. For the past six years, Sea Education Association has traveled an annual cruise track in the East Pacific comprised of six regional transects: 1) San Diego, CA to Mexico, 2) Mexico to Tahiti, 3) Tahiti to Hawaii, 4) Hawaiian-Equatorial circuit, 5) Hawaii to West Coast, U.S. and 6) West Coast, U.S. track ending in San Diego, CA. Over 1200 netson net (1 x 0.5 meter, 333 um mesh) tows were conducted during 50 cruises from October 2001 through December 2007. Zooplankton trawl transects across the entire Pacific cruise track included a doubling of the mean from day to night, and positive correlations with extracted chlorophyll-α and phosphate concentrations. Highest densities were associated with frontal boundaries. However, differences among regional transects were observed in patterns of inter-annual and geographic variation. Morrey, S. L., Florida State University, Tallahassee, USA, morrey@coaps.fsu.edu; Dukhovskoy, D. S., Florida State University, Tallahassee, USA, dddmitry@coaps.fsu.edu; Bourassa, M. A., Florida State University, Tallahassee, USA, bourassa@coaps.fsu.edu; Connectivity Between Variability of the Apalachicola River Flow and the Biophysical Oceanic Properties of the Northern West Florida Shelf Maps of satellite-derived estimates of monthly-averaged chlorophyll-a concentration over the northern West Florida Shelf show high interannual variability concentrated near the coastline and extending at least 150 km offshore over this wide shelf in a tongue-like pattern from the Apalachicola River during the late winter through early spring. The spatial pattern of these anomalies encompasses clusters of spawning habitats for regionally important fisheries. The chlorophyll-a concentration anomalies are consistent with variations in the density of the Apalachicola River at interannual timescales. For instance, low chlorophyll-a offshore transport of the Apalachicola River plume across the inner shelf under upwelling-favorable winds provides the physical mechanism for connecting the variability of the river discharge with oceanic variability over the middle and outer shelf. Morgan-Smith, D., Old Dominion University, Norfolk, VA, USA, dmorgan@odu.edu; Bochansky, A. B., Old Dominion University, Norfolk, USA, abochdan@odu.edu; Morgan, S. B., UPRM - College of Business Administration, Mayagüez, Puerto Rico, smorgan@uprm.edu; Lai, G. J., Royal Netherlands Institute for Sea Research, Den Burg, Netherlands, hernd@nioz.nl; Van Aken, H. M., Royal Netherlands Institute for Sea Research, Den Burg, Netherlands, akken@nioz.nl; Quantification and Characterization of Deep-Sea Eukaryotic Communities Based on Morphology and Fluorescence in Situ Hybridization with a Robotic Microscope The pelagic deep ocean is the largest habitat on earth, yet we know very little about the distribution and activity of protists in this environment. Flagellates, for instance, which are responsible for controlling bacterial abundance in the surface ocean, and which are major players in the material and energy transfer of pelagic food webs, have not been studied to any significant extent in the deep sea. For this project, water samples were taken in the eastern subtropical North Atlantic at depths ranging from 100m to 5000m and were filtered onto membrane filters which underwent pyramide signal amplification fluorescence in situ hybridization (TSA-FISH, also known as CARD-FISH) using oligonucleotide probes of eukaryote-specific sequences. These filters were then scanned for positive TSA-FISH and CARD signals using an epifluorescence microscope with a robotic stage. We compared filters across depths and geographic area in terms of abundance of eukaryotes and by community composition based on DAPI nuclear morphology. In comparison to prokaryotes, numbers of eukaryotes drop off disproportionately with depth. Moreira, R., MSc, Stony Brook University, Stony Brook, USA, bmorosia@gmail.com; Conover, B., U. U. Bremenhaven, Germany; Gallinari, M., LEMAR, Plouzane, France; Laruelle, G. G., Utrecht University, Utrecht, Netherlands; Van Cappel, R., Utrecht University, Utrecht, Netherlands; Garvey, M., AWI, Bremenhaven, Germany; Soetaert, K., NIOO, yereke, Netherlands; Armstrong, R., MSc, Stony Brook University, Stony Brook, USA; Ragueneau, O., LEMAR, Plouzane, France; Biological Silica Recycling in Aggregates and Fecal Pellets is Slower than in Free Cells Shallow-water biogenic silica (bSiO2) recycling is the main source of silicic acid (dSi) in the open ocean. Even though diatoms sink mostly in the form of aggregates and fecal pellets, bSiO2 dissolution rates used to reconstruct bSiO2 profiles are generally measured on free cells. Our experimental results show that in aggregates and in fecal pellets, initial dissolution rates of diatom frustules were 2 to 3 times lower than rates for free cells. Results from modelling experiments suggest that this is the result of high viability of diatoms and elevated dSi concentrations inside aggregates; the latter may in turn be due to dSi adsorption on the aggregate matrix. bSiO2 flux profiles at 8 sites in the global ocean were accurately reconstructed using bSiO2 dissolution rates and sinking rates of two classes of sinking particles: large particles (aggregates + fecal pellets), and small particles (free cells). Morford, S., University of Rhode Island/College of Business Administration, Kingston, RI, USA, morford@coas.uri.edu; Ihemunu, C., University of Rhode Island/Graduate School of Oceanography, Narragansett, RI, USA, ihemunu@coas.uri.edu; Meeting Abstracts ASLO/AGU/TO S/ERF 281
Particle-dynamic controls on the depth of Si recycling, as well as consequences for theballast theory and the silicate pump, will also be discussed.

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A LONG-TERM REAL TIME SEAED MORPHOLOGY EVOLUTION MONITORING SYSTEM IN THE SOUTH ATLANTIC BIGHT

A long-term real sea bed morphology monitoring system has been established on the middle continental shelf in the South Atlantic Bight as part of the SEACOOS observation system and now in support of the BOTTOMS-UP project. The system is composed of an Imagexen Model 881 digital rotating imaging system (2.25 MHz) connected through 1.5 km of cable to a power and controller unit housed on the R2 Naval platform (SABSOON). The system collects high resolution images of the seabed composed of echo intensities along 6 meter long radials with resolution of 0.3 degrees. Data are acquired hourly, transmitted via microwave antenna to shore, to Skidaway Institute via T1 land line, and forwarded to the University of South Carolina over the internet. Raw images are rectified and processed using a 2-dimensional fast fourier transform algorithm providing wavelength and ripple orientation values. Post-data collection image processing allows evidence of bioturbation to be identified as well. The long-term data base (since April 2007) is used for evaluation of time-dependent ripple evolution models. System design, data analysis and example images will be presented.

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VOLUME, HEAT AND SALT FLUXES IN THE NORWEGIAN SEA TOWARD THE ARCTIC DERIVED FROM ALTIMETER AND HYDROGRAPHIC DATA

The flow of the warm and saline water from the North Atlantic and into the Norwegian Sea is vital for the climate in the Nordic Seas and Arctic. The inflow in the Norwegian Sea, the Norwegian Atlantic Current, consists of two branches. While the variability and forcing of the inner branch has been resolved based on long-term current measurements, knowledge of the outer branch is poor. In this work we have estimated the total northward fluxes in the Norwegian Atlantic Current by combining altimetry, repeated hydrographic transect and new in situ data from the BOTTOMS-UP project. The total northward flux of water, heat and salt has increased from 1992 to present due to an increase in the outer branch. The different contributors to the fluxes such as sea surface level, bottom and baroclinic velocities are compared.

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PENETRATION OF UV RADIATION IN STREAMS OF EASTERN PENNSYLVANIA, USA: TOPOGRAPHIC CONTROLS AND THE ROLE OF SUSPENDED PARTICULATES

Attenuation of UVR in stream is determined by the concentration and optical properties of suspended sediment and dissolved DOC. We document the baseflow optical environ- ment in the Fire hole and Little Juniata rivers that drain the Allegheny Plateau of central Pennsylvania. We observed a wide range of attenuation coefficients (Kd800: 0.68 - 151.1 m-1, Kd320: 0.95 - 316.2 m-1) and 1% transmission depths (2 cm - 147 cm). We also quantified the role of particulate material, which generally accounted for 20% ± 10% of the attenuation and DOM. We found a strong relationship between the concentration of DOC and DON with not dissipated by the blue light in 2005 as part of the Integrated Ocean Observing System (IOOS) to provide a comprehensive suite of observations. Buoy light attenuation measurements suggest that factors unresponsive to nutrient enrichment may be responsible for the major effect of the age grading (e.g., sediment resuspension and CDOM). Here we discuss how airborne hyper-spectral remotely sensed information collected during 2007 has been used to expand on the temporally rich buoy data to provide spatially rich information relevant to the goals of regional coastal managers.

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DINOFLAGELLATE BLOOM DYNAMICS AND PATTERNS OF NUTRIENT UPTAKE IN A SHALLOW EUTROPHIC ESTUARY

The Lafayette River is a shallow eutrophic sub-estuary of Chesapeake Bay that frequently experiences algal blooms. We sampled the Lafayette River on a daily basis for a period of 54 days in fall 2005 and 34 days in spring 2006 to better understand the initiation and progression of dinoflagellate blooms. In September, little N uptake was measured as a Gymnodinium sp. bloom was forming despite high levels of DIN. Uptake rates increased from 1992 to present due to an increase in the outer branch. The different contributors to the fluxes such as sea surface level, bottom and baroclinic velocities are compared.

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PENETRATION OF UV RADIATION IN STREAMS OF EASTERN PENNSYLVANIA, USA: TOPOGRAPHIC CONTROLS AND THE ROLE OF SUSPENDED PARTICULATES

Attenuation of UVR in stream is determined by the concentration and optical properties of suspended sediment and dissolved DOC. We document the baseflow optical environ-
in term of cell volume, pigment composition, and packaging effect. The α ratio at 555 relative to 670 nm also decreased by more than about 40% due to the change of pigment composition. The present study may suggest that once the variability in α can be established within a range of nitrite supply, a ratio of α at multiple wavelengths can provide a promising information to remote sensing.

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INTERANNUAL VARIABILITY OF PACIFIC WINTER WATER THROUGH THE BARRINGER CANYON FROM 2000 TO 2006

Time series of temperature, salinity and velocity from 2000 to 2006 at the Barrow Canyon, which is one of the major spreading pathway of Pacific Water into the Canada Basin, document significant year-to-year changes especially in salinity during winter. Interannual variability of Pacific Water (PWV) is well explained by the following two factors except 2004: 1) change in salinity in the upstream region, Bering Sea and Chukchi Sea, and 2) change in cold, saline polynya water input caused by the sea ice formation in the Barrow Canyon polynya, which is the largest coastal polynya in the Western Arctic Ocean. In 2004, saline PWW was rarely observed at the Barrow Canyon, although polynya often occurred. Barrow Cape polynya polynya was considered as latent heat polynya which was an active sea ice producer when polynya was maintained by offshore wind. However, subsurface temperature in 2004 was above freezing point due to reversing of warm Pacific Summer Water from the basin into the canyon, and it reduced sea ice formation in the polynya.

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MECHANISMS OF WARM AND COLD WATER TEMPERATURE EVENTS IN THE FLORIDA KEYS BETWEEN 1988 AND 2003

The potential for thermal stresses on corals is evaluated from bottom temperatures for thirty-three stations in the Florida Keys National Marine Sanctuary. The ensemble annual mean water temperature was 26.5°C ± 2.5°C. The variability of temperature depends on the season and location within the Sanctuary. Temperature changes are small in summer with a standard deviation generally less than ±0.6°C due to weak temperature differences (< 2°C) in surrounding waters. However, water temperature greatly fluctuates during the winter (daily standard deviation of ±0.6 - 1.2°C) due to temperature differences of about 5°C on average between the Florida Current and Florida Bay. The primary mechanisms producing cold water temperature events is atmospheric cold fronts. Warm water temperature events were caused primarily by Florida Bay outflows, but also by locally generated wind forcing, or inshore positioning of the Florida Current. Eleven inshore stations, mainly in the Middle Keys, featured temperatures above 33°C or below 15°C, the thermal stress threshold temperatures harming the corals.

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THE EXPLORATION OF ROUND REEF

In a time when fewer schools allow the students the opportunity to enter the water during school trips and with costs increasing to transport them to field trip sites, there is a challenge to expose young schoolchildren to coral reef biology. By bringing a simulated reef into the hands of a younger audience, this program allows early exposure to ocean literacy in an engaging way. The curriculum is flexible enough to be used from kindergarten through fifth grade and can be easily translated into opportunities for special-needs groups. At the core of the program is the understanding of one's importance in caring for - and taking responsibility for - our coral reefs. By using a simple child's toy we put the reef into the hands of a younger audience, this program allows early exposure to ocean literacy in an engaging way.
results show occasions of strong diurnal cycling of turbulence and intermittent internal wave bursts at frequencies near N, similar to previous intensive profiling observations in 1984, 1987 and 1991. But this is not always, or even typically, the case.

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RECENT SALINITY VARIABILITY AND ASSOCIATED ECOSYSTEM CHANGES ON GEORGES BANK

The surface waters of the Gulf of Maine/Georges Bank region exhibited a large decrease in salinity during the 1990's relative to the 1980's. The decrease appeared to have originated at high latitude and been advected into the Gulf of Maine/Georges Bank region. Analysis of zooplankton data from Georges Bank indicates that a shift in the zooplankton community structure occurred in association with the salinity changes, resulting in higher abundance of smaller copepods during the 1990's. The survival rate from egg hatching to recruitment for the cod and haddock populations on Georges Bank also exhibited a shift between the two periods. Cod survival was three times higher than that for haddock dur- ing the 1980's, while the reverse was true during the 1995-1999 period sampled by the US GLOBEC program. Plausible mechanistic connections between the variability in salinity, zooplankton community structure and fish survival rates will be discussed.

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ENSEMBLE-BASED MODEL SALINITY ERROR COVARIANCES INDUCED BY EXTERNAL FORCING UNCERTAINTIES IN THE EASTERN NORTH-ATLANTIC OCEAN

SMOS and Aquarius satellite missions, scheduled for launch in 2008 and 2009, will provide synoptic sea surface salinity observations at a global scale. These unprecedented data are expected to have a great potential to improve the mixed layer representation when assimilated into ocean models. This however will still require models to be able to faithfully represent the main processes affecting salinity, as well as a proper estimation of the associated model error. In this perspective, this study investigates model-SSS error covariances due to external forcing uncertainties using an ensemble approach. The model is a regional 1/3° configuration of the NEMO-OPA90 model implemented over the eastern subtropical North-Atlantic Ocean. Three 100-member ensemble of model simulations are generated, with perturbations of the wind stress forcing, the precipitations and the open boundary data respectively. The perturbations are linearly combined randomly selected leading EOFs of the fields under consideration. As initial conditions are the same for all experiments, the obtained ensemble covariances estimate the model error covariances induced by forcing errors. The spatio-temporal variability of SSS error variances is presented, as well as the 3-dimensional structure of the multivariate error covariances of salinity for different forcing conditions.

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WHAT IS NORMAL? EXTREME TEMPERATURE VARIABILITY ON A HIGH LATITUDE, FRINGING RED SEA CORAL REEF

Corals in the Red Sea's Gulf of Suez live near the upper thermal tolerance limits, where corals regularly experience 2-4°C daily water temperature differences and seasonal variations that exceed 15-20°C. In this extremely harsh region, few, if any water temperature time series records exist. As part of a larger four year research project documenting a shallow fringing reef in the Gulf of Suez, water temperature observations were collected when mapped, temperature variability appears to be driven by small depth variations ranging from a low of 14°C in February to a maximum of 34°C in September. As part of a larger four year research project documenting a shallow fringing reef in the Gulf of Suez, water temperature observations were collected when mapped, temperature variability appears to be driven by small depth variations ranging from a low of 14°C in February to a maximum of 34°C in September.

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PHOSPHATE AVAILABILITY AND NITROGEN FIXATION IN THE OLGOTROPHIC OCEAN: OVERVIEW AND OBJECTIVES OF THE BOUM CRUISE PROJECT

Oligotrophic marine areas are characterized by a thermal stratification of the water column. This delimits a warm surface mixed layer with high light intensity but depleted in nutrients, and a sub-superficial layer with low light levels and more nutrients. Tropical ar- eas, large anticyclonic gyres, the Sargasso Sea and the Mediterranean Sea (MS), have long been considered to be typical oligotrophic systems. Nitrate concentrations close to zero are generally observed in the upper surface waters of all these areas while large differences in phosphate similar to previous profiling observations in 1984, 1987 and 1991. But this is not always, or even typically, the case.

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OPTICAL DETERMINATION OF PHYTOPLANKTON SIZE DISTRIBUTION FROM SATELLITE

Phytoplankton cell size is important to biogeochemical and food web processes. The goal is to determine the relative importance of phytoplankton cell size in remote sensing reflectance (Rrs) spectra in the presence of other optically active constituents. This is addressed through implementation of a forward optical model that incorporates the range of absorption and scattering variability due to phytoplankton and colored dissolved matter (CDM) in the global ocean from which Rrs is calculated by the radiative transfer software, Hydrolight. Spectral Rrs is investigated in terms of spectral shape and magnitude to ascertain changes in community size structure and the relative contribution of chlorophyll and CDM concentration to Rrs. Thresholds for chlorophyll and CDM concentration are determined, above which, any spectral changes are mainly due to any spectral shifting due to size. In certain situations of CDM values are used in conjunction with matched SeaWiFS Rrs spectra to determine if Rrs shifts can be discerned from a satellite platform. We seek to establish the role phytoplankton cell size has played in the observed change in chlorophyll concentration over the SeaWiFS mission.

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CARBON ISOTOPES (δ13C & δ18O) IN CORALS AND ADJACENT NATURAL WATER AS RECORDERS OF CATCHMENT-TO-REEF REEFS TRANSFER

The terrestrial landscape of Puerto Rico has experienced major changes over the past 150 years, as the production of sugarcane crops dominated the landscape, while after 1960 agricultural practices diminished and many agricultural areas were gradually reforested. This land-use change has resulted in a shift in the average stable carbon isotopic composition of the living plant material (C4 to C3 plants) and surface soil organic matter. A similar isotopic shift may be recorded over the same time period in the skeletons of coastal corals influenced by river discharge. A 56 year record of δ13C in both coastal water samples and the coral skeleton. These data suggest that corals may provide a record of terrestrial influence on coral reefs.

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MULTIDECADAL VARIABILITY OF THE ATLANTIC MOC AND ITS INFLUENCE ONTO THE ATMOSPHERE IN THE IPSL CLIMATE MODEL

The extent to which the climate is influenced by low-frequency changes in the Atlantic Meridional Overturning Circulation (AMOC) is investigated in a 500 year control simulation by the IPSL-CM4 coupled model. The multidecadal fluctuations of the AMOC are mostly sensitive to the deep convection in the subpolar gyre, which occurs South of Iceland in the model, and are primarily forced by salinity advection due to the East Atlantic Pattern (EAP). The North Atlantic Oscillation (NAO) plays a secondary role in the model. During summer, the AMOC variability is shown to have a significant impact on the atmosphere in the North Atlantic-European sector. This influence is due to an intrahemispheric Sea Surface Temperature (SST) anomaly pattern with opposite signs in the two hemispheres but largest amplitude in the north one. This mode corresponds to the model Atlantic Multidecadal Oscillation (AMO) and bears some similarity with the observed one. The atmospheric response is such that it induces a weak positive feedback on the AMOC.

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RESPIRATORY RATES AT THE CARIBBEAN TIME SERIES STATION (CATS)

Plankton community respiratory rates were quantified at the Caribbean Time Series station (CATS) on the AMOC. The changes in photosynthesis are mostly sensitive to the deep convection in the subpolar gyre, which occurs South of Iceland in the model, and are primarily forced by salinity advection due to the East Atlantic Pattern (EAP). The North Atlantic Oscillation (NAO) plays a secondary role in the model. During summer, the AMOC variability is shown to have a significant impact on the atmosphere in the North Atlantic-European sector. This influence is due to an intrahemispheric Sea Surface Temperature (SST) anomaly pattern with opposite signs in the two hemispheres but largest amplitude in the north one. This mode corresponds to the model Atlantic Multidecadal Oscillation (AMO) and bears some similarity with the observed one. The atmospheric response is such that it induces a weak positive feedback on the AMOC.
five to thirteen representative depths between the surface and 1000 m. Over this depth span, the different water masses were sampled in the Caribbean Surface Waters, Subtropical Underwater, Mode water, the tropical Atlantic Central Water and the Antarctic Intermediate Water. Comparison of ET8-derived respiration rates to primary production determinations revealed that the P/R ratio was less than 1 in 64 % of the sample dates showing predominance of heterotrophic metabolism. The remaining 36 % of the cases exhibits a P/R ratio higher than 1 in a minor tendency for predominance of autotrophic metabolism. Respiratory rates, integrated to 1000 m, ranged from 512 to 1922 mg C m-2 d-1. Rates in the euphotic layer (CSW) averaged 373 mg C m-2 d-1 representing 29 % of the total water column respiration. Integrated respiration below the surface mass (SWU, MODE, and ACW water masses) accounted for the remaining 71 %. Heterotrophic communities of the mesopelagic layer (150 - 1000m) thus account for the bulk of respiratory activity in this region. Our results indicate that despite large export of organic matter from surface waters, additional allochthonous inputs of organic matter must be considered. 

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RISING CO2 DISSIPROPORTIONATELY AFFECTS EXTENSION RATES VERSUS MASS DEPOSITION RATES IN REEF CORALS

Although ocean acidification is known to decrease calcification in corals, such effects have been measured almost exclusively in terms of the mass deposition of aragonite. This study used manipulative experiments to test the hypothesis that increasing pCO2 has unequal effects on different components of growth that contribute to colony size and morphology. First, increased levels of CO2 (700 vs. 350 ppm) were tested for effects on the mass deposition (mg cm-2 day-1) and linear extension (µm day-1) of Acropora hyacinthus and A. pulchra from French Polynesia, and second, the results were used to explore the covariance between each growth component. Overall, mass deposition and linear extension were significantly reduced by high pCO2, and in both species the linear extension was reduced more than twice as much (52%) as mass deposition (26%). For these species, the inhibitory effects of elevated pCO2 on aragonite deposition apparently were modulated by changes in skeletal density and/or shape. These results are important as they reveal the potential role of morphological plasticity in translating the effects of ocean acidification into coral reef acroporids.

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CHARACTERIZING POLLUTION PLUME DYNAMICS USING CLOSTRIDIUM PERFRINGENS DISTRIBUTION AND MOLECULAR DIVERSITY.

Clostridium perfringens is a common member of the intestinal tract of many animals and a long-lived fecal pollution marker due to spore forming capabilities. Particle attached C. perfringens was enumerated in sediments captured at three nearshore locations at varying distances from the Milwaukee harbor. Samples collected within the harbor contained an average of 16000 CFU g substrate-1. Particles collected ~200 m from the harbor had concentrations eight times lower than the harbor. C. perfringens was repeatedly recovered from the other locations, but levels fluctuated drastically, which may be due to the influence of current and wind direction on plume dispersion. This organism was also recovered from the other locations, but levels fluctuated drastically, which may be due to the influence of current and wind direction on plume dispersion. This organism was also recovered from the other locations, but levels fluctuated drastically, which may be due to the influence of current and wind direction on plume dispersion. This organism was also recovered from the other locations, but levels fluctuated drastically, which may be due to the influence of current and wind direction on plume dispersion. This organism was also recovered from the other locations, but levels fluctuated drastically, which may be due to the influence of current and wind direction on plume dispersion. This organism was also recovered from the other locations, but levels fluctuated drastically, which may be due to the influence of current and wind direction on plume dispersion.
than elsewhere in the bay. Large eddies form at the jet’s edge and it serves as an important mechanism for stirring and mixing throughout the bay. We report observational data from a field experiment examining the circulation. The jet exhibits a variety of flow structures and appears to be strongly influenced by winds over the bay. The velocity signal of the jet generally appears first at around mid-depth of the water column and evolves until it is confined to the top 2-3 m below the surface with a slow counter flow underneath. However, the jet sometimes spans the full water column. These deeper jet events appear to be associated with the sudden relaxation of wind forcing. The observations, in particular drifter paths, are compared with model results from the hydrodynamic model Dell3d.

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COMPARISON OF EXTENDED RANGE UNDERWATER IMAGING TECHNIQUES

Optical imaging in turbid ocean water is a challenge due to the high probability that light will scatter multiple times as it propagates to and from the object of interest. Techniques that have been developed to suppress the contribution from scattered light and increase the image contrast include those using a pulsed source with a range-gated receiver or a modulated continuous wave source with an coherent RF receiver. The main disadvantage of the continuous wave, amplitude modulated system is that it is impossible to 4f gate out the volumetric backscatter signal as can be done in the pulsed, range-gated system. Therefore, the concept of a modulated pulse, range-gated system is currently being evaluated to understand the benefits and limitations of this approach relative to existing techniques. A theoretical performance prediction model is currently being used to compare these three different underwater imaging approaches. Laboratory tank experiments are also being conducted to validate theoretical predictions and to determine what hardware limitations must be considered when comparing these techniques. Results from both model predictions and laboratory experiments will be presented.

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PROCESSING THE DEEP-BIOSPHERE

Precondition to achieve environmentally relevant results is research in pristine habitat. Benthic in-situ conditions have to be maintained during the sequences of retrieval, transfer, storage and downstream analysis. TUB developed PRESS (Pressurized Core Sub-sampling and Extrusion System) in the EU project HYACE/HYACINTH which enables sterile, anaerobic and well defined sectioning of drilled pressure-cores (HYACE Rotary- and Fugro Percussion Cores) into transportation and investigation chambers. When coupled with DeepSoilBug (University Cardiff) it allows sub-sampling and incubation of coaxial core-sections to examine high-pressure adapted bacteria or remote biogeochemical processes in defined research conditions of the laboratory. A joint project of the Deutsche Forschungsgemeinschaft (DFG) PRESS was successfully deployed in the Gulf of Mexico, on IODP Expedition 311, and as part of the NGHP expedition 01-TUB currently works on concepts to scale down the system, reducing logistical and financial expenses and likewise on the feedback its implementation - requiring less operating space. Redesigning the cutting mechanism simultaneously adjusts the system to harder cores (e.g., ICDP). Novel transportation chambers for processed sub-samples intend to make the system more attractive for a broad spectrum of users and reduce their interdependence.

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THE CARIACO OCEAN TIME SERIES PROGRAM

The CARIACO program has conducted monthly oceanographic cruises to the Cariaco Basin (10°30’N, 64°40’W, SE Caribbean Sea) since November 1995. One mooring with five sediment traps and one with two ADCPs are in place. This basin is open to the Caribbean Sea in the upper 140 m and is well ventilated above this sill depth, but waters below about 250 m are anoxic. The objective of the series is to understand the relationship between hydrography, community composition, primary production, microbially mediated processes and trace inputs, sediment fluxes, and element cycling in the water column, and how changes in these processes are preserved in seafloor sediments. These sediments are one of the most important paleoclimate records available, and the series is designed to link knowledge about modern physical and biogeochemical processes with ancient regional oceanography. We discuss apparent changes in nutrient availability observed over the short life of the time series that have resulted in these ecosystems. These are reflected in the chemistry, amount of sinking particles, and other processes that seem to have affected even the important regional sardine fisheries.

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WAVE-DRIVEN CIRCULATION AND FLUSHING OF A COASTAL BAY

A coupled numerical model is used to simulate the waves and currents in a coastal bay during the landfall of a hurricane with offshore significant wave heights of up to 9.1 m. Extensive wave breaking along the shoreline and over a mid-bay shoal induced the development of a strong mean circulation in the bay, in combination with currents forced by wind, tide and storm surge. The general circulation pattern consisted of inflows along the shoreline and over the shoal region, and outflows that were observed in deeper channels near the shoal. The predicted currents agree with observations of 0.4 m/s mean flows only when wave-forcing is included in the circulation model. Wave-driven flows accounted for over 50% of the high flushing rates during the storm and induced strong velocity gradients over short (~200 m) horizontal length scales.

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RECENT AQUATIC ECOSYSTEM RESPONSE TO ENVIRONMENTAL EVENTS REVEALED FROM 210Pb SEDIMENT PROFILES

The power of the sediment-water interface to record ecological events, anthropogenic impacts as well as catastrophic episodes is unquestionable. However, the reading of the record requires an accurate and well calibrated record on sediment cores collected in several depositional environments that may bring some light on the usefulness of 210Pb as tracer rather than only a geochronological tool. In the Mediterranean sediment cores (Morocco, Algeria), 210Pb as well as its isotopic signature, clearly depicts the origin of heavy metals contents. In another coastal aquatic system, 210Pb, is unable to represent sediment accretion and time, but rather a biogeochemical shift on the sediment water interface that took place few decades ago as a result of aquaculture (Southern Chile). In two different set of sediment cores, one from the Chilean Lake district, and the others from the Argentinean Pampa plains, depict similarly, on the 210Pb record sudden catastrophic events. We discuss the use of 210Pb sediment profiles not only as a timing tool, but also as a tracer of environmental changes both natural and anthropogenic in aquatic ecosystems.

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MODELING THE FLOW PAST ISLANDS USING THE FINE ELEMENT METHOD

Observations of flow past islands have shown a variety of behaviour bearing a resemblance to the classical fluid dynamics problem of flow past a cylinder. Observations have also elucidated the presence of intense shear layers, along the edge of the separation bubble, and the presence of vertical motions and secondary circulations. We report on the results of some simple experiments on flow past a cylinder on which the traditional 2D domain has been expanded to three dimensions with a no-slip bottom boundary condition, the domain is then suitable for the study of idealised flow past islands. By using the Imperial College Ocean Model in a dynamically adaptive mode, we are able to explicitly resolve the shear layers that form in the event of flow separation. The results, at a range of parameter values, reveal complex secondary circulations and vertical motions both up- and down-stream of the cylinder. Those in the wake can be attributed to Ekman spin-down processes. However, those upstream of the cylinder are more likely to be due to the combined effects of shear and flow curvature. In the past, it has been argued that island wakes are closed and cut off from any exchange with the free stream. We present evidence contrary to this and show flow configurations in which the flow crosses the shear layers to enter the wake. We also examine the changes that moving to a domain in which the depth is shallow, with respect to the cylinder diameter, brings to the resulting flow.

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INTER-DECADAL CHANGES OF THE SUMMER CARIBBEAN LOW-LEVEL JET

The summer Caribbean low-level jet (CBNLLJ) has an onset in June, a maximum in July and decay in August. The inter-annual variability of the summer CBNLLJ responds to sea level pressure (SLP) and sea surface temperature (SST) gradients between the tropical Pacific and the tropical Atlantic. The objective of this study is to determine if the CBNLLJ has changed its intensity and persistence in different decades and what conditions have triggered these changes. This is important with respect to the climate conditions that triggered these changes. This is important with respect to the climate conditions that influenced extreme intra American monsoon events. To determine the changes, statistical diagnostics of summer CBNLLJ anomalies are analyzed for different periods, in particular 1958-1978 and 1979-2001. Also analyzed were inter-basin SLP and SST gradient indices. The CBNLLJ showed more intense events and greater persistence during
VARIABILITY IN PRIMARY PRODUCTION RATES OFF THE SOUTHERN CALIFORNIA COAST: APPLICATION OF THE OXYGEN TRIPLE ISOTOPE METHOD

Delphi's fundamental importance of primary production (PP) to marine ecosystems and carbon cycle dynamics, large scale PP estimates remain poorly constrained, particularly for dynamic coastal regions. Conversion of satellite data to quantitative PP estimates requires algorithms that, to date, have relied on in vitro 14C PP measurements. A relatively new in situ technique for estimation of gross primary production (GPP) based on precise measurements of the three stable oxygen isotopes in dissolved O2 provides expanded spatiotemporal resolution and avoids in vitro effects associated with 14C PP. Contemporaneous measurement of O2/Ar gas ratio provides an estimate of the biological oxygen saturation state. Together, these measurements yield the ratio of net community production (NCP) to GPP, or NG, an indicator of carbon export efficiency. We measured the oxygen triple isotopic composition of dissolved O2 and the dissolved O2/Ar gas ratio of seawater samples on five CalCOFI cruises between November 2005 and January 2007 and calculated mixed layer GPP and NCP rates. We will discuss the variability of GPP and NG in the study region and compare these in situ rates to 14C PP rates routinely measured on CalCOFI cruises.

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NON-REDFIELD TYPE BEHAVIOR OF DINOFLAGELLATE ALEXANDRIUM TAMARENSE IN RELATION TO NITROGEN AND PHOSPHORUS LIMITATION IN COASTAL WATER

Dissolved inorganic nitrogen (DIN) occupied 90% by nitrate (NO3-) and dissolved inorganic phosphorus (PO43-) are primary nutrients in coastal ecosystems in Kure Bay, Hiroshima. Their concentrations were significantly and systematically different from sea surface conditions. Furthermore, the data suggested that Alexandrium tamarense is bioconcentrating these nutrients to be exposed to variable nutrient concentrations and ratios. The present study investigated the nutrient dynamics of A. tamarense based on natural environment studies and controlled laboratory experiments. The cells seemed to take up the nutrients with non-Redfield DIN:PO4 ratio ≤ 8, and P-limitation at NO3:PO4 ratio ≥ 16. Under P-limitation, A. tamarense accumulated more paralytic shellfish poison (PSP) than N-limitation. Therefore, DIN:PO4 ratio might be important factor to determine the nutrient limitation and PSP production of A. tamarense, and then shellfish poisoning in a coastal ecosystem.

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ASSESSING THE PERFORMANCE AND OPERATIONAL IMPACTS OF THE OCEAN SCIENCE, TECHNOLOGY, AND OPERATIONS WORKFORCE

One of the major goals of ocean science, technology, and operations (OSTO) workforce is to produce products that enable better management and use of the ocean environment. For example, ocean observing, analysis, and forecasting systems generate products for monitoring and predicting ocean conditions that are used in a wide range of applications (e.g., environmental management, ocean policy, resource extraction, national defense). For many reasons, it is important to objectively and quantitatively assess the performance of these products and their operational impacts (e.g., the accuracy of ocean forecasts and the impacts of these forecasts on the decisions made by end users of the forecasts). A major motivation for conducting such assessments is that they provide valuable feedback to the OSTO workforce on how to improve the quality and effectiveness of its products. For end users, these assessments can lead to improved understanding and application of the products (e.g., increased awareness of ocean forecast uncertainties and how to account for those uncertainties in decision making). We will present examples of online systems for developing these assessments, plus sample product assessments.

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VARIABILITY AND CHANGE IN SOUTHERN OCEAN ECOSYSTEMS: THE EFFECTS OF CLIMATE FLUCTUATIONS AND BIOLOGICAL INTERACTIONS ON THE DYNAMICS OF SCOTIA SEA ECOSYSTEMS

Determining the factors generating change in ocean ecosystems requires an understanding of how biological and physical processes interact across a wide range of scales. Here we consider the Scotia Sea ecosystem and highlight the role of biological and physical interactions in generating large-scale ecosystem structure. We then examine the factors generating coherent variability in the ecosystem between years. In particular, we examine the effects of physical variations (sea surface temperature and sea ice) on the dynamics of the regional populations of Antarctic krill and their predators. We further consider how these fluctuations are linked to climate related variation through the El Nino-Southern Oscillation, the Southern Annular Mode variation and the Antarctic Circumpolar Current. On the basis of these analyses of sub-decadal variation we then consider the factors generating longer-term change (over the last 200 years) in this ecosystem. Finally, we discuss the development of predictions of future change in a system subject to both climate and harvested driving changes.

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TIDAL AND RESIDUAL CIRCULATION IN ST. ANDREW BAY, FL

The St. Andrew Bay System, Florida, consists of four sub-estuaries: North Bay, West Bay, East Bay, and St. Andrew Bay. The system has limited freshwater input and is the only major drainage basin located entirely in the Florida Panhandle. The tide is diurnal with a range of 0.3 m. Two 24-hour surveys were conducted during spring and neap tides to understand the roles of different forces on the residual flow under differing tidal regimes. Observed velocities were fitted to diurnal and semidiurnal harmonics separating tidal from subtidal motions. The results indicate that freshwater input was the main driving force during the measurement periods. The residual flow is compared to an analytic model that allows variations in the relative contributions from Coriolis accelerations and friction through the Ekman number. A solution with an Ekman number of 0.045 makes the observations best. This indicates that the overall dynamics are governed by pressure gradient, Coriolis and friction. Locally, advective accelerations become important, like around a cape at the intersection of West Bay and St. Andrew Bay.

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DIFFERENT APPROACHES TO MODELING INNER-SHELF ÅE SORTED BEDFORMS AND THEIR RESPONSES TO COMPLEX FORCING SCENARIOS

Numerous observations have revealed that a striking type of large-scale pattern adorns many inner continental shelves, in which the sediment is sharply segregated into swaths of coarse material separated by domains of fine sand. Coarse swaths, usually on the order of 100 m wide, often extend kilometers in the offshore direction. Previous work offered a hypothesis for the formation of these Åe-sorted bedforms, and an exploratory numerical model to test its plausibility. The hypothesis and model involve a grain-size sorting feedback and subsequent emergent interactions that lead to an unusual kind of large-scale bedform. The previous exploratory numerical model represented the key relationship between bed composition and sediment flux with simple parameterizations that lump together ripple growth and the effects on sediment and current profiles. A recent model reproduces those results using more explicit representations of relatively small- and fast-scale processes. This new model also allows an exploration of diverse geometries that result under complex wave- and current-forcing scenarios. However, using different parameters does not produce the individual processes produces qualitatively different results. Our attempts to use both top-down models and more explicit numerical reductionist models provide an instructive case study highlighting the advantages and pitfalls of different modeling strategies for dealing with interactions spanning a range of scales.
THERE IS THE DRAMATIC CHANGE IN THE TERMINATION OF THE EUC AND THE ASSOCIATED CASCADES
middle to late Holocene palynomorph assemblages (MW-1 P-4 and IL-2 P-3), the palynomorph assemblages are represented by sudden increase in Pinus pollen and abrupt decrease in Quercus pollen in comparison with the earlier zones. There is also a notable rise in the amount of Gramineae and Artemisia. These assemblages record the onset of more unstable forest condition, and the climatic degradation and forest regression at that time can be presumed. During the deposition of MW-1 P-4 and IL-2 P-3, the climate was probably moister and drier. Radiocarbon dates in the lower part of IL-2 P-3 (-6.543 m) indicate the deposition initiated from 4,470 ± 140 yr BP. The increase in spores from Peridoliophsida (Laevigatosporites, Polyphidioporsides) and the first appearance of spores from Bryophyta (Spinifexes) are another features of MW-1 P-4 and IL-2 P-3. These variations are probably related to increased fluvial activities. The high freshwater input to the coring sites could have also caused the stronger water stratification, favoring the development of fine stratification with very low degree of bioturbation in the upper parts of MW-1 unit-5 and IL-2 unit-3.

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USE OF PASSIVE INTEGRATED TRANSPONDER TAG FOR ASSESSING THE ALONGSHORE TRANSPORT RATE OF GRAVEL, NORTH ARCTIC ALASKA

The seasonal alongshore transport direction and rate was monitored of gravel tagged with 12mm-long passive integrated transponder (PIT). In June 2006 fifty-tagged gravels were injected at each of two seaward MTL sites on Narwhal Island, a sand-gravel barrier in Arctic Alaska. In July 50 gravels were injected at two additional sites. In July, 35-50% of gravels which were identified from the first site, had drifted alongshore up to 3m, and by August this drift had extended up to 8m westward. In mid-October 2006 none of the tagged gravels was identified, while in July 2007 subsequent to the 8-month winter only one of the original 200 tagged gravels was detected. The sole gravel had moved 35m west of the June injection point. The post-winter poor detection of the tagged gravels at beach surface is likely to their burial under ice-pushed sediment mounds (up to 3m high), and their loss to subtidal zone by shoreface ice and meltwater. Thus, PIT tag use to assess the annual alongshore transport rate of gravel in Alaskan arctic can be complicated by ice action.

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BIODIVERSITY OF CHAETOGNATHS OF THE ANDAMAN SEA, INDIAN OCEAN

Andaman Sea is one of the prominent biodiversity hotspots in the Indian Ocean. Stratified zooplankton collections were made at 32 locations during 2003-2006. Average density of chaetognaths was 8.5/m³ in open ocean and 41.6/m³ in coastal waters. Twenty species of chaetognaths including two new species occur in the area. In the oceanic sector Sagitta enflata predominated the layer above thermocline followed by S. neglecta, S. bipunctata, S. crinata, S. pacifica, Pterosagitta draco and S. regularis. In the 500m to thermocline S. decipiens dominated followed by Eukrohnia fowleri. Congregations of S. decipiens, a mesopelagic species was occasionally found in the mixed layer (upto 9.9 m) during NE monsoon associated with the upward movement of species due to recurrent severe cyclones in the Bay of Bengal. In the coastal waters either S. enflata or S. neglecta predominated. Krohnitta balogapali and Sagitta meenakshi are endemic to the area. Maximum species diversity was observed above thermocline. Invariably two clusters were found along each stratum accounting 70% similarity. Latitudinal species diversity increases towards south. Variability in chaetognath community is influenced by unique physical features of the area.

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CLIMATE FORCING OF MID-ATLANTIC ESTUARIES IN THE 20TH CENTURY

To better understand the implications of anthropogenic climate change for three major Mid-Atlantic estuaries (Chesapeake Bay, Delaware Bay, and the Hudson River Estuary), we (1) analyzed the regional output of seven global climate models and (2) estimated the impact of sea-level rise on estuarine salinity. The climate simulation given by the average of the models was generally superior to individual models, which differed dramatically in their ability to simulate 20th-century climate. All models warmed over the 21st century under the six greenhouse gas scenarios considered, with an increase of 4.7 ± 2.0°C (model
mean ± 1 standard deviation) for the A2 scenario (a medium-high emission scenario) over the Chesapeake Bay watershed by 2070-2099. Precipitation projections had much weaker consensus, with a corresponding increase of 3 ± 12% for the A2 scenario, but in winter there was a more consistent increase of 8 ± 7%. Precipitation projections were within the range of interannual variability but temperature projections were not. Streamflow-adjusted salinity variations were analyzed in Delaware and Chesapeake Bay during the past several decades in order to isolate the influence of sea-level rise. Both time series show long-term increases that are somewhat larger than hydrodynamic models forced with increasing sea level predict.

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BATHYMETRY INVERSION BY SEQUENTIAL DATA ASSIMILATION OF TSUNAMI SIMULATION MODEL

We demonstrate the framework of sequential data assimilation for correcting bottom topography which can be regarded as boundary condition of various simulation models. We used shallow water equations model and tide gauge data of tsunami in this assimilation. Not of our concerns are paid to validate information on depths of sea bottom. The reason is that bottom topography data sets are erroneous and correction of depths can make simulation results more accurate. The particle filter is used as assimilation method because of the computational reason. In this study, we conducted two types of numerical experiment and analysis: twin experiment of bottom topography correction and bottom topography estimation in the Japan Sea. The result of twin experiment shows the efficiency of our sequential data assimilation approach. It also shows the guideline on the noise term of simulation model. The result of assimilation to real data suggests that almost all of Yamoto Rises is shallower than the average of available data sets.

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SMALL-SCALE EDDIES AROUND THE KURIL STRAITS GENERATED BY BAROTROPIC TIDAL FLOW

Numerous small-scale eddies have been found from LANDSAT infra-red imagery around the Kuril Straits, which are located between the Okhotsk Sea and the North Pacific Ocean, whose ventilation is deeply affected by the transport and mixing at the Kuril Straits. We demonstrate the framework of sequential data assimilation for correcting bottom topography which can be regarded as boundary condition of various simulation models. We used shallow water equations model and tide gauge data of tsunami in this assimilation. Not of our concerns are paid to validate information on depths of sea bottom. The reason is that bottom topography data sets are erroneous and correction of depths can make simulation results more accurate. The particle filter is used as assimilation method because of the computational reason. In this study, we conducted two types of numerical experiment and analysis: twin experiment of bottom topography correction and bottom topography estimation in the Japan Sea. The result of twin experiment shows the efficiency of our sequential data assimilation approach. It also shows the guideline on the noise term of simulation model. The result of assimilation to real data suggests that almost all of Yamoto Rises is shallower than the average of available data sets.

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VARIAIBILITY OF NONLINEAR INTERNAL WAVES ON THE CONTINENTAL SHELF

Nonlinear Internal Wave (NLIW) packets are pervasive features in the coastal ocean. Yet while they arrive like clockwork in some regions like the South China Sea, they occur with a high degree of variability on most continental shelves. Here we explore their variability using moored observations from the New Jersey Shelf obtained during the ONR Shallow Water '06 (SW06) experiment. During a 50-day period, NLIW activity was found to be both spatially inhomogeneous and temporally intermittent. Wave packets propagated in many different directions, producing highly 3D wave fields and irregular wave timing. Initial results indicate that NLIW energy levels do not scale with the strength of the barotropic tide. Instead, NLIW activity is found to be linked to the strength of the internal tide, with greater activity occurring during the neap barotropic tide. While topographic forcing and, seasonal stratification are certainly important, sudden changes in the location of shelfbreak fronts and mesoscale motions must play a role in setting the strength of the internal tide, its nonlinear steepening, and subsequent propagation of NLIWs.

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LONG-TERM (1992-2007) CHANGES IN DIATOM AND PHAEOCYSTIS GLOBOSA SPRING BLOOM DYNAMICS IN COASTAL WATERS OF THE EASTERN ENGLISH CHANNEL.

Massive Phaeocystis globosa and diatom spring blooms succession occur each year in coastal waters of the eastern English Channel. The present study aimed to determine the long-term trends of phytoplankton dynamics from 1992 to 2007 with special emphasis on community composition. The correlations observed between the North Atlantic Oscillation (NAO), nutrient loads and phytoplankton species dynamics were similar to those recorded at a long-term scale (1988-2001) in the Southern Bight of the North Sea. Drastic changes in diatom biomass and composition appeared in 1994 and 2004. They consisted in a shift between a Guinardiaceae assemblage (Rhizosolenia spp. and Guinardia spp.) and potentially toxic species of the genus Pseudonitzschia. The first assemblage is probably related to the intensity of the North Atlantic inflow into the English Channel, the second one seems to be linked to changes in nutrient ratios. Moreover, these Pseudonitzschia spp. blooms concomitantly increased with the dominance of Phaeocystis globosa. We suggest that these pennate microzoic diatoms could develop on organic components produced by Phaeocystis colonies.

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LATERAL MIXING BY INTERLEAVING IN THE EQUATORIAL THERMOCLINE

The observation of interleaving of water masses within the thermocline of the equatorial Pacific raises questions as to why the interleaving is present and what impact it has on mixing and the broader scale structure of the flow and tracer fields. Individual layers are of order 10m thick and stretch for order 200 km and 1000 km in the meridional and zonal directions, respectively. Numerical experiments which reproduce the interleaving suggest that the interleaving can have a large impact on both vertical and lateral mixing of momentum, potential vorticity and tracers. Here we report on theoretical and numerical work on the stability of steady and time dependent background flows and the subsequent equilibration of the flow. We contrast freely evolving and forced flows as well as 2D versus 3D disturbances. The relative roles of inertial and parametric subharmonic instabilities change depending on the flow configuration and as the flow evolves. The implications for lateral mixing in the equatorial thermocline and its impact on ocean dynamics will be discussed. The inference is that scale interactions involving interleaving may link mixing in the equatorial thermocline to variations of the larger scale flow on interannual to interseasonal timescales.

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INFRASONIC PRECURSOR OF TROPICAL CYCLONE

Intense infrasonic emission was observed prior to the birth of a tropical cyclone (Netrava, 1999). It is connected apparently with instability of atmospheric layers in cyclone area. There are different mechanisms of this effect, the condensation instability is considered in the present paper. The Cooling of air in upward convection flow makes water vapor supersaturated. This is a nonequilibrium state of fluid where effect of instability can be developed in the process of infrasonic precursor. Solution of initial equation indicates the effect of infrasonic wave amplification and its nonlinear evolution. Corresponding analyses of them make it possible to clarify the principally important aspects of cyclone infrasonic precursors.

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VARIAIBILITY OF MODE AND INTERMEDIATE WATERS IN DRAKE PASSAGE DURING THE LATE 20TH AND EARLY 21ST CENTURIES

The variability of the Subantarctic Mode Water (SAMW) and Antarctic Intermediate Water (AAIW) flowing through Drake Passage in the last four decades is examined using 24 hydrographic and tracer sections and over 400 Argo hydrographic profiles. SAMW exhibits a decadal trend toward increasing potential temperature and salinity during the 1970s and a reverse decreasing tendency between 1990 and 2005, at which point the coldest and freshest SAMW on record is encountered. In contrast, AAIW undergoes a steady freshening between the 1970s and the 21st century. Both SAMW and AAIW experience marked interannual changes in their thermohaline properties, potential vorticity, and oxygen and nutrient concentrations that co-vary differently for each water mass. The contrasting evolutions of SAMW and AAIW over the study period are interpreted in terms of distinct formation areas and mechanisms. These reveal that SAMW variability is predominantly controlled by tropical modulation of air-sea interaction in the Southeast Pacific, and that AAIW changes are more closely linked to the rapid climate change west of the Antarctic Peninsula. The likelihood of an anthropogenic influence in the observed variability is discussed.

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PLANKTONIC RESPONSE TO UV IN A CHANGING ENVIRONMENT: EFFECTS OF ACUTE AND CHRONIC UV-B INFRARED WARMING AND OTHER STRESSORS ON THE FUNCTIONAL RESPONSES

Planktonic sensitivity to UV is affected by climate change through variations in UV exposure (modulated by surface irradiance, CDOM and vertical mixing), temperature, and CO2. Warming can enhance repair of UV damage, especially important when the UV temperature ratio is high in the early spring. We manipulated temperature and UV exposure of natural microbial assemblages from Lake Giles, PA during April when surface temperature is rapidly increasing. Biological weighting functions for UV inhibition of photosynthesis and bacterial incorporation of leucine were estimated based on polychromatic exposures to filtered xenon lamp irradiance. At the initial temperature (5.5°C), surface UV 2

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SHORELINE ANALYSIS AND BARRIER ISLAND DYNAMICS: EVENT TO DECADECAL SCALE PATTERNS FROM CEDAR AND PARRAMORE ISLANDS, VIRGINIA

Data from aerial photographs and topographic maps have been analyzed in tandem with aerial LiDAR and high-resolution GPS surveys to determine decadal-scale and event-scale coastal retreat rates and patterns on Cedar and Parramore Islands. In past literature, it
was suggested that Cedar and Parramore lie in two distinct erosional zones (threshold retreat and moderate to high rates). Periodically, the islands are geographically neighbors, exposed to the same general forcing processes and conditions. Cedar Island is prone to parallel beach erosion while Parramore Island undergoes clockwise rotational erosion. The current data, however, suggest that Cedar Island has undergone some degree of clockwise rotation and is eroding at an average island rate of 5.3 m/yr (1852-2002) while Parramore experienced parallel beach retreat of about 12.6 m/yr (1994-2007) based on end-point measurements. The data further indicate that there has been acceleration in erosion rates over the past decade.

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ROSE: COINCIDENT SEISMIC AND HYDROGRAPHIC SURVEY OF THE GULF STREAM AND SLOW WATERS SOUTHEAST OF NOVA SCOTIA

In the summer of 2007, the Government of Canada contracted a large-scale multi-channel seismic (MCS) survey southeast of Nova Scotia with the intent to extend Canadian jurisdiction of the seabed and its natural resources under the United Nations Convention on the Law of the Sea (UNCLOS). The survey lines crossed a major oceanographic boundary between the Gulf Stream and the slope waters. The primary goal of our research undertaken on R/V Endeavor during the 2007 cruise EN438 was to collect a hydrographic dataset coincident with a part of the UNCLOS MCS survey. We collected ~350 km of hydrographic data at a spatial density ~500-1000 m using shipboard XBTs and CTDs. In addition to analyzing the MCS data to gain quantitative understanding about the recorded water column reflux, we plan to use XBT/CTD data to produce reflectivity sections and carry out waveform modelling to study spatial resolution limits of seismic oceanography. We also recorded repeat and reverse profile XBT/CTD data to investigate short period temporal effects on seismic imaging in this dynamic environment.

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VIRUS AND BACTERIA DISTRIBUTION AND ABUNDANCE ALONG A EUTROPHICATION GRADIENT IN THE COASTAL BAYS OF MARYLAND, USA

Anthropogenic activities including increased use of fertilizers, poor sewage treatment, and watershed development have increased nutrient input in estuaries worldwide. The Coastal Bays of Maryland are characterized by high nutrients, long water residence times, and decreasing water quality. This study explored how different land uses in these coastal bays impact virus and bacterial distribution and abundance. Bacteria concentrations ranged from 10^{9}-10^{10} m^{-3} and VLP concentrations ranged from 10^{-10}-10^{9} m^{-3}. Bacteria abundance was significantly positively correlated (p < 0.05) with VLP abundance, salinity, chlorophyll and total nitrogen (predominantly organic), total phosphorus, and temperature. The patterns emphasize the importance of the microbial loop in estuarine nutrient processing.

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SYNTHESIS AND APPLICATIONS OF THE MULTI-YEAR TIME SERIES DATA FROM THE LOBO SENSOR NETWORK IN ELKHORN SLOUGH, CA

The Land/Ocean Biogeochemical Observatory (LOBO) in Elkhorn Slough, CA has operated since 2001; a period sufficient to resolve the seasonal variability in nutrient fluxes and metabolic processes of the estuary. The combination of chemical, biological, and physical measurements from the LOBO network allowed extensive characterization of complex ecosystem processes related to nutrient cycling and primary productivity in the coastal environment. The extended high resolution time-series using shipboard XBTs revealed important relationships between climate, tides, and anthropogenic activity on estuarine nutrient levels and primary productivity. As a whole, the observations from the LOBO network have contributed to the conservation of this important ecosystem through: 1) scientific understanding, 2) effective management decisions, and 3) public outreach and education. We will describe these contributions with an emphasis on how the capabilities of the network could not be duplicated with traditional sampling methods.

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SEASONAL VARIABILITY OF OCEANIC ORGANIC SULFUR COMPOUNDS IN THE SUBTROPICAL GYRE OF THE NORTH ATLANTIC OCEAN: DMS, DMSP AND DMSO

Monthly vertical profiles of dimethylsulfide (DMS), particulate and dissolved dimethyl-sulfoniopropionate (DMSPp and DMSp), and dimethylsulfoxide (DMSO) are sampled in the North Atlantic Ocean at the Bermuda Atlantic Time-series Study (BATS) site from March 2005 to September 2005. Clear seasonal cycles are evident in the distributions of DMS and DMSP. DMS displays the so-called summer-paradox with increased concentrations (up to 4 nM) during the summer-stratified period in the subtropical gyre surface waters. DMSP concentrations show complex variability with concentrations typically <1 nM. DMSPp routinely is the largest reservoir of dimethylated sulfur with concentrations ranging from 10^{-7}-10^{-4} nM. Correlations between the sulfur compounds and the extensive time-series data sets collected from the Sargasso Sea are expected to address the sources of this seasonal variability.

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THE INFLUENCE OF MESOSCALE EDDIES ON INORGANIC CARBON CYCLING AND AIR-SEA CO2 GAS EXCHANGE IN THE NORTH ATLANTIC OCEAN

In the subtropical gyre of the North Atlantic Ocean, recent studies have shown that mesoscale eddies have an important role in modulating nutrient supply, new production and export production. Mesoscale eddies may also have an important role in controlling the inorganic carbon cycle of the upper ocean and influencing air-sea carbon dioxide gas exchange. As part of the EDDIES project in 2004 and 2005, and from earlier studies in the late 1990s, we examine how mesoscale eddies influence inorganic carbon distributions and carbon dioxide dynamics in the upper ocean. We find that the influence and response is different for a variety of mesoscale eddy features, from cyclonic eddies to Eighteen Degree Mode Water eddies, and also dependent on the age and evolving nature of the feature. For example, the wind-driven mesoscale eddy resulted in excess inorganic carbon relative to nitrate and canonical C:N elemental stoichiometry in the surface with subsequent enhancement of sea-to-air carbon dioxide flux. With field and model understanding of eddy type and frequency, we examine their contribution to the carbon dioxide sink and sources.

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COUPLING AN IN SITU AUTONOMOUS PLATFORM AND A MONITORING PROGRAM IN THE CALOOSAHATCHEE RIVER, FL TO UNDERSTAND NUTRIENT DYNAMICS OF COASTAL HABS

The primary objective of this project was to assess potential links between Kariena brevis blooms in southwest Florida ocean waters and changes in Caloosahatchee river flow and nutrient inputs into this region. Two continuously moored MARVIN platforms were used with a traditional field sampling approach. DMSP to survey the un gated portion of the river for various water quality and nutrient parameters since 2005. Results indicate significant amounts of nitrogen and phosphorus, in both organic and inorganic forms, enter the Caloosahatchee River at different locations, but were not easily correlated with changes in river flow. The fate of these nutrients entering the West Florida Shelf depends upon the complex physico-chemical and biological parameters present in various regions of the river. These include: prevailing coastal current direction and velocity, optical properties of the water, the phytoplankton community structure and nutrient needs at the time of nutrient delivery, short- and long-term climatological events like the passage of fronts.
or droughts. The paradox of certain historical water quality parameters improving while others decline underscores the need for high frequency measurements provided by autonomous platforms.

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HYDROCARBONS AND METALS IN TISSUES OF BENTHIC CRUSTACEANS AND MOLLUSCS FROM THE NEAR-SHORE BEAUFORT SEA: POSSIBLE EFFECTS OF OIL AND GAS DEVELOPMENT

Concentrations of saturated and aromatic hydrocarbons and 18 metals were measured in soft tissues of benthic crustaceans (amphipods, isoports, and mysids) and bivalve molluscs collected from the near-shore Alaskan Beaufort Sea during the summers of 2004, 2005, and 2006. In order to do so, offshore oil and gas development were accumulating in the coastal marine food chain. This study was part of the cANIMI-DA Project, sponsored by the Minerals Management Service. All species of benthic invertebrates sampled contained low concentrations of polycyclic aromatic hydrocarbons (PAH) and metals, similar to concentrations in similar species from uncontaminated environments. The PAH assemblage was consistent with mixed petrogenic, pyrogenic, and biogenic sources. Concentrations of PAH and saturated hydrocarbons were not higher near oil and gas operations. The saturated hydrocarbon assemblage in crustaceans was dominated by pristine, probably derived from consumption of phytoplankton or peat eroding from coastal sediments. Lead concentrations were higher in amphipods from the Northwestern facility than in those from nearby undeveloped locations in 2004 and 2005, but not in 2006. Benthic invertebrates are not bioaccumulating hydrocarbons and metals from oil and gas development activities.

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MOTION OF DISCRETE PARTICLES ON A PLANE SLOPE UNDER REGULAR BREAKING WAVES

The motion of solid spheres and the corresponding fluid velocity fields under regular breaking waves were measured on a plane slope using particle image velocimetry (PIV). The two-phase measurements were separated into the fluid phase and solid phase by morphological operation. The fluid velocity field was decomposed into a wave component and a turbulence component by ensemble averaging. The particulate phase was tracked as individual trajectories to determine their dispersion, velocity and acceleration. sediment sizes and wave conditions investigated, the glass spheres moved along the bottom and did not suspend. Breaking-wave-generated coherent structures were characterized by individual downstreams of turbulence impinging on the bed. The net motion of the sediment particles over a wave cycle was typically offshore and dominated by the undertow. Because the turbulence velocities in the downwash were larger than the wave velocity and undertow velocity, a sediment particle trapped in a downburst could occasionally overcome the effect of the undertow and be transported onshore. The frequency of occurrence of onshore transport was found to be higher in plunging breakers than in spilling breakers.

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SATELLITE OCEAN COLOR RECORD OF SEASONAL AND INTER-ANNUAL VARIABILITY IN CDOM DYNAMICS IN THE SOUTH ATLANTIC BIGHT

Ocean color satellite imagery from SeaWIFS and MODIS Aqua has been obtained from the late fall of 1998 to present. Here we examine inter-annual variability in the CDOM-associated signal in ocean color imagery on the South Atlantic Bight continental shelf, focusing on winter-spring, along with regional rainfall, river discharge, hydrographic conditions and possible modes of cross-shelf exchange. Cruise data and time series measurements at offshore towers are consistent with high CDOM absorption in lower salinity surface water masses on the shelf and a terrestrial/riverine origin for highly colored CDOM on the shelf. However, accurate retrieval of CDOM absorption coefficients from satellite ocean color measurements remains challenging, and is discussed in relation to in situ data obtained from several cruises (hydrographic properties, absorption measurements, optical profiles). Despite these uncertainties, CDOM-related products provide a useful tracer of terrestrial-derived DOM and where and when cross-shelf transport of coastal-derived water masses occurs. Examples compare CDOM from satellite ocean color between low, average and anomalously high FW discharge years and case studies where in situ data were available during CDOM events.

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CDOM IN THE DEEP SEA: DISTRIBUTION AND DYNAMICS FROM TRANS-OCEANIC SECTIONS

Chromophoric DOM (CDOM) is a ubiquitous component of ocean waters, found at all depths in all ocean basins. Our ongoing project is studying the distribution and dynamics of CDOM in the surface and deep seas, using meridional sections of the CO2/CLIVAR Repeat Hydrography Project in the Atlantic, Pacific, and Indian Oceans. Lack of correlation with DOC indicates that CDOM in the open ocean has local sources and sinks and represents a very small portion of the DOM on a carbon basis. Ventilation supplies CDOM at low concentrations to intermediate and deep water masses, but CDOM in slowly ventilating water masses is well correlated with AOU, indicating a slow microbial source for CDOM in the ocean interior. Comparison of CDOM in deep ocean water masses to ventilation age tracers indicate that there is no significant microbial consumption of CDOM in the deep ocean, leaving slow blooming to be the only known source. Systematic changes in CDOM:DOC relationships, DOM quality indices, and optical characteristics of CDOM in the deep ocean give tantalizing hints of the chemical transformations involved in DOM diagenesis.

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GENETICS OF PACIFIC ZOOPLANKTON INVASION OF THE ARCTIC OCEAN.

Climate change will increase opportunities for southern marine organisms to become established in the Arctic Ocean. The study of intraspecific genetic variation across oceanic transition zones holds great potential for early detection of such invasions and of ecological change. Using molecular genetic analysis of the 16S rRNA gene, we find that Calanus glacialis from the Bering Sea and the Arctic Ocean are genetically distinct from each other. Further, we find that C. glacialis from the Bering Sea is advected into the Arctic with the northward flow of Pacific water but is not observed outside areas of recent Pacific water inflow. This suggests that Bering Sea C. glacialis is not reproductively established in the Arctic Ocean at present. We conclude that the restriction of gene flow across the Pacific Arctic boundary has been sufficient to allow for molecular and phenotypic divergence of C. glacialis. The genetic assay and baseline study we report provides a sensitive tool to monitor Arctic marine ecosystem change.

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USING UNDERWATER VIDEO TO EXAMINE THE OCCURRENCE OF GREEN MACROALGAL BLOOMS ON A REGIONAL SCALE IN WASHINGTON STATE, USA.

Green macroalgal blooms are a threat to marine ecosystems, can release toxic compounds, and are thought to be increasing worldwide. These blooms have not been as well-studied in the Northeast Pacific as in other areas. We used underwater video surveys conducted by the Washington State Department of Natural Resources (WADNR), originally intended to determine seagrass cover, as a means to examine the abundance and geographic distribution of green macroalgal blooms over the regional scale. We have completed analysis for sites sampled in 2004 and 2005 and are beginning analysis for 2006. Seasonal regional trends, in particular the variability on spatial scales, are noted. We have also identified several strengths and weaknesses of this approach for both scientific and management purposes. The advantages of this technique over more traditional alternatives include the large sample size (per site and number of sites), the ability to digitally archive the original video, safety to personnel, and low cost. Disadvantages are primarily related to the use of video originally intended for examining other species, in particular times delays from sampling until videos are available for analysis. The likelihood of underestimating green algal abundance when water clarity is low and other primary producers are abundant is also problematic, although green macroalgal blooms that are sufficient to have substantial ecosystem consequences would not likely be missed.

Nelson, T. R., University of South Carolina, Columbia, South Carolina, USA, tnelson@geol.sc.edu; Voulgaris, G., University of South Carolina, Columbia, South Carolina, USA, gvoulgaris@geol.sc.edu; Warner, J. C., U.S. Geological Survey, Woods Hole, Massachusetts, USA TEMPORAL AND SPATIAL EVOLUTION OF SMALL SCALE RIPPLES ON THE INNER SHELF

Bedforms on the inner shelf were observed from October 2003, until March 2004, off Long Bay, South Carolina. During this period waves propagated to the northwest with an average significant wave height of 0.6 m and period of 4.8 s. The site was composed of fine-medium sand (D50 =177 microns). The geometry of the bedforms (wavelength, orientation, and plan-view shape) was determined using spectral and visual analysis of sonar images produced by an Imagenex rotating sonar system. This analysis focuses on the temporal and spatial evolution of continuous and discontinuous linear, wavy, bifurcating, and irregular ripples with 6-26 cm wavelengths. The analysis includes a time series com-
Nencioli, F., Ocean Physics Laboratory, University of California at Santa Barbara, Goleta, USA, francisco.nencioli@ucsb.edu; Dickey, T. D., Ocean Physics Laboratory, University of California at Santa Barbara, Goleta, USA, tommy.dickey@ucsb.edu; Kuwahara, V. S., Soka University, Tokyo, Japan, victor@soka.ac.jp; Ri, Y. M., University of Hawaii at Manoa, Honolulu, USA, shimi@hawaii.edu; Bidigare, R. R., University of Hawaii at Manoa, Honolulu, USA, bidigare@hawaii.edu; MESOSCOPIC EDDIES IN THE LEE OF HAWAII: CLOSED OR OPEN SYSTEMS? Mesoscale eddies are often treated as closed systems with respect to horizontal exchanges with the surrounding waters. Therefore, nutrient injections into the euphotic zone are assumed to occur only during the time of eddy formation. On March 2005, the cyclonic cold-core eddy Opal was sampled during the E-Flux III field experiment in the lee of Hawaii. Analysis of physical and biogeochemical data revealed a well developed, fairly circular eddy. Opal's core region was characterized by an intense doming of isopycnal surfaces and enhanced nutrient and chlorophyll concentrations. Vertical profiles of density show that the anomalies associated with the eddy extend to ~700 m. However, Opal's cyclonic circulation is primarily limited within the upper mixed layer. Analysis of the potential vorticity field suggests that the portion of Opal isolated from the surrounding waters is relatively shallow, and that radial exchanges of water might occur before this portion, as the eddy migrates. We therefore hypothesize a conceptual model in which nutrient inputs are not limited to a single injection, but can occur more or less continuously during the eddy's lifetime.

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ESTIMATION OF MODEL BIAS BY THE ASSIMILATION OF SATELLITE CHLOROPHYLL DATA INTO A GLOBAL MODEL OCEAN Chlorophyll concentration estimates by ocean-biogeochemical models show typically significant errors. Data assimilation algorithms based on the Kalman filter can be applied to improve the model state. However, these algorithms do usually not account for possible biases in the model prediction. Taking model bias explicitly into account can improve the assimilation estimates. Here, the effect of bias estimation is studied with the assimilation of chlorophyll data from the Sea-viewing Wide-Field-of-view Sensor (SeaWIFS) into the NASA Ocean Biogeochemical Model (NOBM). The ensemble-based SEIK filter has been combined with an online bias correction scheme. A static error covariance matrix is used for simplicity. The performance of the filter algorithm is assessed by comparison with independent in situ data over the 7-year period 1998–2004. Compared to the assimilation without bias estimation, the bias correction results in significant improvements of the surface chlorophyll. With bias estimation, the daily surface chlorophyll estimates from the assimilation show a 3.3% lower error than SeaWIFS data. In contrast, without the bias estimation, the global surface chlorophyll estimate without bias estimation is 10.9%. Next to the improvement of the estimated chlorophyll concentrations, the estimated biases indicate regions with systemic errors in the model-represented chlorophyll.

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THE ROLE OF CARBONATE IN INFLUENCING PARTICULATE ORGANIC CARBON EXPORT IN THE SUBTROPICAL NORTH ATLANTIC GYRE Long term time series data offer the opportunity to test hypotheses regarding our current paradigms in ocean biogeochemistry. Here we investigate the cause of the observed difference in export production between the two subtropical North Atlantic gyre time series stations, BATs and EOSTOC, situated at about the same latitude but on opposite sides of the gyre. The two stations exhibit similar seasonality in phytoplankton biomass and productivity but export production measured with free-drifting and moored traps is higher by a factor of 2-4 at BATs. Gianca et al. (2007) found that nutrient availability is slightly higher at BATs which could partially explain the higher export production. But calcium carbonate sedimentation is also higher by about a factor of 1.5 at BATs, as is the slope and correlation coefficient of the flux of particulate organic carbon vs calcium carbonate; indicating that POC sedimentation is also linked to calcium carbonate sedimentation at BATs compared to EOSTOC. This may partially explain a higher POC export in the western compared to the eastern NA gyre because of the greater carrying capacity associated with calcium carbonate.

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NAT-WORKING MARINE RESEARCH - A SCHOOL ENCOUNTER BEYOND LAB EDUCATION Stimulating young talents at school to join the natural sciences appears to be a task of modern societies poor in other resources. As there is no silver bullet for this age old conundrum, students, scientists and teachers joined in a project, "Nat-Working - Ocean Sciences" funded by the Robert-Bosch Foundation/Germany. To meet various demands of the students various opportunities can be chosen. The range covers almost the entire scale of scientific work from a laboratory - work to group work or excursions as well as a many kinds of demonstration like student symposia, single or group lectures or posters. Symposia and teacher training courses complement the practical work by providing the scientific background. Contributing to research work teaches scientific thinking and methodology in a more sustainable fashion than standardized exercises in a school setting. Science careers can thus be accelerated in general, as students already know basic scientific capabilities at the very beginning of their university studies. Students however learn in a framework of curricula which potentially limit their own as well as scientific engagement in such a cooperation.

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THE INFLUENCE OF HEAT AND FRESHWATER FLUXES ON CONVECTIVE ACTIVITY IN THE CENTRAL IRMINGER SEA The temporal evolution of the hydrographic structure of the Central Irminger Sea from 2002 to 2006 is investigated. Particular attention has been drawn to the mixed-layer depth as the region has been suggested to be a deep water ventilation site. During the period we report here a maximum mixed-layer depth of about 500m was found in winter 2000/2005, while shallower measured winter depth of 350m was found in winter 2002/2003 (no data in 2003/04). In the past convection activity has been related to the intensity (strength, frequency and direction) of the Greenland Icecap Jet (GIJ). As the GIJ intensity was rather similar in 2002/03 and 2004/05 it can not explain the difference in mixed-layer depth. However, in 2002/2003 a buoyancy gain through an anomalous high freshwater content was observed which may explain the difference in mixed-layer depth. During all times the mixed-layer did not reach into the stratum of the upper Labrador Sea Water and thus no renewal took place, at least at the mooring site. The highest depth that has been reached was 27.68 kg/m² during winter 2004/2005.

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THE SPATIAL-TEMPORAL DISTRIBUTION OF NEARSHORE MYSIS SWARMS AND THEIR PRIMARY PREDATOR, GRAY WHALES The spatial-temporal variability in the nearshore (10 m isobath) distribution of mysw swarms and their predator, gray whales, was examined along a 12.5 km stretch of the Oregon coast. Summer surveys were conducted from 2003-2007. Acoustic transects were conducted to estimate the thickness and distribution of the mysw swarms, while net tows, underwater imaging and direct observations (SCUBA) provided confirmation of acoustic observations. Ten recurring swarm sites were documented and mysw swarm thicknesses varied annually at these sites from 0.5 m to 6 m. A three-week deployment of a 1-MHz Nortek Aquadopp (TM) documented changing patterns in the distribution and biomass of the mysws during late summer. Residence time of gray whales within the region of the swarms varied from two to 112 days. The predation pressure from the whales and changing environmental conditions played an important role in the structuring of this nearshore ecosystem.

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AN EVALUATION OF VARIOUS DRIVERS FOR INCREASING HYPOXIA IN HOOD CANAL, WASHINGTON

Hood Canal (Washington State) is a classic fjord estuary with a shallow sill and sluggish circulation. It receives direct input from the Pacific Ocean via the Strait of Juan de Fuca. Increasing persistence and distribution of low dissolved oxygen concentrations in Hood Canal observed during the 1990-2000’s and repetitive fish kills during the 2000’s have galvanized interest to better understand the drivers of the hypoxia and, specifically, to assess whether human activity is involved. The situation is complex because several factors could be driving the present situation, including natural factors (e.g., climate, ocean, and freshwater dynamics), as well as human factors (e.g., carbon and nutrient loadings from a variety of sources). The Hood Canal Dissolved Oxygen Program-Integrated Assessment and Modeling study is a three-year effort to use observations and models to quantitatively evaluate possible causes for the increasing hypoxia. Emerging results from the study, begun in 2005, will be presented and discussed. While natural factors appear to be involved, the role of human loads of nitrogen cannot be ruled out.
Mesoscale activity has been hypothesized to be an important source of nutrients to base plankton growth in the Gulf. These factors resulted in a pronounced CHL maximum, suggesting aeolian deposition of micronutrients (seemingly iron) as a crucial factor regulating phytoplankton growth in the Gulf.

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4DVAR ASSIMILATION USING THE NAVY COASTAL OCEAN MODEL IN THE MONTEREY BAY

The recently developed 3DVAR and 4DVAR systems based on the Navy Coastal Ocean model will be used for data assimilation experiments in the Monterey Bay area. The high resolution limited area model will be nested into a regional model which in turn will be nested into the global model. Ocean observations from moored buoys, gliders, high frequency coastal radars and satellites will be assimilated in order to obtain a model solution that best fits the data and model dynamics with minimal errors. Assimilation results from 3DVAR and 4DVAR will be compared to each other and to independent observations in an attempt to evaluate the accuracy and efficiency of each method. Preliminary results will be presented.

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ASSESSMENT OF THE ECCO2 COUPLED OCEAN AND SEA ICE SOLUTION IN THE ARCTIC

One of the primary objectives of the Estimating the Circulation and Climate of the Ocean, Phase II (ECCO2) project is to realistically estimate the Arctic ocean circulation and sea ice distribution during the ocean satellite era (1978-present). ECCO2 state estimates are obtained by fitting a high-resolution (18-km horizontal grid spacing) global-ocean and sea ice configuration of the Massachusetts Institute of Technology general circulation model (MITgcm) to the available ocean and sea ice data. Towards ECCO2 Release Candidate 1 (RC1), an optimized solution has been obtained by (i) computing 70 forward-model sensitivity experiments and (ii) using a Green's function approach to minimize model/data misfits. Here we present a comprehensive assessment of ECCO2 RC1 in the Arctic Ocean using satellite and in-situ measurements of sea ice, freshwater fluxes, and temperature and salinity profiles. In addition, we assess ECCO2 RC1's ability to reproduce and to maintain important water mass properties, e.g., the Arctic halocline and the warm Atlantic layer. The purpose of this assessment is both to evaluate ECCO2 RC1 as well as to suggest improvements for the representation of the Arctic Ocean in future ECCO2 solutions.

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DEEP EUPHOTIC ZONE NET COMMUNITY PRODUCTION IN THE SUBTROPICAL NORTH PACIFIC GYRE FROM AUTONOMOUS GLIDER MEASUREMENTS

Mesoscale activity has been hypothesized to be an important source of nutrients to base plankton growth in the deep euphotic zone and hence a driver of net community production. We use the signature of biologically produced oxygen measured by autonomous gliders as a geochemical tracer of net community production. Seagliders, deployed through most of 2005 in the subtropical North Pacific gyre, made measurements of temperature, salinity and dissolved oxygen using both Aanderaa optode and Seabird Electronics SBE43 oxygen sensors. A simple mass balance model was used with objectively mapped Seaglider data to calculate net biological oxygen production in the deep euphotic zone, beneath the mixed layer. We find that productivity in the deep euphotic zone, beneath the mixed layer is strongly influenced by the vertical movement of isopycnals driven by Rossby waves and other mesoscale events. Net biological oxygen production in the deep euphotic zone was 0.9 – 1.5 mol O2 m−2 yr−1. This production rate accounts for 17 – 25 percent of net community production at Station ALOHA in 2005.

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NEARSHORE FLOWS IN CALIFORNIA: THE PRESENCE OF A COASTAL BOUNDARY LAYER

Nearshore flow is one of the most important and understudied issues in physical oceanography. The movement of ocean waters near the coast has important implications for larval recruitment and other ecological processes. Of particular interest are velocity gradients caused by the interactions of the coastline and alongshore flow, referred to as the Coastal Boundary Layer (CBL). Here, we examine the presence of a CBL at multiple sites on the South and Central California coast. We deployed Acoustic Doppler Current Profilers in transects perpendicular to the shore to measure velocity gradients in the nearshore waters. Data indicate the presence of a CBL whose characteristics reflect interactions of flow with the shoreline and the shallow seabed nearshore. Slower flows nearshore due to the presence of a CBL may be responsible for decreased alongshore transport and increased local retention of certain waterborne constituents, such as larvae and pollutants.

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LATERAL CIRCULATION IN STRATIFIED AND WELL-MIXED ESTUARINE FLOWS WITH CURVATURE

We will present observations of density, velocity, and turbulent stress under varying stratification conditions in an estuarine channel with significant curvature. Instrumentation was deployed in the Seal Bend region of Elkhorn Slough, in Monterey Bay, California, that permitted of all the terms in the lateral momentum balance to be calculated. Classical helical (two-layer) flow occurs only when stratification and lateral density gradients are weak; lateral Reynolds stresses balance the centrifugal acceleration. In contrast, stratified conditions produce strong streamwise velocity shear that results in a three-layer lateral velocity profile that is balanced primarily by lateral density gradients. We will discuss the relative balance between density gradients, vertical mixing, and lateral velocity in relation to the redistribution of salt in the channel cross-section and the concomitant effects on longitudinal dispersion.

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IRON LIMITATION OF RESIDUAL PHYTOPLANKTON COMMUNITIES IN THE ICELAND BASIN

The high latitude (≈55°N) North Atlantic Ocean is a highly productive region with deep winter overturning and intense spring blooms. Residual nitrate concentrations of 3-5 μM, low chlorophyll concentrations (≤0.5 μg chl a l-1), and low photochemical quantum yields (Fv/Fm) have been observed in mid-late summer (2004-2007) in the Iceland Basin. These results indicate the potential for seasonal iron limitation. During cruise D321 in late summer dissolved iron concentrations in the surface waters ranged from 20-80 pM. In vitro iron addition experiments carried out during this cruise demonstrated enhanced chlorophyll accumulation in treatments amended with 2 nM Fe, compared to controls. Phytoplankton photophysiology also differed between control and Fe amended treatments with increased (Fv/Fm) observed following Fe amendments. The results imply that the iron supply to the region is sub-optimal for complete macronutrient utilization suggesting that the seasonal HNLc condition developed in response to iron limitation. This can be rationalised by a sub-optimal Fe/N ratio in winter overturned deep water.

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BENTHIC MICROBIAL FUEL CELLS AT COLD SEEPS REFLECT VARIABLE TRANSPORT PROCESSES AND MICROBIAL COMMUNITIES

A benthic microbial fuel cell (BMFC) was deployed at cold seeps in Monterey Canyon, CA. The BMFC included a chamber that enclosed a carbon-fiber brush anode above the sediment-water interface. Repeat deployments at one seep used different valve technologies so that in one deployment flow through the anode chamber was occluded while in a
second, flow was possible. Assuming that hydrogen sulfide was the major electron donor, power records from the first deployment were consistent with a diffusive flux of sulfide to the anode chamber (31 mmol m\(^{-2}\) d\(^{-1}\)). With different valves, power increased by a factor of five, showed tidal variability, and was consistent with a dominantly advective flux of sulfide (157 mmol m\(^{-2}\) d\(^{-1}\)). The change in transport regime coincided with a significant change in microbial community from one dominated by epsilonproteobacteria (93% of phylotypes found) under diffusive conditions to a diverse community with representatives from deltaproteobacteria (23%), epsilonproteobacteria (23%), firmicutes (11%) and flavobacterium-cytophaga-bacteroides (17%) groups under advective conditions. These fuel cells delivered usable levels of power (40-80 mW) and did not exhibit signs of electrochemical passivation.

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WHERE STREAMS COMMINGLE WITH THE SEA: ENVIRONMENTAL CONTRIBUTIONS OF PATHOGENIC BACTERIA IN COASTAL WATERS

Human pathogens in the genus Vibrio (e.g. V. cholerae, parahaemolyticus, and vulnificus) thrive in warm brackish coastal waters. Because these pathogens are natural estuarine flora, rather than being simply washed into the coastal zone as pollutants, understanding the infection risk that they pose is complicated by myriad ecological interactions. Temperature and salinity tolerance appear to be major influences on the autecology of pathogenic Vibrio spp., but their relative importance is context dependent. In Lake Pontchatrain, Louisiana, for example, we found that V. vulnificus abundance was strongly correlated with lake temperature over a seasonal cycle. In coastal waters of Hawaii, on the other hand, variability in abundance was best explained by changes in salinity. Multiple strains of the same vibrio species were frequently isolated from a given sample, but which controls the balance of viable and avirulent strains in the environment is not known. We propose that bacteriophages, which infect selectively, mediate horizontal gene transfer, and contribute to virulence through lytic conversion, will be key to better understanding the synergy, evolution, and changing virulence potential of pathogenic Vibrios in the environment.

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“UPPER OCEAN & EDDY MOMENTUM, VORTICITY AND THERMAL ENERGY CONVERGENCES COMPUTED FROM LAGRANGIAN OBSERVATIONS”

Since 1985, drifting buoys have been built to accurately follow the horizontal trajectories of water parcels at 15m depth below the ocean surface. These data are used to calculate the Lagrangian acceleration of water particles and the rate of change of mixed layer temperature. The ensemble average in a spatial domain over many observations of the Lagrangian acceleration is the sum of the mean and eddies convergences of momentum and is used to also calculate the mean and eddies convergence of vorticity. The ensemble average of the Lagrangian acceleration is the sum of the mean and eddies convergences of vorticity. In a similar fashion, the sum of the mean eddies convergences of thermal energy is computed from the ensemble average time rate of change of temperature following the drifter tracks. These ensemble averages are robust in the tropical Pacific where over 4000 drifters have been deployed since 1988. The eddy flux of the tropical Pacific in relation to the time mean vorticity gradient is discussed in light of the common use of horizontal eddy viscosity parametrizations in models that do not resolve the eddy vorticity fields directly.

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RADIATION AND DISSIPATION OF INTERNAL WAVES IN THE SOUTHERN OCEAN.

Direct observations and inverse models suggest that small-scale turbulent mixing is enhanced in the Southern Ocean above bottom topography. The eddy enstrophy spectrum, directly related to the PDI, has been obtained for each study’s variable. Singularity spectra are shown to be scale-invariant and so fully describe changes in scale of the observed PDFs. We have compared the singularity spectra obtained from some altimeter-derived maps (SLA, velocity and vorticity) and those obtained from the PDFs of the spatial variation of SST and Chlorophyll concentration satellite gridded maps, in order to determine the scaling properties which are common to the different variables and hence improve our understanding of oceanic turbulence.

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SCALE ANALYSIS OF NON-GAUSSIAN PROPERTIES OF ALTIMETER-DERIVED VARIABLES

Velocity probability density functions (PDFs) derived from scalars such as Sea Level Anomalies (SLA) have been studied in the past to analyze ocean turbulence. It has been argued that the non-Gaussian character of velocity PDFs is mainly due to the presence of intense vortices. However, the influence of changes in scale in those non-Gaussian properties has not been fully described. In this work, we will show that velocity PDFs, as well as other satellite-derived scalar PDFs, present scalar invariance properties but with a non-trivial dependence on the observation scale. We will show that these properties are related to the multifractal behavior of the variables under study, intimately connected with the action of ocean turbulence. The singularity spectrum, directly related to the PDFs, has been obtained for each study’s variable. Singularity spectra are shown to be scale-invariant and so fully describe changes in scale of the observed PDFs. We have compared the singularity spectra obtained from some altimeter-derived maps (SLA, velocity and vorticity) and those obtained from the PDFs of the spatial variation of SST and Chlorophyll concentration satellite gridded maps, in order to determine the scaling properties which are common to the different variables and hence improve our understanding of oceanic turbulence.

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DNA BARCODING OF MARINE PLANKTONIC OXACILLARIA (ARThROPODA; CRUStacea) FROM THE SARGASSO SEA, NORTH ATLANTIC OCEAN.

Oxacillaria (Arthropoda; Crustacea) are an important but little-known component of the marine holozooplankton assemblage. During a cruise to the Sargasso Sea (western North Atlantic Ocean) in April 2006, 65 species of oxacillaria – of 140 species known from the North Atlantic – were identified from samples obtained from 5,000 m to the surface at five stations spread between 33.5°N and 14°N. A portion of the mitochondrial cytochrome oxidase I (mtCOI) gene was sequenced for identified specimens at sea for multiple individuals of 38 species. Patterns of variation of this gene fragment were suitable for use as a DNA barcode (i.e., short DNA sequence for species recognition and discovery), with low intraspecific variation (1% to 3%) and diagnostic differences between species (12% to 26%). mtCOI can be used as an accurate and reliable tool for taxonomic identification of known oxacillaria species and for revealing cryptic taxa within geographically widespread species, but does not resolve deeper phylogenetic relationships above the genus level.
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A CONCEPTUAL DESIGN FOR BOREHOLE OBSERVATORIES OF GAS HYDRATES BURIED IN OCEANIC SEDIMENTS
Most of gas hydrates are buried stably in the sediments which are located in 0-1000m depth below seafloor. The climate, oceanographic and tectonic processes can affect gas hydrate stability conditions, resulting in highly dynamic changes of subsurface environments (GH05S, 2007). A coupled seafloor/borehole gas hydrates observatories can be used to monitor the chemical, microbiological and physical data to understand the dynamic changes, the carbon cycling in gas hydrate- bearing continental margin and serve for exploration and exploitation of gas hydrate as an energy in the future. It is more difficult to deploy the borehole gas hydrates observatory than the seafloor’s because of the former needing drilling. Borrowing ideas from the experiences of operating CORK or ACCC in OD and MOWD or LWD in oil drilling, this paper develops a conceptual model of borehole gas hydrates observatory. The model mainly includes borehole instruments, data recorder and power module, shrinking cables and data transmission unit. Sensors integration and the mode of data transmission may be the primary problems of carrying out the borehole observatory of gas hydrates buried in the oceanic sediments.

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SPECIES DIVERSITY IN THE MESOPELAGIC ZONE: IMPLICATIONS FROM MULTI-SPECIES SYMMETRIC ASSEMBLAGES OF CONGENIC COPEPODS
The mesopelagic zone of the oceans is among the largest biospheres on earth and with moderate vertical gradient of environment that is highly stable compared with coastal waters and epipelagic zones. Zooplankton assemblages in the mesopelagic zones commonly exhibit highest species diversity at a local scale among various marine pelagic habitats, but detailed patterns and possible mechanisms for generation and maintenance of species diversity have rarely been addressed. An examination of the patterns of species diversity in mesopelagic copepods indicated correspondence of morphological/functionspecialization in feeding appendages with high species richness, e.g., in Scoleicirrhitidae (modified chormoraptors, ca. 160 nominal species), Eucryptidae (sucker-like appendages, ca. 70 spp.) and Heterorhabdus (poison-fang, 31 spp.). Also noted is co-existence of extremely large number of congenic or closely-related species occurring in the local waters, e.g., in Scoleicirrhitidae (43 spp. in Sagami Bay, 57 spp. in Celebes Sea) and Eucryptidae (35 spp. in Celebes Sea), in both of which vertical segregation and food-resource partitioning appear to be major, if not all, mechanisms for the species co-existence, but necessitating further evidences of feeding specificity.

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IMPROVED REPRESENTATION OF MIXED LAYER DEPTH AND MODE WATERS IN THE HIGH-RESOLUTION MODELS OF THE WESTERN NORTH PACIFIC
A series of high-resolution simulations of the western North Pacific is performed changing the horizontal resolution. Two basin scale eddy-resolving models, whose horizontal resolutions are about 7.5 km and 2.5 km, are nested within a control eddy-permitting (about 22.5 km) North Pacific model. These models basically reproduce important features of the western North Pacific, such as separation of Kuroshio/thermocline structure of the upper ocean (mode waters) and salinity minimum of North Pacific Intermediate Water. But the representation of these features is highly improved in the eddy-resolving models from the eddy-permitting model. We focus on the representation of the subtropical mode water, where mixed layer, subduction, and circulation are involved. As a first step, we investigate the representation of the mixed layer depth (MLD) distribution in these models, comparing with observational data. The five-year mean March MLD distribution of the eddy-resolving model is similar to the HydroBase climatology of February-March MLD from Suga et al. (2004, JPO). On the other hand, the fact that the eddy-permitting model shows an overestimation of MLD in the northern deep mixed layer region. The general features of the seasonal variation of the mixed layer, which have been shown from recent analyses of the Argo profiling floats (e.g. Oka et al. 2007, JO), are also reproduced in the eddy-resolving model.

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THE VALUE OF TEMPORAL PERSPECTIVE FOR UNDERSTANDING COASTAL SEDIMENTATION: THIRTY YEARS ON THE WESTERN NORTH AMERICAN SHELF
Quantitative studies of sedimentary change in various regions have focused on 30-40 years ago, and environmental changes over that period can be evaluated by comparisons with the earlier observations. A recent study examined sediment accumulation on the Washington continental shelf, through measurements of Pb-210 geochronology and grain size. These observations were contrasted with similar measurements made thirty years ago. Sixteen stations were reoccupied, triplicate cores were collected at some stations, and consistent analytical techniques were used. Across- and along-shelf trends in accumulation rate and sediment texture have remained the same. Despite potential impacts from land use (log-ging), damming, and the Mt. St. Helens eruption, Pb-210 profiles are very similar today to those thirty years ago. Consequently, sediment accumulation rates have not changed significantly, likely attributing to the modulating effects of terrestrial and marine portions of sediment dispersal systems. However, grain size of the accumulating sediment is significantly coarser (~10 % more sand) at most sites reoccupied, and may reflect intensified wave activity. A likely source of sand is from shallow-shelf and coastal locations, where erosion has been observed.

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OLIGOTROPHICATION - COMING TO AN ESTUARY NEAR YOU?
Just as limnologists perceived the threat of eutrophication ahead of marine ecologists, they have also taken the lead in studying the reversal of that process, oligotrophication - a decrease in the supply of organic matter to an ecosystem. Decreases in the supply or production of organic matter in aquatic systems can come about for a variety of reasons, including the introduction of herbivorous animals, reductions in the numbers of predators on herbivores, management or climate induced reduction of nutrient inputs, and climate induced changes in phenology. The impact of oligotrophication resulting from various causes has so far received very little attention in marine ecology, though the growing success of nutrient management programs in some parts of the world suggests that the phenomenon will become increasingly important, at least in Europe and North America. In some areas, such as Narragansett Bay, ongoing management interventions will be interacting with a climate-driven oligotrophication that has been underway for decades. The process deserves our attention, though we should not forget that eutrophication will likely continue to intensify in much of the world.

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UNDERSTANDING THE IMPACT OF STORMWATER ON THE COAST OF NORTH CAROLINA, USA
Microbial contaminants from stormwater runoff negatively impact the water quality along the North Carolina (NC) coast, and have the potential to adversely affect public health through both water contact and consumption of shellfish. The extent and nature of microbial contamination of stormwater runoff in NC has not been adequately characterized. We studied a total of 123 runoff samples and found that 79% were contaminated with Bacteroides sensu lato, a generic marker for fecal contamination. We document a large difference in the composition of these bacteria, with changes in composition corresponding to fundamental downstream processes. Barometric influence, along with proximity to dominant wind direction, may be the primary reasons for changes in contamination levels. Our results may be the first to document the potential impact of changes in climatic patterns on microbial contamination of stormwater runoff.

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INCREASED FRESH WATER FLUX AND THE SLOWING OF THE MOC -- WILL IT WARM OR COOL EUROPE?
We were motivated by Bryden et al. (2005) analysis which implies that the MOC has slowed down significantly (20%) during the past 50 years and that, as a result, Europe should have cooled during this period. Although the article has been subject to strong criticism, and, although there have been claims in various blogs (e.g., www.realclimate.com) that Bryden himself retracted at least some of his conclusions, his results are consistent with recent observations of an increased fresh water flux into the Atlantic. And yet, western Europe "failed" to cool during the past 50 years. To examine this issue, we considered a coupled analytical model where the MOC responds to increased fresh water fluxes and altered salinity. Convective, heat exchange and Ekman layers are all parts of the model dynamics corresponding to fundamental counter-intuitive heat-flow processes. On the basis of that model, we suggest that, in contrast to what the global numerical climate models predict, a slow down of the MOC will cause Europe to warm, not cool. As in the numerical models, the analytically modeled slow-down is accompanied by a reduced heat flux to the North Atlantic, damming, and the Mt. St. Helens eruption, Pb-210 profiles are very similar today to those thirty years ago. Consequently, sediment accumulation rates have not changed significantly, likely attributing to the modulating effects of terrestrial and marine portions of sediment dispersal systems. However, grain size of the accumulating sediment is significantly coarser (~10 % more sand) at most sites reoccupied, and may reflect intensified wave activity. A likely source of sand is from shallow-shelf and coastal locations, where erosion has been observed.
AUTOTROPHIC PICOCYANOTON DISTRIBUTION IN THE WESTERN PACIFIC
- FROM CHUK LAGOON TO EAST CHINA SEA

Autootrophic picocyanoton distribution was investigated from Chuk Lagoon (FSM) to the coastal waters of Korea (Inner Chuk Lagoon (IC), outer Chuk Lagoon (OC), North Equatorial Current (NEC), Kuroshio current (KC), East China Sea (ECS)). Prochlorococcus (PRO), Synechococcus (SYN), picocyanotones (PEUK) were both enumerated using FlowCytometry. Diversity and type distribution of picocyanotones were analyzed through 18SrRNA gene sequencing. Importance of autootrophic picocyanotone biomass was assessed using size fractionated chlorophyll a analyses. Summer size fractionated chlorophyll a contributed more than 50% for most part indicating their importance as primary producers in these regions. PRO were the most abundant autootrophic picocyanotone in the surface waters but not observed in the IC and ESC shelf waters. High abundances of surface SYN were observed in IC and ECS, but lower abundances were enumerated in NEC and KC. PEUK in OC and ECS showed a characteristics of having abundance maximum whereas NEC showed mixed surface layer. PEUK showed that the whole study area have novel picocyanotone group and picotyposome as a dominant group. The current study tries to understand how the changes in environmental variables effect autootrophic picocyanotone distribution in the Western Pacific.

EVOLUTION OF TURBULENCE IN THE OCEAN MIXED LAYER RESPONDING TO THE STABILIZING BUOANCY FLOW SIMULATED BY LES

The formation of a diurnal thermocline in the ocean mixed layer under the stabilizing buoyancy flow was simulated successfully by large eddy simulation, reproducing various features consistent with observations. It was found that wave breaking and Langmuir circulation play a critical role in the formation of a diurnal thermocline. The TKE flux dominates TKE production within the mixed layer, while turbulence maintained by shear production at the thermocline causes restratification in the remnant layer. The depth of a diurnal thermocline is determined by both the Monin-Obukhov length scale and the Ekman length scale. Further, the effects of stratification on turbulence were investigated for the sake of parameterizing the vertical mixing process.

THE STABILIZING BUOANCY FLUX SIMULATED BY LES

This study examined the effect of the environmental conditions of temperature, salinity and light on germination of south Florida Vallisneria americana in a controlled setting. A randomized block split-plot design was used in a controlled growth chamber study; the main plot was temperature (30, 24, 18°C) with sub plots of salinity (0, 5, 10, 15psu) and light (presence, absence). Increased temperature significantly increased the final percent germinated (p<0.001). Across all salinity and light levels, final percent germinated was always highest in 30°C (p<0.001). The three-way interaction of temperature, salinity and light significantly affected germination rate (p<0.001), where germination rate was directly related to temperature and light but inversely related to salinity. Overall, the rate was fastest in 30°C, 15psu and light and slowed in 18°C, 15psu and light. Increased temperature significantly increased the number of days until last germination (p<0.001). None of the main effects (p>0.05) nor their interactions (p>0.05) had a significant effect on time to first germination. Placing V. americana seeds in water of 30°C with a salinity of <5psu and in the presence of light will maximize germination. Applying these conclusions to south Florida populations will assist in restoration and sustainability of V. americana and help determine environmental tolerances and thresholds for the long term management of this species and the Caloosahatchee River.

HYPERPYCNAL FLOW WITHIN LOW GRADIENT RIVER DELTAS AND IMPLICATIONS FOR SEDIMENT TRANSPORT TO THE SHELF: BRAZOS RIVER

Hyperpycnal flow is a well documented process for high gradient rivers, but is not generally accepted as a common phenomenon in low gradient rivers. The Brazos River provides an example of such a low gradient system. The Brazos River Delta and proximal shelf were sampled during the July 2007 floods with a CTD, equipped with a turbidity sensor, and a short gravity core on transects running the 8m isobath along shelf and across shelf from the river mouth. A turbid hypopycnal river plume as well as a turbid bottom layer was found emanating from the river. Brazos River mud is characteristically red, while marine sediment is olive-grey. Preliminary result reveal a distinctively red, porous storm layer, composed of up to 30% sand, material coarser than would be carried in the suspended load, that extends from the river mouth. The strong layer suggests hypopycnal transport during the flood discharge. If this is the case, hyperpycnal flow may occur regularly on the Brazos River, providing an important mechanism for transporting sand and mud across the inner shelf.
ABUNDANCE AND TOXICITY OF A KARLODINIUM VENEFICUM BLOOM IN THE WEEKS BAY NATIONAL EUTRIFIED RESEARCH RESERVE, ALABAMA. Weeks Bay NERR experienced multiple dinoflagellate blooms in 2007. The phytoplankton community was dominated by a bloom of Prorocentrum minimum in February followed by Kryptoperidinium foliaceum and Karloidiurn veneficum in July - October. Five fish kills occurred within Weeks Bay and its tributaries during the summer. Analyses of the water and the dead fish indicated that karlotoxin contributed to these. We mapped phytoplankton community structure, toxin levels and a range of environmental and optical variables repeatedly during the Karlotium bloom. Karlotium formed spatially localized peaks of cell density and cell toxicity. The highest abundance was 120 million cells/liter (466 &micro;mol/l Chla) in the upper reach of the estuary. High cell densities reflected elevated nutrient loading. Toxicity reached 1 ng cell in the bloom, 67% of the variability in the environmental data (T, S, DIN, DIP and kd) was explained by the first 2 PCs in a principle components analysis. Per-cell toxin concentration was highly correlated with PC2, which was correlated (p<0.05) with DIP (R = 0.91) and kd (R = 0.81): toxicity was highest at low DIP/high water clarity.

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ROLE OF UPPER TROPHIC LEVELS ON SILICON, NITROGEN AND PHOSPHORUS CYCLING IN THE OCEAN: A BOX-MODEL STUDY

Robust estimates of biologically-mediated fluxes are critical to our understanding of nutrient cycling in the ocean. The magnitude of these fluxes is partly driven by spatial and temporal variability in the structure and the dynamics of the marine food web. To date the potential influence of upper trophic levels, i.e. organisms larger than mesozooplankton, on nutrients cycling has been seldom considered. Here we examine their potential influence on silicon, nitrogen and phosphorus cycling using different global ocean models, which differ by their horizontal resolution (Southern Oceans, Low-latitude Oceans and Northern Oceans). In all case, the vertical resolution considers an epipelagic (0-200 m), mesopelagic (200-1000 m) and bathypelagic (> 1000 m) layer. The biological model is derived from Tye's (Nature, 400, 525-531, 1999) with inclusion of the silica cycle, and a simple description of upper trophic levels. The biological parameters are constrained using alometric laws. Afterward, the role of large organisms is examined through a model sensitivity analysis to nutrients stoichiometry, food-web structure, or biomass size spectra. At the end, the results will help to answer how large the impact of higher trophic levels in nutrient cycle and how big the different of nutrient concentration among horizontal and vertical resolution.

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A NEW SAMPLING DEVICE FOR COLLECTING ZOOPLANKTON WITH EASE AND ACCURACY

Numerous different devices are employed for sampling zooplankton. Every sampler has its advantages and limitations in terms of sampling ease, adaptability and efficiency. Because of these considerations researchers are always in search of samplers that increase efficiency and decrease human effort. In this study we compared zooplankton densities and composition obtained from sampling with a new sampling device, the Nunez sampler, and three long-standing vertical sampling devices, an integrated tube sampler, a plankton tow, and a Van Dorn bottle. The results of this experiment indicate that the zooplankton communities observed using the Nunez sampler were statistically similar to the results obtained using the integrated tube sampler and the Van Dorn. All three of the devices had statistically higher quantitative values than the plankton tow. The advantages of the Nunez sampler for zooplankton collection principally relate to its relative ease of use and its fast mode of operation, particularly compared to the Van Dorn bottle and plankton nets. The Nunez sampler also provides easy quantification of zooplankton densities for entire water columns, thereby avoiding biases related to vertical stratification of plankton.

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THERMODYNAMIC ANALYSIS OF OCEAN CIRCULATION

Calculating a stream function as function of depth and density is proposed as a new way of analysing the thermodynamic character of the overturning circulation in the global ocean. The sign of an overturning cell in this stream function directly shows whether it is driven mechanically by large-scale wind stress, or “thermally” by heat conduction and small scale mixing. It is shown that the integral of this stream function gives the thermodynamic work performed by the fluid. The proposed method is applied both to an idealized coarse-resolution three-dimensional physical ocean model, to the ECCO GODAE model, and to the real-time resolution OCCAM model. The overturning circulation in OCCAM between 200 m and 1000 m depth is dominated by a thermally induced cell of 25 Sv, forced by Ekman pumping. In the deepest and deepest waters there is a thermally direct cell of 18 Sv, which requires a forcing by around 100 GW of parameterized small-scale mixing.

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A MODEL OF WINTER GROWTH FOR ANTARCTIC KRILL (EUPHASIA SUPERBA) DURING THEIR FIRST AND SECOND YEAR

A model to predict growth of individual Antarctic krill (Euphausia superba) during their first and second winters was constructed with experimentally-derived estimates of winter ingestion of water column and sea ice associated food, assimilation efficiency, and respiration. Environmental variables included chlorophyll concentration both in the water column and sea ice, and carbon to chlorophyll ratio of the food. Krill feeding in the water column or at the sea-ice surface was predicted by day length. Net growth rates for individuals were positive or negative depending on initial food conditions. Daily growth rates were consistent with published rates. Model results indicated that while krill can survive or grow under a variety of food conditions, when sea ice is absent krill in their second winter would not survive or grow at low water column food concentrations that would not support krill in their first winter. Linking physiological growth models to dynamic models of winter primary productivity would allow prediction of the impact of future changes in annual sea ice production on winter survival of krill.

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SOLITON PACKET IMPACT ON ACOUSTIC PROPAGATION AND ARRAY PERFORMANCE DURING ASIAEx2001

During ASIAEx 2001, SAR imagery and temperature strings showed a strong soliton packet passing along an acoustic path from a 300 Hz source to a bottomed horizontal array. Observed array performance was degraded during the soliton passage. Performance degradation due to acoustic variability is being related to oceanographic features by an integrated modeling effort and resultant data/model comparisons. The ASIAEx oceanographic data forms a basis for initial and boundary conditions in sub-mesoscale hydrodynamic computational models (EULAG, NMCO, and NRL-MIT) to simulate the evolution and propagation of such internal soliton packets with external forcing, stratified flow, and variable bathymetry. The resulting temperature and salinity distributions are mapped to the time updates of sound speed field. Those sound speed fields are input to a 3D acoustic code, which computes the acoustic field at the array. The modeled acoustic array performance is then computed and compared to the observed array performance, using measures related to array performance. [This research is supported by ONR and has the support of HPC time grants from the DoD HPCMP!].

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A SEQUENTIAL CLEAN FILTERING SYSTEM FOR PARTICULATE TRACER METALS IN OCEANIC SURFACE WATER (GE0SS/BIOCARBON)

Iron and several other trace metals in seawater play crucial roles in cell physiology and in biochemical reactions of marine organisms in many oceanic regions. For our better understanding of the trace metals role on oceanic ecosystem, a composition of suspended particle matter gives us essential information on phytoplankton, biogenic particles and mineral dusts. In order to correspond to time and spatial variations of biological activities at the surface layer, we present here an in-line clean filtering system for surface seawaters. Using the system, whose flow lines were made of Teflon, polyethylene and polycarbonate, eight of surface samples (1.5 - 3.2 L) can be filtered sequentially. This filtering system is
CABRON THE LOWER MISSISSIPPI RIVER: TYPES, TRANSFORMATIONS, TRANSPORT

The Lower Mississippi River collects water from 41% of the contiguous U.S. before entering the Gulf of Mexico. Particulate and dissolved materials transported by the river are critical to biological and chemical processes occurring both in the river and in the Gulf. For approximately two years, we have measured quantities and fluxes of various materials, including organic carbon, transported in the main channel of the Lower Mississippi River. Additionally, we have made the most detailed measurements to date for this system of primary and secondary microbial production, respiration, and biomass. Our objectives in this presentation are to describe temporal patterns in the quantities of organic carbon in various living and non-living components, rates of carbon fluxes within the microbial food web, and the magnitudes of different forms of organic carbon transported by the Mississippi River during 2006-07.

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AN ARTIFICIAL FISHERY? THE RECOVERY OF THE NILE DELTA FISHERY VIEWED THROUGH A STABLE ISOTOPIC LENS

After the closure of the Aswan High Dam in 1965, the coastal fishery off of Egypt's Nile Delta collapsed. While this consequence was unexpected, the real surprise came later; in the mid-1980's, when landings of marine and estuarine fish began to rise again and then exceed landings prior to the dam's closure. A hypothesis has been advanced that nutrients (N and P) from agricultural runoff and sewage are artificially supporting this rebounded fishery. We have made a first test of this hypothesis by measuring the stable isotopic signatures of fish, plants, particulate matter, and water from the Nile River, agricultural drains and offshore. There are significant differences between inshore and offshore samples and fish caught from across the delta. Also interesting is the evolution of the N isotopic signature of the water and fish in the Nile River and its distributaries as it flows north to the Mediterranean Sea.

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SURFACE CURRENTS AND BOTTOM OXYGEN VARIATIONS IN WESTERN LONG ISLAND SOUND

The bottom waters of western end of Long Island Sound experiences hypoxia each summer. Moored CTD and DO sensors revealed intermittent ventilation events during the transition to hypoxia. We hypothesize that the mechanism that controls the ventilation is the wind induced modulation of the re-stratification rate by principal tidal currents. This is quite different from the variability observed in the Narragansett Bay which has been associated with spring-neap changes in the amplitude of the tidal currents. Surface currents in the Narragansett Bay system as determined by an HF RADAR system reveal significant correlation with the rate of change of DO at the bottom and support the hypothesis. These results suggest that subtle variations in the wind statistics can have substantial influence on the seasonal variability of the duration and extent of hypoxia.

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CENSUSING MARINE LIFE - DIVERSITY, DISTRIBUTION AND ABUNDANCE

The Census of Marine Life (COML) is a global ten-year initiative by over 2000 researchers from 80 countries to assess and explain the diversity, distribution, and abundance of life in the oceans – past, present, and future. The History of Marine Populations analyses sea life diversity retrospectively as historians and biologists trace life before significant human exploitation. The Ocean Realm Projects demonstrate standardized protocols and novel technologies for observing marine organisms, yielding new biodiversity data ranging from the global intertidal to the abyssal plains, earth’s largest habitat. The Future of Marine Populations integrates biogeographic data in models for statistical analyses and forecasting, providing a wide synthesis of data types. All data are available online in the Ocean Biogeographic Information System. In 2003, COML summarized known marine biodiversity globally, characterizing life on the planet.

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TEMPORAL VARIATION PROPERTY OF DISSOLVED ORGANIC CARBON, NITROGEN AND PHOSPHORUS IN SURFACE OF THE WESTERN SUBARCTIC PACIFIC

The temporal variations of dissolved organic carbon (DOC), nitrogen (DON) and phosphorus (DOP) in surface waters of the Western Subarctic Pacific were investigated along the different two timescales. One is the seasonal changes found in time series observations at KNOT stations (44N, 155E) during 1999-2000. The other is the daily changes on the inside of diatom-blooming water mass induced by the mesoscale iron enrichment of SEEDS I (48N, 16E). The elemental composition of dissolved organic matter (DOM) at KNOT showed the seasonal change from C-rich ratio (C/N=19, C/P=380) in the pre-bloom (May) to relatively N-rich ratio (C/N=14, C/P=310) in the post-bloom (July). Also in SEEDS I (13 days after enrichment), the accumulation of relatively N-rich DOM (C/N=16, C/P=310) was observed with diatom bloom compared with pre-bloom (C/N=18, C/P=410). These suggest that relatively N-rich DOM are supplied through phytoplankton bloom and they are preferentially decomposed within the surface, consequently C-rich DOM remain.

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MICROBIAL DEGRADATION OF BIOCHEMICAL COMPOUNDS DERIVED FROM MARINE PHYTOPLANKTON

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Marine dissolved organic matter (DOM) is likely transformed from photosynthetic products of phytoplankton through microbial degradation processes. However, changes in the chemical composition and biogeochemical properties during transformation processes are still unknown. Here, we followed the fates of major biogenic compounds of photosynthetic products such as neutral aldehydes, amino acids and fatty acids using gas chromatography/carbon isotope mass spectrometry (GC/C/IRMS) combined with $^{13}$C as a tracer. We incubated natural phytoplankton populations with addition of NaH$^{13}$CO$_3$ by simulated in situ method for 36 hours, and labeled photosynthetic products with $^{13}$C. After the subsample was recovered at the end of the light period, the samples were incubated in the dark for 150 days. The concentration of organic carbon in photosynthetic products decreased only by 9.0% of the maximum concentration which we observed at the end of the light period, remained on day 30. The contribution of dissolved fraction to total products increased from 10 to 32% in the first 30 days. The analyses using GC/C/IRMS was able to determine the $^{13}$C content precisely and elucidate the degradation process from biochemical composition.

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With a population dynamics model the influence of environmental factors on the distribution of anchovy eggs and larvae in the Black Sea is studied. The model is initialized by specifying the location of eggs with a given individual weight at different spawning areas indicated by the available observations. Zooplankton biomass within the sea is computed by a lower trophic food web model. Spawning is considered to begin in early June and last for 90 days when mixed layer temperatures are greater than 20°C. Each cohort of daily spawned eggs is subject to natural and predation mortalities, as well as somatic growth and metabolic demands which are all dependent on zooplankton biomass and temperature. They are advected by current fields provided by daily circulation model (POM) predictions which involve the assimilation of alimter data for 1992-1994. The present version of the model includes neither active swimming of juvenile and adults, nor fishing mortality. These simplifications are introduced to isolate the effect of life cycle characteristics as well as environmental influences on anchovy dynamics. Model results indicate that individuals are strongly controlled by advection through the Rim Current circulation around the periphery of the basin and are locally controlled by mesoscale eddies. It is found that the coastaly attached anticyclones are more preferential foraging grounds of anchovy. Future plans are to couple the model dynamically with the lower trophic food web model.

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PARTICLE BACKSCATTERING, ABSORPTION AND BIOGEOCHEMICAL PROPERTIES IN THE MID-ATLANTIC BIGHT We examined the relationships among inherent optical properties and remotely sensed quantities in the Mid-Atlantic Bight. Surface particulate backscattering $b_p$ (442) was more strongly correlated with non-algal particulate absorption $a_{ph}$ (443) ($r = 0.80$) than the phytoplankton absorption $a_p$ (443) ($r = 0.69$). These results, along with the $a_{ph}$ ($r = 0.43$)/$POC$ indicated that suspended non-algal particles with high inorganic content are the major water constituents regulating $b_p$ (442) variability. Surface $b_p$ (660, 676) and $a_p$ (660, 676) were significantly correlated with $POC$ ($p < 0.001$ at 660 and 676 nm) and Chl a ($p < 0.001$ at 660 and 676 nm), respectively. Variation in remote sensing reflectance R$_{665}$, which is a function of $b_p$ (660) and $a_p$ (660) ($p < 0.001$), was correlated with POC/Chl a ($p < 0.05$). These relationships could provide an algorithm for estimating surface $a_{ph}$ (443) from $b_p$ (442) and POC/Chl a from $R_{665}$ (in the Mid-Atlantic Bight).

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CLIMATOLOGICALLY DRIVEN VARIATION IN PHYTOPLANKTON COMMUNITY COMPOSITION AT A COASTAL STATION IN THE NORTHERN CALIFORNIA CURRENT Strong seasonal upwelling in the Northern California Coastal Current promotes the rapid proliferation of a predictable suite of chain forming diatoms during spring and early summer off the central Oregon coast. Variations in both the strength and duration of upwelling, increasing thermal stratification and uptake by diatoms results in the rapid depletion of surface nutrients and a transition to a dinoflagellate dominated community as summer progresses. A final fall diatom bloom generally marks the close of the growth season after which inshore transport of high abundances of relatively low biomass oceanic nanoflagellate species results in a complete turnover of the phytoplankton community. Variations to this paradigm however are known to occur in response to local, basin-scale forcing (e.g. Pacific Decadal Oscillation) and more remote climate phenomena such as the El Nino Southern Oscillation. Here we examine the effects of such events on the structure and composition of the phytoplankton community between 1998 and 2007 and assess their influence on higher trophic level dynamics in particular, copepod and euphausiid egg production rates, at a coastal station off the central Oregon coast.

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SURFACE CURRENT TRAJECTORIES FROM HF RADAR; PARAMETERIZING SUBGRID SCALE MOTIONS Lagrangian trajectory information in the coastal ocean is important for a variety of applied and purely scientific problems. Improving trajectories from high frequency (HF) radar observations requires knowledge of time-space averaged velocities and unresolved eddy velocities. Pathways of surface drifter triplets from the Santa Barbara Channel demonstrate
that eddy diffusivities for scales of $O(10-100)$ m range from $10^{-7}$ to $10^{-9}$ m$^2$/s. These values agree with Richardson's $1/4$ power law scaling and Okubo's empirical fits. They relate the idea that realistic sub-grid scale parameterizations must be scale dependent. HF radar trajectories from a random walk Lagrangian stochastic model agree poorly with drifter observations despite incorporation of observed sub-grid scale information. Large differences ($\sim 15$ cm/s) in mean velocities between drifters and HF radar occasionally occur, causing rapid divergence of modeled and observed trajectories. Possible sources include artificial sub-grid scale energy for an enlarged PDF of HF radar derived trajectories, and incorporation of numerical model output to constrain HF radar observations.

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Meso Zooplankton Grazing Pressure in Different Spatial Domains in the California Current System

The CCEE LTER (California Current Ecosystem-Long Term Ecological Research) site is exploring the use of spatial differences within the CCEE site as a surrogate measure of how ecosystem characteristics may change over time. As one component of this study, we have measured mesozooplankton grazing pressure in 8 different regions of the southern sector of the California Current System, in conditions ranging from vigorous upwelling to a strongly stratified water column. All measurements are made with a Lagrangian design, in which we follow water parcels for 4-5 days at a time using Globalstar-track drifter. Meso zooplankton grazing pressure was measured using gut fluorescence in 5 size fractions ranging from 200 $\mu$m to $5 \text{ mm}$. Four replicate day-night sequences of gut fluorescence, together with one more intensive study of diel periodicity, were conducted at each of the experimental cycles. Specific grazing rates varied from 0.02 to 0.17 d$^{-1}$ in May 2006 and 0.06 to 0.54 d$^{-1}$ in April 2007, with a disproportionate share of mesozooplankton grazing in the two smallest size fractions. Rates decline monotonically from inshore to offshore in both years.

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STUDY ON VERTICAL PROFILES OF RARE EARTH ELEMENTS BY USING AN OCEAN GENERAL CIRCULATION MODEL

Observations of rare earth elements (REEs) in the North Pacific suggest that vertical profiles of their concentrations in water are dramatically different from lighter to heavier REEs. In this study, in order to evaluate role of each source and sink in controlling the vertical profiles of REEs, we conduct numerical simulations of REEs by an ocean general circulation model (OGCM). In the first experiments, external fluxes such as river runoff, atmospheric dust deposition, and flux from coastal regions are given individually as a source of REEs. In the second experiments, we focus on internal recycling associated with reversible scavenging process onto particles where a scavenging parameterization is incorporated into an OGCM. The model clearly demonstrates that vertical transport of REEs by reversible scavenging process is essential for reproducing the observed vertical profiles of REEs. The model successfully reproduces the observed difference in vertical profiles among REEs, where adsorption reactivity of REEs on particles controls it. This study also suggests that external flux from river transported sediments at river mouth plays a role in the observed inter-basin difference of REEs concentration between the Atlantic and Pacific. In the case of Nd, our simulations suggest that about half of Nd of deep water in the North Pacific originates from external flux given in the other basins.

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SEASONAL AND INTERANNUAL VARIATIONS OF THE NORTH PACIFIC SUBTROPICAL MODE WATER IN 2003-2006

Seasonal and interannual variations of the North Pacific Subtropical Mode Water (STMW) over its entire distribution region were examined by using Argo profiling float data during 2003-2006. In 2008, STMW is formed in late winter in the recirculation gyre of the Kuroshio/Kuroshio Extension, which extends north of about $28^\circ$ N, from $136^\circ$ E to near the date line. The recirculation gyre consists of several anticyclonic subgyres, in each of which thick STMW with a characteristic temperature is formed. After spring, STMW with each temperature tends to be continually trapped in the respective subgyre, remaining in the formation region, while part of it leaves the subgyre, entering the region south of $28^\circ$ N where the surface current transports relatively thin STMW southwestward. The temperature of STMW formed in the recirculation gyre increases by about $1^\circ$ C from 2001 to 2006, and the salinity also increases by 0.05 from 2003 to 2005, with eastward decreases of both temperature and salinity in each year. These interannual changes are clearly detected in the downstream region south of $28^\circ$ N, with time lags consistent with the estimated geostrophic flow speed.

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FLORIDA BAY CORALS: RESILIENT TO STRESS?

Significant experimental evidence suggests increases in $pCO_2$ can cause a decrease in the calcification and ultimately the health of corals, a finding which has particular significance in view of the increase in the global $CO_2$ by ~100 ppm since 1800. Despite these findings, corals such as Solenastrea sp. and Siderastrea sp. have been observed growing in extreme environmental such as Florida Bay where the $pCO_2$ varies by 100s of ppm from year to year without having any demonstrable effect on the coral growth and health. In order to assess whether these corals have adapted to variations in $pCO_2$, a series of experiments are being carried out in which the rates of calcification are being measured as the corals respond to these natural variations and variations which we impose on the corals through artificially lowering the pH. These studies will assess whether naturally occurring corals can and have already adapted to changing $pCO_2$.

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TIME SERIES OBSERVATIONS, 1983-2006, OF INORGANIC CARBON AND NUTRIENTS IN HIGH LATITUDE NORTH ATLANTIC

We present results of observations of ocean CO$_2$ partial pressure, total dissolved inorganic carbon and nutrients from two hydrographically different regions: The northern Irminger Sea and the Iceland Sea. The former represents relatively warm and saline Modified North Atlantic Water derived from the North Atlantic Current. The latter is dominated by the cold Arctic Water and Atlantic Water formed at high latitude Polar Water with varying proportions. These regions not only constitute significant North Atlantic CO$_2$ sink areas, but also represent important source areas for the North Atlantic Deep Water (NADW). Therefore, pronounced hydrographic changes that have induced significant biogeochemical changes in these regions, but at different rates, must be taken into account in evaluating the future course of ocean CO$_2$ uptake in response to increasing atmospheric CO$_2$.

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AN APPLICATION OF LAGRANGIAN COHERENT STRUCTURES TO HARMFUL ALGAL BLOOMS

The largest and most frequent harmful algal blooms (HABs) caused by the toxic dinoflagellate Karenia brevis tend to occur along the southern portion of the West Florida Shelf (WFS). A necessary condition for achieving a high population density is that stretching and folding of fluid elements do not act to significantly reduce the population during the growth phase. It is argued that the presence of a cross-shelf transport barrier may provide favorable conditions for the development of HABs on the WFS by inhibiting exhausitively losses and allowing for a greater nutrient buildup on the shoreface of the barrier. The barrier is characterized as a Lagrangian coherent structure (LCS), which is a material line that separates fluid domains with different advection properties. Because the early stages of HABs are usually not detected, there is limited understanding of the environmental conditions that lead to their development. We employed simulated LCSs to trace the early location of a HAB before it was transported to an area where it could be detected by satellite imagery. Then a population dynamics model is used to infer the factors that may have led to its development. Two nearshore nutrient sources are identified, one associated with a coastal upwelling event and the other produced by river run off. These results show that the use of simulated LCSs and a population dynamics model can enhance our understanding of the early stages of HAB development.

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CHEMICAL AND ISOTOPIC CHARACTERIZATION OF PRODUCTS FROM RUTHENIUM TETRIOXIDE OXIDATION OF MACROMOLECULAR ORGANIC MATTER IN MARINE SEDIMENTS

The majority of organic matter in marine sediments is insoluble, macromolecular, and poorly characterized. While novel analytical techniques shed light on the molecular level composition of these refractory materials, understanding their origin and deposition requires additional information. Age and isotopic composition of macromolecular organic matter may vary due to source(s) and pre-depositional history. Deconvolving inputs is important for understanding organic matter cycling within a specific environment, and for constraining global carbon cycling budgets. Ruthenium tetroxide (Ru4O4), a relatively mild chemolytic agent, selectively oxidizes aromatic units, un saturated moieties, and ether bonds. The aliphatic and alicyclic compounds liberated from the macromolecular matrix using a mild chemolytic agent, selectively oxidizes aromatic units, unsaturated moieties, and ether bonds. The aliphatic and alicyclic compounds identified, one associated with a coastal upwelling event and the other produced by river run off. These results show that the use of simulated LCSs and a population dynamics model can enhance our understanding of the early stages of HAB development.
face that was repeatedly forced to the surface by internal oscillations. Striking cross-shore variation in phytoplankton abundance and community composition were observed, with dinoflagellates dominating onshore of the 15 m depth contour, and diatoms dominating in deeper areas over a cross-shore distance of 8 km. This integrated cross-shore perspective indicates that these shallow-water events may carry significant implications for the growth and success of phytoplankton taxa commonly associated with shelf waters. Funded by CA Seagrant, ONR, SCoCOn, CA Coastal Conservancy, and NOAA.© Mori, Y., University of Tsukuba, Tsukuba, Japan, mori.327@eisei.tsukuba.ac.jp; Hama, T., University of Tsukuba, Tsukuba, Japan, thama@biol.tsukuba.ac.jp; Ishii, M., Geophysical Research Department, Meteorological Research Institute, Tsukuba, Japan; Saito, S., Geophysical Research Department, Meteorological Research Institute, Tsukuba, Japan

MOLECULAR WEIGHT COMPOSITION OF MARINE HUMIC SUBSTANCES IN THE SUBTROPICAL WESTERN NORTH PACIFIC

Marine humic substances (MHS) are one of the main components of marine dissolved organic matter. However, molecular weight (MW) composition of MHS, which is closely related to dynamics of MHS, is largely unknown. In the present study, we measured the depth and spatial changes in MW composition of MHS in the subtropical western North Pacific. Samples were collected between 15–30ºN along 137ºE. We extracted MHS by solid phase extraction using ODS cartridges. MW compositions of ODS-MHS (O-MHS) were fractionated by high-performance size-exclusion chromatography. O-MHS was composed of three MW groups: high, middle and low MW, in all samples, and the vertical profiles of these groups were different each other. In surface mixed layer, the concentration of the high and middle MW groups were lower than those in deeper layer, suggesting that UV-light damage these two groups was more severe for irradiated. In intermediate waters, on the other hand, the concentration of high MW group substantially increased relative to surface layer. This increase in high MW group likely reflects the production of high MW O-MHS as by-products of the microbial decomposition processes.

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HYDROGRAPHIC AND MICROBIAL VARIABILITY IN SURFACE WATERS OF THE HUDSON RIVER ESTUARY

The lower Hudson River is a well-flushed temperate estuary influenced by substantial urban discharges. Continuous underway surface water sampling was performed during twelve monthly surveys of the lower Hudson River Estuary to determine the spatial and temporal variability of hydrographic variables and microbial metabolism. When combined with discrete samples of microbial diversity and abundance, observations reveal both spatial and temporal transitions in River metabolism that occur at a variety of scales. Temperature stratification was observed both seasonally and during short term wet weather events. Spatial variability was observed along the estuarine salinity gradient but also at smaller scales due to tributary and urban inputs and cross-river variability in production and respiration. While expansive regions of the River were relatively homogeneous in the well flushed mid-channel, comparatively large changes in microbial abundance, diversity and activity were observed at mixing interfaces and along the shallow edges of the river.

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NEAR IR WATER-LEAVING RADIANCE MEASUREMENTS IN TURBID WATERS

We have recently developed a new technique for measuring near-IR bands using a modified Saltic HypOCR Hyperspectral Radiometer. The typical HypPro radiometer is only calibrated by Satlantic to measures from 350 to 800 nm. Our HypPro is custom built with a fiber optic coupling instead of a collector head and has been calibrated out to 1100 nm. The new technique includes reprogramming the instrument to turn off the automatic gain and manually setting the integration times, thus allowing visible bands to saturate and maximizing the signal in the near-IR. A 25 mm fiber optic cable is attached to the coupling input and is attached to a buoy for deployment from a boat. These near-IR measurements have become part of our routine sampling techniques in the Chesapeake Bay and are used to validate ocean color atmospheric correction techniques. The new instruments and sampling techniques are described and preliminary results presented.

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NITROGEN FIXATION IN CHESAPEAKE BAY TRIBUTARIES: A SEASONALLY IMPORTANT NITROGEN SOURCE?

It is generally believed that nitrogen fixation is not an important process in regions with high external N inputs, due to the energetic cost of the N fixation process for microbes.

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TIME-RESOLVED DETECTION, VALIDATION AND QUANTIFICATION OF GLOBAL OCEAN BIOMASS/WATER MASS BOUNDARIES

We have developed an objective classification algorithm that detects global ocean biomes and water masses based on statistical concepts developed in bioinformatics. The predicted boundaries of the detected biomes and water masses are quantitatively accurate according to the upwelling radiance and temperature measured within each water mass or biome. In addition, boundaries of water masses and biomes are independently validated by in-situ ship track data from several different regions and time periods of the global ocean. This results presented here are based on the MODIS-Aqua mission, but this technique has been used with other satellite data sets of ocean color and sea surface temperature originating from OCM, AVHRR and SeaWIFS. Most importantly, this technique is time-resolved allowing for detection of local, regional and global changes in water mass and biome distributions. Applications of this technique include i) the tracking of river plumes and associated pollutants ii) establishing long-term baselines of water mass distributions and iii) detecting climate induced, large scale secular change in ocean biomes.

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SUBMARINE GROUNDWATER INPUTS TO GULF OF LION (FRANCE) REVEALED BY 226Ra AND 228Ra ENRICHMENTS.

Here we propose to use 226Ra and 228Ra as tracers of submarine groundwater (SGW) inputs to the Gulf of Lion. We measured the radionuclide isotopes activities by thermal ionization mass spectrometry (TIMS) in coastal waters and in the aquifer waters of the Rhone deltaic plain. Radium isotopes have the capacity to repair that damage. Exposure experiments conducted on other taxa suggest that UV affect trout survival through a feedback loop wherein UV both damages DNA and reduces the capacity to repair that damage. Exposure experiments conducted on other taxa suggests that UV both damages DNA and reduces the capacity to repair that damage. Exposure experiments conducted on other taxa suggests that UV both damages DNA and reduces the capacity to repair that damage. Exposure experiments conducted on other taxa suggests that UV both damages DNA and reduces the capacity to repair that damage. Exposure experiments conducted on other taxa suggests that UV both damages DNA and reduces the capacity to repair that damage. Exposure experiments conducted on other taxa suggests that UV both damages DNA and reduces the capacity to repair that damage. Exposure experiments conducted on other taxa suggests that UV both damages DNA and reduces the capacity to repair that damage. Exposure experiments conducted on other taxa suggests that UV both damages DNA and reduces the capacity to repair that damage. Exposure experiments conducted on other taxa suggests that UV both damages DNA and reduces the capacity to repair that damage. Exposure experiments conducted on other taxa suggests that UV both damages DNA and reduces the capacity to repair that damage. Exposure experiments conducted on other taxa suggests that UV both damages DNA and reduces the capacity to repair that damage. Exposure experiments conducted on other taxa suggests that UV both damages DNA and reduces the capacity to repair that damage. Exposure experiments conducted on other taxa suggests that UV bothdamages DNA and reduces the capacity to repair that damage.
Tributaries of the Chesapeake Bay including the Sassafras and Potomac Rivers, have been experiencing seasonal cyanobacterial blooms (e.g., Anabaena, Oscillatoria (Planktothrix), Lyngbya and Microcystis). These water column blooms, as well as macrophytes (e.g Lema n Uva), subemerged aquatic vegetation, and sediments (which often have associated ni-

trogen-fixers), were sampled during the summers of 2005-2006 and assayed for nitrogen fixation using the acetylene reduction assay. All had measurable rates of nitrogen fixation, with cyanobacteria having highest rates, followed by macrophytes and then sediments.

That significant rates of N fixation were measured despite high ambient N concentra-
tions, suggests that this nitrogen input term may be more important, particularly on seasonal and local scales in Chesapeake tributaries, than previously thought. Furthermore, cyanobacterial blooms appear to be increasing spatially and temporally in the bay and therefore N fixation may be on the increase in these systems and should be captured in mechanistic and statistical models.

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MAPPING BENTHIC SUBSTRATES IN WESTERN CANADIAN COASTAL WATERS USING HYPER SPECTRAL IMAGERY

Eelgrass, an important component of inter- and sub-tidal ecosystems, has exhibited worldwide community decline in hypothesized response to light attenuation imposed by eutrophication and sedimentation. Therefore to assess the status of this valuable coastal ecosystem, there is a growing need to know cost- and time-effective monitoring methods. The goal of this study is to determine the optimum spectral resolution for accurately mapping eelgrass distribution around Sidney Island, British Columbia. Two-metre resolu-
tion hyperspectral imagery was acquired over Sidney Island with airborne sensor AISA, as well as 30-metre resolution Landsat 7 data. Concurrently, in situ above-water hyperspec-
ral remote sensing was conducted, underwater videography, and water samples for optical-

constituent analysis were collected. The Empirical Line Calibration method was used to minimize atmospheric effect on the airborne imagery. Various spectral resolutions were simulated from the dataset, and the Spectral Angle Mapper classification technique was applied to each product. The study resulted in recommendations for remote ecosystem integrity monitoring and park management.

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GENERATION AND DISSIPATION OF THE DIURNAL COASTAL-TRAPPED CURRENTS (CTWs) OVER THE SAKHALIN SHELF IN THE OKHOTSK SEA

Numerical experiments with a three-dimensional tidal model were conducted to examine the generation and dissipation mechanisms of the diurnal coastal-trapped waves (CTWs) over the Sakhalin shelf. The model implies that the CTWs are mainly generated at the northern corner of Sakhalin, where the shelf bends sharply, and are amplified by the influ-

ences from Sakhalin Bay and Khashevarov Bank. The observations showed that the CTWs are dissipated by the strong spin-down due to the bottom friction. The conventional turbulent closure model cannot reproduce the observed damping, which overestimates the tidal currents associated with the CTWs. Given the vertical eddy viscosity value esti-
mated from the observations in advance, the model roughly reproduces the damping of the CTWs. The conventional turbulent closure scheme should be modified in modeling the tidal fields in high-latitude regions where the CTWs exist. The model also suggests that the spin-down effects due to the friction associated with the sea-ice cover as well as ocean bottom play important role on the tidal currents reduction in the region where the CTWs exist. The ice concentration is high, as observed.

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METABOLIC MEASUREMENTS OF ENERGY FLOW THROUGH OCTOPUS RUBESCENTS

Cephalopods form a unique and important link in the food webs of the oceans. Virtually all convert a high percentage of the food they consume into body mass (gross conversion efficiency, GCE). In their, their soft bodies without shells or bones make them favored prey items of many higher predators. This suggests that cephalopods, including the oct-
opuses, play a disproportionately larger role in the energy flow of their food webs than their biomass would indicate. To date little work has been done to explore this ecological role. The first step in evaluating octopus role in energy flow is to make careful metabolic measurements under controlled conditions. 17 male Octopus rubescents were collected from Admiralty Inlet, Washington and their metabolic rate measured around the clock by respirometry. Stepwise multiple regression was used to determine correlation between metabolic rate and other factors. Octopus mass and time of day were found to have the strongest correlation with metabolic rate while diet and amount of time spent in the respi-

rometer were found to have weaker yet still significant correlation.

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GLOBAL OCEAN OBSERVATIONS - GOVERNMENT AND INDUSTRY ROLE

Industry has potentially large roles in enabling and exploiting ocean science and engi-

neering conducted at oceanographic institutions and can complement support from the federal government and states. This includes the research and development appropriate for both aspects. The Center for Earth Observations & Applications (CEOA) held a sym-

posium at UCD and Scripps in August 2007 entitled: The Integrated Ocean Observing System and the Ocean Observatories Initiative (OOI): The Role of Industry. This sym-

posium brought together leaders from academic, industry, and government agencies to highlight current ocean research efforts and applications, and to explore opportunities for fostering new, innovative collaborations in ocean observing. 22 senior executives in indus-

try attended the symposium with approximately equal numbers from each of academia and
government. While the symposium was directly related to observatories, the issues covered were broadly applicable to ocean sciences and engineering/technology. Questions and subjects addressed included public/private partnerships: why they succeed, why they fail; what is industry’s role within impact/outcome driven systems; research to operations: the view from industry; Intellectual property rights were a substantial topic of discussion, but were not seen as fundamental impediments to academic-industry partnerships.

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SHOTGUN PROTEOMICS AND BIOMARKERS FOR DISSOLVED ORGANIC CARBON (DOC) IN THE OCEANS

There are 730 GT of DOC sequestered in the world’s oceans, however, its composition, sources and fate remain mostly unknown. Protein biomarkers provide a window to under-

standing the complex sources and dynamics of DOC. We studied the relationship be-

tween downstream water DOC environmental samples and those in a model phyto-

plankton cell using mass-spectrometry-based proteomics. We investigated how environ-

mentally induced changes in the proteome of Thalassiosira pseudonana can influence the composition/reactivity of marine DOC. T. pseudonana was grown under different sources of nitrogen and whole-cell qualitative and quantitative (ICAT: isotope-coded affinity tag) experiments were conducted. MS/MS data was searched using the Trans-Proteomic Pipeline and channeled into Gaggle, a bioinformatics platform allowing visualization and analysis of proteomic data in context of metabolic pathways, and genome annotations. We identified 1350 proteins in T. pseudonana: 530 have functional annotations; 674 have matches into protein family signatures (Interpro/COG); 1 predicted; 141 hypothetical protein. Cyanobacterial blooms appear to be increasing spatially and temporally in the bay and seasonal and local scales in Chesapeake tributaries, than previously thought. Furthermore, the view from industry; Intellectual property rights were a substantial topic of discussion, but were not seen as fundamental impediments to academic-industry partnerships.

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OBSERVATION AND MODELING OF PERIODIC UPWELLING/DOWNWELLING IN THE ADRIATIC SEA

An experiment, carried out in the Adriatic between February and September 2006, showed that subsurface temperature oscillations, characterized by the 24, 12 and 8 h periods, were strong at the Lastovo island thermistor station and that this corresponding baroclinic current variability was largest at a nearby ADCP station. Wavelet spectral analy-

sis of meteorological and oceanographic time series revealed that the sea/land breezes were responsible for the periodic interchange of upwelling and downwelling in mid-July 2006, with the relatively weak morning breeze corresponding to thermocline reaching the deepest point, the relatively strong (up to 10 m/s) afternoon breeze coinciding with thermocline being close to the sea surface. The range of thermocline variability surpassed 20 m. A simple straight-coast, reduced-gravity model reproduced the observed phases but underestimated the corresponding amplitudes, probably because it did not allow for the resonant excitation of internal Kelvin waves traveling around the island and the nonlinear interaction of various wind-driven constituents. Further modeling addressed these issues, and also enabled the other spots at which diurnal upwelling/downwelling occurs and from which higher frequency inertia-gravity waves emanate to be detected.

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MARGIN-WIDE HOLOCENE SEDIMENT DISPERSAL ADJACENT TO THE MUDDY WAIPAOA RIVER, NORTHEASTERN NEW ZEALAND

At the muddy Waipaoa River margin of northeastern New Zealand, rapid erosion of fri-

able catchment lithologies has resulted in thick mid-outer shelf sediment depocentres, and
localised thick deposits on the upperslope. New data from a suite of 0.7-3.2 m-long cores document millennial-scale pattern of sediment dispersal. Tephra and radiocarbon ages afford accumulation rate estimates for the outer shelf and intercanyon areas. Down-core measurements show broad changes around 600,000 yr BP, coincident with the Kahanaro tephra and Polynesian settlement, which persisted for ~200 yrs. Over longer time scales, the seaward-tapering edge of the shelf deposit yields a relatively condensed, 1.8 m-long 16 kyr sequence. Here, the deep-water surface current correlates to a strong seafloor current. Millennial accumulation rates are ~0.3 cm/yr over the mid-late Holocene. The consistency of these Holocene rates with modern radiochemical estimates described in partnering studies suggests that significant mid and outer-shelf sediment transport pre-dates the increase in sedimentation resulting from colonization. Collectively these imply pre-colonization sedimentation was not supply limited. The efficiency these rivers transport fine sediments are dispersed is longstanding and suggests strong oceanic drivers.

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CONNECTIVITY AMONG RESTORED OYSTER BARS IN THE SEVERN RIVER ESTUARY

In the effort to restore eastern oysters (Crassostrea virginica) in the Chesapeake Bay, oyster bars have been placed in numerous locations. One such bar exists in College Creek, a tributary of the Severn River (Annapolis, Maryland USA). To place oyster bars in the most optimal positions, the circulation patterns of the Chesapeake Bay and its sub-estuarine system was used (Jaccard et al., 2014). Extensive studies have been carried out in the Iceland-Faroe Front (IFF) over the past two decades. A field experiment was conducted along a broad 5 m deep section of the Hudson over one month in fall, 2007. An autonomous instrumented catamaran was used to observe density stratification. Of particular interest are the effects of tidal currents and a superimposed along-estuary wind (e.g., a seabreeze) on upper water column turbulence. The overriding goal of this research is to address how simplified models may be broadly used to predict upper water column turbulent kinetic energy dissipation and air-sea exchange in an estuary.

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TIDE AND WIND FORCING OF ESTUARINE UPPER WATER COLUMN TURBULENCE

Upper water column turbulence is often important to estuarine dynamics and constituent transport, yet our lack of comprehensive observations limits our understanding, and its prediction is a weakness of numerical models. Here, we describe observations of turbulence over a range of wind and tidal forcing in the Hudson River estuary and preliminary comparisons of the observations against a series of empirical and theoretical models of increasing complexity. A field experiment was conducted along a broad 5 m deep section of the Hudson over one month in fall, 2007. An autonomous instrumented catamaran was anchored near a bottom-mounted 1200 kHz acoustic Doppler current profiler that was measuring vertical profiles of velocity and several turbulence parameters using the variance method. The catamaran was fitted with an acoustic Doppler velocimeter, a sonic anemometer, an inertial sensor, and other instrumentation (e.g. carbon dioxide air-sea fluxes). Anchor stations (12-hour) and along- and across-channel transects were conducted from a small boat with CTD profiling to observe density stratification. Of particular interest are the effects of tidal currents and a superimposed along-estuary wind (e.g., a seabreeze) on upper water column turbulence. The overriding goal of this research is to address how simplified models may be broadly used to predict upper water column turbulent kinetic energy dissipation and air-sea exchange in an estuary.

Ortiz, K. A., Geoecological Institute, University of Bergen, Bergen, Norway, orvik@ghi.uib.no; Jacegad, P., Norwegian Institute of Water Research, Bergen, Norway, pierre.jaccard@innra.no; The Eddy Field of the Polar Front in the Southern Norwegian Sea: From SEASoAR-CTD and VM-ADCP Observations

Extended studies have been carried out in the Iceland-Faroe Front (IFF) over the past decades. This study deals with the dynamics of the extension of the IFF, the polar front in the southern Norwegian Sea. The eastward flow of North Atlantic water associated with the IFF bifurcates north of the Faroes and partly continues into the Norwegian Sea as the western branch of the Norwegian Atlantic Current. This study is based on a series of SEASoAR-Soar-CTD and VM-ADCP transects across the polar front, from the bifurcation zone and about 300 km downstream into the Norwegian Sea. The flow shows a meandering and eddy structure, with cold-core cyclonic eddies and warm-core anti-cyclonic eddies. The most prominent features are the warm-core eddies on the cold side of the front and transporting warm water into the Norwegian Sea. An almost 100 km wide anti-cyclone with current speeds up to 100 cm/s in the bifurcation zone. The Norwegian Sea. We investigate the meandering eddy field in light of topographic effects, eddy shedding and lateral mixing.

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Chromophoric dissolved organic matter (CDOM) is a key parameter in water light attenuation and is involved in a large number of biogeochemical processes mediated by photochemical reactions. Thus, there is a growing interest in better understanding the CDOM dynamics in the world's oceans. We quantified CDOM generation by bacterioplankton and krill in the world's oceans. We quantified CDOM generation by bacterioplankton and krill in the world's oceans. We quantified CDOM generation by bacterioplankton and krill in the world's oceans. We quantified CDOM generation by bacterioplankton and krill in the world's oceans. We quantified CDOM generation by bacterioplankton and krill in the world's oceans. We quantified CDOM generation by bacterioplankton and krill in the world's oceans. We quantified CDOM generation by bacterioplankton and krill in the world's oceans. We quantified CDOM generation by bacterioplankton and krill in the world's oceans. We quantified CDOM generation by bacterioplankton and krill in the world's oceans. We quantified CDOM generation by bacterioplankton and krill in the world's oceans. We quantified CDOM generation by bacterioplankton and krill in the world's oceans. We quantified CDOM generation by bacterioplankton and krill in the world's oceans. We quantified CDOM generation by bacterioplankton and krill in the world's oceans. We quantified CDOM generation by bacterioplankton and krill in the world's oceans.
RESOLVING OPTICAL AND CHEMICAL MEASUREMENTS OF TERRESTRIAL DOM FLUX IN THE NORTH SEA-BALTIC SEA MIXING ZONE

In the Kattegat-Belt Sea region, territorially-dominated brackish Baltic Sea water mixes with saline North Sea water. Few studies have examined the terrestrial flux of Baltic Sea DOM in this region. We report seasonal surveys of key DOM measurements such as UV-vis absorption and excitation-emission (EEM) fluorescence, dissolved inorganic and organic carbon (DIC and DOC) stable isotopes, and dissolved lignin. The distribution of terrestrial DOM in this region appears to be driven by influx of saline North Sea water below the outflow of brackish Baltic Sea surface water. In terms of water mass mixing, we have found excellent agreement between qualitative DOM optical measurements such as spectral slope and qualitative chemical measurements such as carbon stable isotope values. Further, the quantity of ocean color measured as absorption at 375 nm was well-correlated to both DOC concentration and dissolved lignin concentration. Terrestrial DOM flux in this region is conservative and may be scalable to remote sensing measurements through its optical properties.

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RESOLVING OPTICAL AND CHEMICAL MEASUREMENTS OF TERRESTRIAL DOM FLUX IN THE NORTH SEA-BALTIC SEA MIXING ZONE

In the Kattegat-Belt Sea region, territorially-dominated brackish Baltic Sea water mixes with saline North Sea water. Few studies have examined the terrestrial flux of Baltic Sea DOM in this region. We report seasonal surveys of key DOM measurements such as UV-vis absorption and excitation-emission (EEM) fluorescence, dissolved inorganic and organic carbon (DIC and DOC) stable isotopes, and dissolved lignin. The distribution of terrestrial DOM in this region appears to be driven by influx of saline North Sea water below the outflow of brackish Baltic Sea surface water. In terms of water mass mixing, we have found excellent agreement between qualitative DOM optical measurements such as spectral slope and qualitative chemical measurements such as carbon stable isotope values. Further, the quantity of ocean color measured as absorption at 375 nm was well-correlated to both DOC concentration and dissolved lignin concentration. Terrestrial DOM flux in this region is conservative and may be scalable to remote sensing measurements through its optical properties.
Cont. Shell Res., 26(17-18). Because most transport of such mudflow occurs within the wave boundary layer, typical coastal models cannot directly resolve such transport and effective parameterization is required (Harris et al. J. Geophys. Res., 110). In this study, the behavior of such downslope transport due to various wave-current forcing, sediment parameters and bed erodibility is investigated by a high resolution numerical model for near-bed fluid mud transport (Hsu et al. 2007, J. Geophys. Res., 112). The model results are first verified by field data observed in Po Delta (Trezkorkis et al., Cont. Shell Res., 27(3-4)). Model results are further analyzed to study the variation of drag coefficient and Bilk Richardson number with respect to wave and alongshore current velocities. The limiting conditions for auto-suspension are also investigated.

ECCOLOGICAL RESPONSES AND RECOVERY OF THE PAMLICO SOUND SYSTEM DURING A PERIOD OF ELEVATED HURRICANE ACTIVITY: WHAT’S MANAGEABLE AND WHAT’S NOT? Since the mid-1990’s, the Atlantic Basin has experienced elevated hurricane and tropical storm activity. During this time frame, coastal North Carolina has been impacted by 10 major storms, and this frequency is forecast to continue for the next several decades. Storms exhibited individualistic hydrologic and nutrient impacts. In the Pamlico Sound (PS), the second largest estuary, different rainfall amounts among hurricanes led to variable freshwater, sediment, organic matter and nutrient (N and P) inputs. This variability differentially affected physical-chemical properties and ultimately biotic properties such as primary production, phytoplankton composition, dissolved oxygen and higher trophic levels (zooplankton to fish). Floodwaters from the two largest hurricanes, Fran (1996) and Floyd (1999), exerted multi-month to multi-annual hydrologic and biogenic-chemical effects. In contrast, the PS showed a rapid recovery in ecosystem properties following relatively low rainfall hurricanes (Isabel 2003, Ophelia 2005). Freshwater discharge and physical forcing are important drivers and must be integrated with nutrient loading in assessing and managing ecological impacts and recovery to these storms during a period of elevated hurricane frequency and intensity.

ECOLOGICAL RESPONSES OF THE PAMLICO SOUND SYSTEM DURING A PERIOD OF ELEVATED HURRICANE ACTIVITY: WHAT’S MANAGEABLE AND WHAT’S NOT? Since the mid-1990’s, the Atlantic Basin has experienced elevated hurricane and tropical storm activity. During this time frame, coastal North Carolina has been impacted by 10 major storms, and this frequency is forecast to continue for the next several decades. Storms exhibited individualistic hydrologic and nutrient impacts. In the Pamlico Sound (PS), the second largest estuary, different rainfall amounts among hurricanes led to variable freshwater, sediment, organic matter and nutrient (N and P) inputs. This variability differentially affected physical-chemical properties and ultimately biotic properties such as primary production, phytoplankton composition, dissolved oxygen and higher trophic levels (zooplankton to fish). Floodwaters from the two largest hurricanes, Fran (1996) and Floyd (1999), exerted multi-month to multi-annual hydrologic and biogenic-chemical effects. In contrast, the PS showed a rapid recovery in ecosystem properties following relatively low rainfall hurricanes (Isabel 2003, Ophelia 2005). Freshwater discharge and physical forcing are important drivers and must be integrated with nutrient loading in assessing and managing ecological impacts and recovery to these storms during a period of elevated hurricane frequency and intensity.
AN 18-YEAR TIME SERIES OF CORAL REEF DECLINE IN THE FLORIDA KEYS NATIONAL MARINE SANCTUARY FROM SATELLITE DATA

The decline of coral reef habitats has been witnessed at a global scale. Here, we utilize an 18-year time series of Landsat satellite images to assess changes in eight coral reef sites in the Florida Keys National Marine Sanctuary. Twenty Landsat images (1984-2002) were used, with imagery every two years. The image dataset was georectified, calibrated to remote sensing reflectance and corrected for atmospheric and water-column effects. A Multivariate Distance Classification was trained for four classes using in situ coral-truthing data collected in 2003-2004 and using the spectral statistics from a 2002 image. The habitat classes are 'coral', 'sand', 'bare hardbottom' and 'covered hardbottom'. Overall mean coral habitat decline for all sites was 61% (3.4%/y), from 1984% to 7.6% (2002). In situ monitoring data acquired by the Coral Reef Evaluation and Monitoring Project (CREMP) for the eight reef sites between 1996 and 2002 showed a loss in coral cover of 52% (6.7%/y). A direct trend comparison between the full CREMP percent coral cover data (1996-2004) and the full Landsat-derived coral habitat class showed no significant difference between the two time series (ANOVA, p = 0.303, n = 32), despite the different scales of measurements. This dataset provides a relatively long-term continuous time series showing a significant decline in coral reef habitat.

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A TALE OF TWO HOT SPOTS: AT-SEA SEGREGATION IN HAWAIIAN ALBATROSSES

Laysan and black-footed albatrosses breed sympatrically at Terr Island (23.87°N, 166.28°W), Northwest Hawaiian Islands. When breeding, tracking studies reveal that Laysans forage north and west of Terr Island, and black-foots forage northeast. Post-breeding distributions are not well defined, but we hypothesize that habitat segregation is less distinct because adults are no longer tied to the breeding colony. We tagged 42 albatrosses with geolocator loggers in 2004 (4 Laysan, 2005) (10 Laysan, 9 black-foot), and 2006 (7 Laysan, 12 black-foot). Time at sea ranged from 128-160 days and albatrosses traveled up to 4,500 km from Terr Island, covering 35,000-43,000 km for Laysans and 50,000-68,000 km for black-foots. Laysans traveled to oceanic waters with a narrow temperature range (12-14°C), whereas black-foots occurred in a broader temperature range (12-20°C). Home-range analysis revealed that Laysan hotspots occurred north-northwest of Terr Island, in the Subarctic Gyre, whereas black-foot hotspots occurred along the coast of central California, north to British Columbia. These results indicate that both species segregate at sea year round. Habitat modeling efforts are underway to unravel species-environment relationships using remotely-sensed oceanographic variables.

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OPTICAL DETECTION OF A DINOFLAGELLATE BLOOM IN MONTEREY BAY, CA

A massive red-tide in Monterey Bay, CA was extensively sampled during the GOES-R COAST cruise in September 2006. The bloom occurred in the northeastern region of the bay known as the ‘red-tide incubator’ and persisted until November 2006. The dominant species was the dinoflagellate, Akashiwo sanguinea with chlorophyll concentrations exceeding 500 mg m⁻³. During periods of stress, dinoflagellates may produce UV light-absorbing compounds, such as mycosporine-like amino acids (MAAs), found both inside the cell and released into surrounding water. Presence of UV compounds, characteristic of red-tide forming dinoflagellates, has motivated the ocean color community to request UV sensor bands on future airborne and satellite sensors. Our objectives were (1) to develop a method to discriminate UV-absorbing MAAs from other absorbing compounds, such as chlorophyll a, and (2) to evaluate this method to be effective in categorizing different vegetation communities than direct unsupervised classification. We evaluated the capabilities of the NASA Experimental Advanced Airborne Research Lidar (EAARL) to delineate vegetation communities in Jean Lafitte National Park (JLP); Louisiana, using a hierarchical approach. Five-meter-resolution grids of bare earth, canopy height (CH), canopy reflectance ratio (CRR), and height of the median energy (HOME) were derived. We used a statistical-based approach to divide the CH in 5 distinct classes and for each height class we carried out a principal component analysis (PCA) and an independent component analysis (ICA). Within each height class, original principal components (PC) and independent components (IC) were sub-classified in 4 groups either by k-means or neural-gas algorithms. Unsupervised original metrics classifications and PCA- and ICA-based classifications were compared with JELA infrared aerial photography. Ground-truth data are being acquired at two test sites to assess species composition, canopy cover, and to identify biologically consistent vegetation patches. Our study reveals that neural-gas PCA- and ICA-based classifications performed better in categorizing different vegetation communities than direct unsupervised classification of the four metrics or k-means based classifications of PC and IC.

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LINKAGE OF SEABED AND WATER-COLUMN OBSERVATIONS TO QUANTIFY EVENT-SCALE SEDIMENT DEPOSITION AND EROSION

A new approach to examine event-scale sedimentation is described that establishes a connection between water-column signals and changes in the seabed. The Po River (Italy) shelf is used as a case study due to the dominance of winter storms on events sediment transport and the availability of coincident measurements necessary for the analysis. Repeated deployments of an instrumented bottom-boundary layer tripod at a site on the shelf have produced a nearly continuous record of sediment transport over ~35 yr. Sediment cores were collected every ~3 mo during this time, and seabed inventories of ‘Be (half-life 53.3 d) were used to determine net sediment deposition or erosion during each deployment. Comparison of these values with the net elevation change obtained from the tripod altimeter over a deployment agrees well, varying from ~2 cm deposition to ~1 cm erosion. Within each event, analysis of the altimeter record has proved challenging due to changes in sediment porosity that likely occur during a storm event. However, the maximum erosion occurring at the peak of storm events can be evaluated with suspended-sediment data and bottom shear stress calculations.

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is directly dependent on the quantity of assimilated phosphorus. However, the feeding history of A. tamata, initially fed on food of different elemental composition, did not affect elimination rates.

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A SATELLITE-BASED ASSESSMENT OF SEASONAL AND INTERANNUAL CHANGES IN BIOLOGICAL PRODUCTIVITY OF THE BEAUFORT SEA, CANADIAN ARCTIC

The Arctic Ocean is currently experiencing unprecedented changes in sea ice extent and sea surface temperatures, both of which affect biological productivity. However, not all areas of the Arctic are responding in the same way. We used satellite remote sensing of chlorophyll from SeaWIFS and MODIS-Aqua to investigate seasonal to interannual changes in phytoplankton production of the Beaufort Sea (215W-155W), from 1997-2007. The Beaufort Sea, unlike most of the Arctic, has decreased in open water extent and phytoplankton productivity since reaching maximum values for both in 1998, when temperatures were anomalously warm. Annual production decreased by almost half of its 1998 maximum to a minimum in 2000 and has remained relatively constant since then. The flow polynya generally exhibited two distinct phytoplankton blooms, which varied in intensity and timing due to interannual differences in both the onset of polynya formation and the extent of open water. Our results suggest that although temperatures are warming over the entire Arctic region, smaller scale changes may not be as easy to predict and may follow local patterns more than previously assumed.

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INTENSE MIXING OVER MODERATE SHELF TOPOGRAPHY

Stratified flow over shelf sea banks have been shown to result in enhanced levels of turbulent mixing most commonly linked to the breaking of locally generated internal waves. Invariably such studies have focused on steep topography where the existence of such waves is predictable. In contrast, Jones Bank rises only 30m above the seafloor over 40km in 120m of water. It is situated over 10km from the continental shelf break in the middle of the Celtic Sea, which is predominantly strongly stratified throughout the summer months. We present a new series of measurements of current and temperature structure on the slope of Jones Bank during the summer of 2003 that demonstrates intense internal wave activity. Additionally, measurements of TKE dissipation identifies regular bursts of intense turbulent mixing occurring in the bottom mixed layer following off bank flow, suggesting this is the work of locally generated lee waves. Our measurements are compared to the results from a non-hydrostatic model to investigate the generation and timing of these mixing events.

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HORIZONTAL PRESSURE GRADIENTS IN THE SWASH ZONE

Stockdon et al. (2007) developed a morphological response model for hurricanes requiring the results from a non-hydrostatic model to investigate the generation and timing of these mixing events. Our measurements are compared to the results from a non-hydrostatic model to investigate the generation and timing of these mixing events.

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ON THE SOURCE OF GULF STREAM NUTRIENTS

Along density surfaces, nutrient concentrations in the Gulf Stream are elevated relative to concentrations to either side of the current. We assess the source of these elevated nutrient concentrations in the Western Boundary Current using historical hydrographic data. The analysis is extended to the separated Gulf Stream with four hydrographic sections recently occupied as part of the Clivar Mode Water Dynamics Experiment. The results of this analysis suggest that imported, extra-tropical waters are the primary source of the elevated nutrient concentrations. Because the high nutrient signature is likely imported, dacypral mixing need not be invoked to explain the Gulf Stream’s high nutrient concentrations, as had been proposed in the past. Moreover, nutrients do not increase along the length of the Stream, further suggesting that the Stream’s high nutrient signature is imported rather than manufactured by processes within the current. The imported nutrients are likely advected into the North Atlantic within the low salinity water masses that contribute to the shallow limb of the meridional overturning circulation. Thus, the availability of nutrients to the North Atlantic may be linked to upstream processes in the tropics and possibly the Southern hemisphere, as well as variability in the volume of imported water and its distribution in density space.

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VARIABILITY OF LIPIDS AND THEIR DELTA-C13 COMPOSITIONS OF DIATOM (THALASSISORIA PSEUDONANA) DURING CELL GROWTH, AUTO-METABOLISM, AND MICROBIAL DEGRADATION

Phytoplanktonic lipid biomarkers and their compound-specific delta-C13 ratios have been used to study OC cycling in marine systems. However, it remains unclear how the biomarker compositions and isotopic signatures vary from formation stage to recycling phase. We conducted laboratory experiments to examine variability of lipids (phystol, sterol, fatty acids) and their compound-specific delta-C13 during cell growth (exponential and stationary phases), auto-metabolism, and microbial degradation. Our results showed: (1) the cells synthesized more lipids (as energy storage component) during stationary phase than in exponential growth stage (as membrane component); (2) lipid compositions remained relatively stable until microbial degrada- tion; (3) auto-metabolism consumed more fatty acids than neutral lipids; (4) microbial degradation dragged almost all algal fatty acids but partial neutral lipids; (5) lipid delta-C13 ratios varied in a larger range (~6-9‰ of enrichment) during exponential growth stage than in other processes; and (6) variability of delta-C13 of lipids during auto-metabolism and microbial degradation were diversified, depending on individual compounds. This study implies that phytoplanktonic biomarkers and their delta-C13 signatures can be altered in different ways during cycling.

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SATELLITE REMOTE SENSING RETRIEvals OF INHERENT OPTICAL PROPERTIES WITHIN U.S. SOUTHERN MIDDLE ATLANTIC BIGHT

In coastal waters, bio-optical properties are typically complicated due to seasonal river discharge, shallow bathymetry, anthropogenic impacts, and so on. At present, satellite remote sensing of coastal water quality and constituent quantity is subject to large errors as compared to its capability for oceanic waters. In this study, we have conducted a series of efforts since 2004 to detect improvements in satellite retrievals of various optical and biogeochemical products. Algorithms were developed to retrieve the inherent optical properties (here absorption coefficients) from field measurements of remote sensing reflectance (Rrs). Validation match-ups between field measurements and satellite retrievals of absorption by particles (ap), phytoplankton (ap), CDOM (ag), non-pigmented particles (ad), and chlorophyll a, showed that the mean absolute percent differences (MAPD) were typically lower than 25%. Seasonal variability of absorption coefficients was also obvious and reasonable. Based on regionally specific bio-optical models, the satellite-derived absorption coefficients can be transformed to study the relevant biogeochemical parameters such as chlorophyll a concentration, primary production, dissolved organic carbon, particulate organic carbon, and total suspended particles.

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HYPOGENESIS OF HIGH-TEMPERATURE CATALYTIC OXIDATION DOC ANALYZER TO IRMS: SIMULTANEOUS QUANTITATIVE AND ISOTOPE DETERMINATION OF DOC IN NATURAL SAMPLES

A commercially-available high-temperature catalytic oxidation dissolved organic carbon analyzer (HTC-DOC) with cryogenic trapping was coupled to an IRMS system to allow precise and accurate isotope determination in small volumes of natural aquatic and marine waters. Simple modifications to the HTC-DOC aimed at reducing blank signal contribution through permeation of ambient CO2 (replacing Teflon for stainless steel tubing) and CO2-catalyst interaction (changing Pt-impregnated silica for a cupric oxide/quartz rod mix) improved detection limits for isotope determination with a slight improvement to DOC instrument performance. Cryogenic trapping of CO2 following NDIR detection by the HTC-DOC serves both to increase the mass of analyze CO2 and focus the IRMS analyte peak, resulting in excellent IRMS peak shape. Additionally the need to amplify IRMS sensitivity at the cost of dynamic range is not necessary with this set-up.

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NOT SO CONSERVATIVE? CHLORINE AND BROMINE IN CHEMICAL OCEANOGRAPHY

According to conventional wisdom, chlorine and bromine are present in the ocean as ions that are conservative with salinity, with the exception of some simple gases (i.e. CH, Br). However, numerous studies have shown that thousands of marine organohalogens are natural products. Furthermore, recent studies have identified organic bromine comprises a substantial (up to 70%) portion of the total bromine in sediment samples, and that Br in sediments can trap more than 98% of the organic bromine.

Patterns of dispersal in the deep-sea remain largely unknown, yet are key elements in the comprehension of biogeochemistry and biodiversity. We are interested in whether seawater samples of specific age, as a result of deep-sea dredging, are made of deep-sea samples that have not or that have only partially escaped from the water masses. Seismic migration produces a pseudo 3D image of the water structure, whereas VSP can map out the boundaries between water masses and map temperature have different acoustic velocity (and density). Seismic methods designed for imaging the subsurface can thus map out the boundaries between water masses and map temperature have different acoustic velocity (and density).

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PHYLOGEOGRAPHY OF DEEP-SEA CHYOSORGODID CORALIS (Cnidaria: Octocorallia) FROM THE NEW ENGLAND AND CORNER SEAMOUNTS (WESTERN NORTH ATLANTIC OCEAN)

Patterns of dispersal in the deep-sea remain largely unknown, yet are key elements in the comprehension of biogeochemistry and biodiversity. We are interested in whether seawater samples of specific age, as a result of deep-sea dredging, are made of deep-sea samples that have not or that have only partially escaped from the water masses. Seismic migration produces a pseudo 3D image of the water structure, whereas VSP can map out the boundaries between water masses and map temperature have different acoustic velocity (and density). Seismic methods designed for imaging the subsurface can thus map out the boundaries between water masses and map temperature have different acoustic velocity (and density).

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IS RESTORATION OF THE MISSISSIPPI DELTA FEASIBLE?

We review controls, including subsidence, sediment supply, sea-level rise, vegetation dynamics, and carbon storage, that influence the feasibility of restoring wetlands in the Mississippi Delta. We use data from physical experiments, modern deltaic systems, and different approaches to reconstruct the stratigraphic record to obtain broad constraints on delta response to these controls. We then combine this information with relatively simple mass-balance models to investigate how much wetland area could be sustained under different scenarios of sediment retention and subsidence. Even with the current total reduced sediment supply, and assuming historical rates of coastal relative sea-level rise (1-2 cm/yr), there is sufficient sediment to maintain a total wetland area of the order of several hundred square kilometers or more, if natural processes of wetland dynamics and sediment delivery can be restored.

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VERTICAL SEISMIC PROFILING (VSP) IN SEISMIC OCEANOGRAPHY - A PROOF OF CONCEPT

As part of the European funded GO Project the concept of vertical seismic profiling was tested for being a tool to image water mass boundaries in 3D. Water bodies with different temperature have different acoustic velocity (and density). Seismic methods designed for imaging the subsurface can thus map out the boundaries between water masses and map mixing processes at meso-scale with unprecedented horizontal resolution. In addition to conventional surface streamer geometry, a new approach of vertical seismic profiling (VSP) has been developed. Following standard VSP techniques (walkaway- and offset- VSP), a first approach using 2 ships has been tested to collect 3D seismic data of different water masses. Seismic migration produces a pseudo 3D image of the water structure, which, when combined with 2D seismic profiles and oceanographic data, give detailed information on the lateral extent of boundaries involved in the mixing process.

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VERIFICATION OF CH3D-SSMS FORECASTING SYSTEM FOR CHARLOTTE HARBOR, FL. WITH DATA DURING HURRICANE WILMA (2005)

Storm surge and inundation due to hurricanes represent the greatest threat to life and property in US coastal regions. Numerical surge and inundation models can provide forecast to enable timely emergency response. However, surge and wave data are usually limited with little information of the spatial extent and temporal dynamics of inundation. This paper verifies the CH3D-SSMS forecasting systems using a comprehensive dataset of wind, surge, and inundation in Florida during Hurricane Wilma (2005). CH3D-SSMS is a CH3D-based integrated storm surge modeling system which includes a coastal surge (CH3D) and wave (SWAN), plus large scale surge (ADICIRC/UnCoH3D) and wave (WW3) models. We compare the accuracy of forecast winds with FCMIP and COOPS data to determine the sensitivity of surge and inundation forecasted obtained by CH3D-SSMS to various forecast wind fields. We then conduct a thorough validation of CH3D-SSMS forecasts using high frequency storm surge and inundation data obtained at 30+ locations by USGS and COOPS in Charlotte Harbor, Florida; examine simulations sensitivity to hurricane track and intensity errors and river flows inclusion.

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OCEANIC BIOGEOCHEMICAL MODELING OF TRACE METALS: PROGRESS, UNCERTAINTIES AND OUTLOOK

Observational studies have shown that trace metals, most notably iron, are essential micronutrients necessary for biological activity. This has in turn led to the inclusion of iron into oceanic biogeochemical models over the past decade. Here I will review the evolution of iron modeling in global scale biogeochemical models and the uncertainties in the models. I will also discuss process studies and measurements that could lessen these uncertainties, as well as the potential insights that the inclusion of modelling studies can bring to programs such as GEOTrACES and SOLAS.

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SEA SURFACE HEIGHT VARIABILITY OBSERVED BY PRESSURE-RECORDING INVERTED ECHO SOUNDERS AND SATELLITE ALTIMETRY IN THE KUROSHIO EXTENSION

AVISO sea level anomaly (SLA) products are compared with in situ sea surface height (SSH) anomaly measurements from an array of 41 pressure-recording inverted echo sounders (PIES) in the Kuroshio Extension during 2004–2006. PIES measure bottom pressure and round-trip acoustic echo time from the sea floor to the sea surface, which are used to estimate, respectively, mass-loading and steric height variations in the SSH anomaly. Good correlations (r>0.9) are found between satellite and PIES measurements with the best agreement near the jet, where the largest SSH variations exist. The mass-loading component affects the correlation and regression coefficients slightly and improves them overall by ~5%. Comparisons agree best with the AVISO up-to-date product, merging all available satellite measurements. Satellite-derived absolute dynamic topography (ADT) maps are also compared with PIES-derived ADT maps. Several mean dynamic topography (MDT) maps, added to SLA products to obtain satellite-derived ADT maps, are tested. Comparisons reveal that R̂io06, the most recent AVISO MDT utilizing GRACE data, is the best MDT in this region. It is significantly improved over R̂io03, a previous AVISO MDT without GRACE contributions. We compare the accuracy of forecast winds with FCMIP and COOPS data to determine the sensitivity of surge and inundation forecasted obtained by CH3D-SSMS to various forecast wind fields. We then conduct a thorough validation of CH3D-SSMS forecasts using high frequency storm surge and inundation data obtained at 30+ locations by USGS and COOPS in Charlotte Harbor, Florida; examine simulations sensitivity to hurricane track and intensity errors and river flows inclusion.

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MASS TRANSPORT MECHANISM IN KUNGGI BAY AROUND HAN RIVER MOUTH, KOREA

OCEANIC BIOGEOCHEMICAL MODELING OF TRACE METALS: PROGRESS, UNCERTAINTIES AND OUTLOOK

Observational studies have shown that trace metals, most notably iron, are essential micronutrients necessary for biological activity. This has in turn led to the inclusion of iron into oceanic biogeochemical models over the past decade. Here I will review the evolution of iron modeling in global scale biogeochemical models and the uncertainties in the models. I will also discuss process studies and measurements that could lessen these uncertainties, as well as the potential insights that the inclusion of modelling studies can bring to programs such as GEOTrACES and SOLAS.

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The horizontal, two-dimensional Princeton Ocean Model was modified to include the salt and heat balance equation. It was applied to Prydz Bay (Korea) to reproduce mean conditions for one typical year. Extensive data were compiled and analyzed to evaluate input parameters representative of long-term mean conditions for the tide, salinity and temperature. The model, forced by four major tidal constituents (M2, S2, K1 and O1), daily freshwater discharges and daily net surface heat exchange, produced a reasonable reproduction of observed tidal elevations, tidal currents and long-term mean monthly distributions of salinity and temperature. The calculated residual circulation pattern is consistent with previously observed, though limited, data collected in the vicinity of Kangwja Island and Inchon Harbor. The model was used to study the following mass transport mechanisms: tidal nonlinearile, barotropic pressure gradient associated with freshwater discharge, and baroclinic pressure gradient due to density gradient. The residual circulation pattern, and its variations under different freshwater flow regimes, was examined.

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APPLICATION OF HIGH FREQUENCY RADAR FOR SURFACE CURRENTS
ANALYSIS AND DATA ASSIMILATION

A new vector mapping method is developed. This method is based on a variational algorithm for the calculation of stream function and velocity potential from given velocity fields, and has the ability to interpolate vectors over any irregular domain with complex coastlines and multiple islands. The method was used to map surface current fields in the Florida Straits, while other surface events are induced by the passage of hurricanes and atmospheric fronts. During periods of observed eddy activity, the combination of WERA surface and ADCP subsurface current measurements provide insight into the kinematical and dynamical structure of the Florida Current. Parsons, C.; Word Craft, Monterey, USA, cparson@word-craft.com
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YOUR WEBSITE & U.S. DIVERSITY: WHAT THE RESEARCH LITERATURE SAYS ABOUT MULTICULTURAL DESIGN

U.S. demographics are changing rapidly. By 2050 minority populations combined are expected to be half of the U.S. resident population. Yet within science & engineering fields racial and ethnic minorities are underrepresented for the most part. To address this, COSEE and many other groups are reaching out to underrepresented audiences through education and outreach efforts, including websites. The question is: Are our web-based outreach efforts effective? Can a website be "culturally neutral," that is, for all racial, ethnic and cultural groups within the U.S.? If so, what are the design guidelines? If not, what makes websites attractive, useful and relevant to our society’s culturally diverse audiences? This paper summarizes an NSF-funded research literature review focused on what is currently known about website outreach to culturally diverse audiences. It concludes with a synthesis of the findings into guidelines for outreach that more effectively meets the expectations and the needs of these audiences within the U.S. The purpose is to assist those involved in education and outreach who are trying to engage diverse audiences via the web.

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PHOTOPHYTONK DYNAMICS IN THE PLUME OF THE MISSISSIPPI RIVER:
RESPONSES TO NITROGEN ENRICHMENT, SILICA LIMITATION, AND PHOSPHORUS LIMITATION

The Mississippi River watershed is the largest in North America, terminating in the northern Gulf of Mexico. Nitrate concentrations in the river have tripled over the last century, resulting in higher phytoplankton productivity, contributing to the development of the second largest area of coastal hypoxia in the world. Silica concentrations in the river have dropped 50% during this time period, causing the N:Si ratio to drop from 4:1 to 1:1, resulting in episodes of silica limitation affecting phytoplankton dynamics since the 1980s. Recent studies suggest that phosphorus limitation is an even more recent development, further influencing the phytoplankton dynamics of this coastal
ecosystem. Phytoplankton samples have been collected on a routine basis in the plume of the Mississippi River since 1990. Examination of these samples, coupled with comparisons with historical data, has indicated that 1) harmful algal species (primarily Pseudo-nitzschia sp.) are now more prominent versus the past; 2) larger, more heavily siliciated diatom species (e.g., Paralia sulcata) have been replaced by smaller, more lightly siliciated ones (e.g., Cyclotella chocticawhatchenea); and 3) primary consumer (copepod) biomass decreases substantially during periods of silica limitation.

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DISTRIBUTION OF MICROALGAL BIOMASS OFF EAST ANTARCTICA: MODEL RESULTS

Sea ice plays a key role in structuring the Antarctic ecosystems. It has been shown in different regions of the Southern Ocean that there is a strong relationship between sea ice extent and krill abundance and recruitment. Bottom algal communities thriving in the underside of ice floes provide food for krill during the critical winter and early spring period. In order to improve our understanding of the relationships between sea ice extent, sea ice properties and the biological productivity in the Southern Ocean, we present the first results of a sea ice ecosystem model applied in the seasonal ice zone off East Antarctica. The 1-dimensional coupled sea ice thermodynamical, bio-optical and biogeochemical model is applied using a backward lagrangian approach. The model allow us to explore the links between sea ice properties and the dynamics of sea ice algal communities, and give some insights into the temporal dynamics of this ecosystem with a particular emphasis on the spatial distribution of primary production and microalgal biomass in the pack ice during winter and early spring.

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EARLY DIAGENETIC PROCESSES IN A ROMAR SYSTEM: THE RHÔNE DELTA

The biogeochemistry of coastal sediments is greatly influenced by terrestrial inputs and especially material from rivers. These inputs disrupt the normal sedimentation and diagenetic regimes and thus often create non steady state conditions for carbon and nutrients cycles in Riomar sediments. Detailed geochemical analyses of sediments (polarity, grain size, reactive Mn and Fe, Corg, C/N, pigments, amino-acids) and porewaters (Mg2+, Fe2+, NO3-, NO2-NH4+, Si, PO4, SO4) are reported in 10 sites along a depth gradient in the mouth and the plume of the Rhône River. These parameters were supplemented with microelectrode measurements of O2 and pH as well as benthic fluxes (O2, CO2, NH4+). 1-dimensional coupled models allowed for ecosystem simulations over the last several years. The detailed sedimentary measurements were combined with mineral provenance analysis and 3D numerical modeling to determine the dominant sediment transport pathways in the region. Powerful tidal currents that exceed 2.5 m/s generate bedforms of up to 317 m in wavelength and 10 m in height. Modeled tidal residuals determined by 2D flow modeling broadly agree with bedload transport directions inferred from the bedform measurements. This collective analysis suggests that the system is ebb dominated, with net seaward-directed sediment transport. Therefore, great caution must be exercised when artificially modifying San Francisco Bay sediment volumes and transport pathways as this could limit the coastal sediment supply. This multi-faceted research approach using state-of-the-art tools has greatly advanced our understanding of sediment, morphology, and sedimentary processes in the San Francisco Bay Coastal System and high energy estuaries in general.

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MULTIPLE PROXY RECORDS OF DELTA EVOLUTION AND DISPERAL SYSTEM BEHAVIOR: DEEP BOREHOLE EVIDENCE FROM THE BENGAL BASIN, BANGLADESH

Evolution of the Ganges-Brahmaputra delta over the Late Quaternary has been dominated by climate, eustasy, tectonics, and immense sediment discharge. The complex history of river behavior, delta evolution, and catchment scale processes is not easily recognizable within the simple sand and mud stratigraphy developed to the Bengal margin. We present new stratigraphic, paleoenvironmental, and provenance data for two deep boreholes (150 meters) from the Ganges-Brahmaputra delta in order to resolve the sequence and timing of delta evolution through the Late Quaternary. Continuous natural gamma, conductivity, and magnetic susceptibility logging reveals distinct lithologic packages tied with monsoon strength as a major control on sediment provenance, weathering, and flux to the margin. In conjunction with existing Sr and Nd isotope data, detrital zircon geochronology is used to reveal erosional response to shifting climate in the Himalayan catchment. This multiple proxy approach has proven useful for unraveling complex fluviodeltaic response to external forcing.

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VOLUNTEERS AND SCIENTISTS UNITE TO MONITOR MARINE PHYTOPLANKTON AND HARMFUL ALGAL BLOOMS

The volunteer Phytoplankton Monitoring Network (PMN) is a NOAA sponsored community outreach program developed to promote a better understanding of harmful algal by participating in phytoplankton sampling and identification. PMN currently has 135 sampling sites from Massachusetts to Texas with volunteer groups including teachers, students, parks, aquaria, citizen groups, and research facilities. Volunteers receive instruction on phytoplankton identification and collect samples on a weekly or biweekly basis, reporting data via a secure website to researchers at the Marine Biotoxins Program. Since the program began in 2001, over 50 blooms have been reported by volunteers. During November 2006, a multi-species bloom of Pseudo-nitzscha was observed by student monitors in North Carolina. Bloom samples were positively identified as Pseudo-nitzscha pungens, P. multiseries, and P. pseudodelicatissima. Analysis of seawater samples from the bloom detected domoic acid, making this the first report of domoic acid from the Carolina coast. Identification of this toxic bloom along North Carolina’s coast is an example of a volunteer monitoring program contributing to a greater awareness of harmful algal presence and distribution patterns.

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DETERMINING SEDIMENT TRANSPORT PATHWAYS IN THE SAN FRANCISCO BAY COASTAL SYSTEM BY UTILIZING MULTIBEAM BATHYMETRY, NUMERICAL MODELING AND MINERAL PROVENANCE

The length, height, depth, and asymmetry of over 3000 individual bedforms were measured from high resolution grids derived from a series of multibeam surveys conducted in the San Francisco Bay Coastal System over the last several years. The detailed bedform measurements were compared as a function of satellite zenith angle to determine the optimum cut-off angle for effective applications requiring the most recent data available. However, in areas where there are few marine as well as sensor and environmental effects at high satellite viewing angles. Near-real-time daily mosaics and seven-day latest pixel composites of Sea-viewing Wide Field of View Sensor (SeaWiFS) derived products such as divers viability, chlorophyll concentration and the solar diffuse attenuation coefficient at 532 nanometers. Data quality is known to decrease at the edges of satellite image swaths due to significant increases in pixel sizes as well as sensor and environmental effects at high satellite viewing angles. Near-real-time applications require the most recent data available. However, in areas where there are multiple SeaWiFS passes available within a couple of hours, it may be advantageous to use better quality data values from a slightly older overpass in place of more recent data values observed by the very high satellite resolution in situ measurements. NOAA’s Aquarius satellite data collected from the Bloom of domoic acid, making this the first report of domoic acid from the Carolina coast. Identification of this toxic bloom along North Carolina’s coast is an example of a volunteer monitoring program contributing to a greater awareness of harmful algal presence and distribution patterns.

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THE OPTIMUM SATELLITE ZENITH ANGLE FOR NEAR-REAL-TIME SEAWIFS COASTAL IMAGES

The Naval Oceanographic Office uses the Automated Optical Processing System developed by the Naval Research Laboratory at Sennix Space Center to create near-real-time daily mosaics and seven-day latest pixel composites of Sea-viewing Wide Field of View Sensor (SeaWiFS) derived products such as divers viability, chlorophyll concentration and the solar diffuse attenuation coefficient at 532 nanometers. Data quality is known to decrease at the edges of satellite image swaths due to significant increases in pixel sizes as well as sensor and environmental effects at high satellite viewing angles. Near-real-time applications require the most recent data available. However, in areas where there are multiple SeaWiFS passes available within a couple of hours, it may be advantageous to use better quality data values from a slightly older overpass in place of more recent data values observed by the very high satellite resolution in situ measurements. NOAA’s Aquarius satellite data collected from the Bloom of domoic acid, making this the first report of domoic acid from the Carolina coast. Identification of this toxic bloom along North Carolina’s coast is an example of a volunteer monitoring program contributing to a greater awareness of harmful algal presence and distribution patterns.
TEMPORAL VARIABILITY OF CARBON FLUXES IN THE SUBTROPICAL ATLANTIC AT 24.5°N

A transatlantic hydrographic section including carbon measurements has been occupied in 1992, 1998 and 2004, allowing us to examine decadal changes in the circulation and fluxes of heat, salt and carbon and the net budgets north of 24.5°N. The principal changes in the circulation have been a reduction in the overturning circulation, compensated by an increase in southward thermocline circulation shallower than 1000 m. The northward transport of inorganic carbon/anthropogenic carbon in the Gulf Stream is increasing with time and is compensated by an increasing southward flux in the interior. The net flux for inorganic carbon is southward and for anthropogenic carbon is northward. Here we examine the sensitivity of the net fluxes to and of inferences of their temporal changes to uncertainties in the circulation and for anthropogenic carbon in particular to its method of estimation.

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ROUGH BED BOUNDARY LAYER PROCESSES AT THE KILO NALU OBSERVATORY

The turbulent motions generated along the seabed by surface waves and currents play a fundamental role in nearshore environments through their effects on energy dissipation and sediment transport. Near-bed turbulent shear stresses also directly affect benthic ecosystems via nutrient transport. These processes are especially important for coral reef environments that are characterized by very high roughness with significant spatial variability and inhomogeneity. Analysis of field observations of steady and wave-driven flow over roughness caused out by the Kilo Nalu Observatory (Oahu, Hawaii) is presented. Drag coefficients with corresponding apparent hydrodynamic roughnesses are estimated for mean currents using log fits to observed velocity profiles with wave friction factors estimated using wave-current boundary layer models. These are compared with direct measurements of roughness over the reef to examine the relevance of standard roughness parameterizations for the tropical reef environment. Observations indicate that the bed friction and apparent roughness are generally insensitive to variations in wave forcing, in contrast with existing wave-current interaction models of flow over homogeneous roughness. The observations are consistent, however, with highly inhomogeneous roughness with broadly varying length scales.

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PHYSICAL FACTORS AFFECTING PRODUCTIVITY IN THE STRAIT OF GEORGIA

We have developed a circulation scheme for the Strait of Georgia, British Columbia, which shows a surprising insensitivity to variations in fresh-water inflow. The scheme can be used to identify the sources and sinks of nutrients. Sinks occur at the surface as more nutrients are upwelled than are removed by advection. These sinks can in turn be used to estimate primary productivity. By comparison with coincident observations of zooplankton and phytoplankton biomass and species composition we describe the evolution of a number of spring blooms and attempt to quantitatively synthesize a food web in this system.

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TEMPORAL AND SPATIAL VARIATION OF NUTRIENTS AND PLANKTON PRODUCTIVITY IN THE CALIFORNIA CURRENT SYSTEM: A MODEL-DATA COMPARISON STUDY

As part of evaluating a Pacific physical-biogeochemical model performance, we compared simulation results with the existing times series observations from the California Cooperative Ocean and Fisheries Investigation (CalCOFI) and Monterey Bay Aquarium Research Institute (MBARI). The physical model is based on the Regional Ocean Model System (ROMS) with 50-km spatial resolution. The biogeochemical model is based on the Carbon, Silicate, Nitrogen Ecosystem (CoSINE) model. The coupled model is forced with air-sea fluxes from the NCEP reanalysis from 1990 to 2005. Although the model is not intended to reproduce near-shore dynamics, primary production and seasonal phytoplankton groups success success along the coast are well simulated with the Pacific basin-wide model. The model is also able of reproducing the seasonal cycle for temperature, mixed layer depth, nitrate, silicate, chlorophyll, and oxygen concentrations. High correlation...

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between simulated and observed time series capabilities the model of the reproduction of long-term observations for the California Current System. Some sensitivity analyses have also been performed to evaluate the model with higher resolution (12.5km) and with different physical forcing.

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USE OF WAX READS TO FACILITATE BIOCAPSULATION OF OXYTETRACYCLINE BY ARTEMIA SALINA NAUPLII

Artemia salina nauplii, a live feed commonly used to rear marine fish larvae, were evaluated for their ability to biocapsulate antibiotics by feeding them on wax spray beads (WSB) containing oxytetracycline (OTC). Feeding experiments using WSB containing riboflavin were initially conducted to determine gut filling and expected rates, followed by experiments with OTC-WSB to evaluate uptake of OTC into tissues of purged nauplii, estimated using an E. coli growth rate assay. Tissues of Artemia fed WSB produced with cores of aqueous solutions of OTC had significantly higher OTC concentrations than adult Artemia produced with particulate OTC. Our study found the average concentration of OTC in purged Artemia was 20.48 ng per individual - a concentration that was comparable to an estimated effective OTC concentration of 17.64 ng per day for zebrafish larvae. WSB appear to be an effective means of facilitating bioencapsulation of OTC by Artemia nauplii.

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LABORATORY INVESTIGATIONS OF NONLINEAR INTERNAL WAVES

We present the results of laboratory experiments investigating the generation and dynamics of nonlinear internal waves in a variety of scenarios, including: barotropic tidal flow past steep ocean ridges; the interaction of a wave beam with the thermocline; and the scattering of internal tides by topography. We compare our results with the predictions of numerical simulations and ocean observations.

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AUTOMATED LARGE-SCALE SHORELINE VARIABILITY ANALYSIS FROM VIDEO

Land-based video systems are a cost effective and versatile tool for coastal science, combining the ability to assess short- and long-term shoreline changes. We report on a video system deployed at Rehoboth Beach on the Atlantic coast of Delaware to monitor and quantify the evolution of a nourished beach. Hourly images from 7 cameras are geo-referenced to a horizontal plane at the tidal elevation in a local coordinate system. Shorelines are automatically identified using pixel intensity gradients from time exposure and variance imagery, achieving correlation scores with user-defined shorelines exceeding r2 values of 0.92. Variations in camera azimuth and tilt are automatically corrected through image correlation procedures. Shoreline data are tidally and seasonally-averaged to quantify seasonal morphodynamic variability. Comparison of mean summer and winter shoreline locations reveals a mean seasonal beach retreat of ~1.4 m, consistent with prior studies of this area. The spatial variation of yearly shoreline position change will also be discussed. [This work is being supported by Delaware’s Department of Natural Resources and Environmental Control]

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UNDERGRADUATE AND PRE-COLLEGE EXERCISES UTILIZING RECENT AND HISTORICAL DATA FROM CORKS AT SEVERAL ODP AND IODP DRILL SITES ON THE JUAN DE FUCA PLATE

Interactive exercises were developed for undergraduate and pre-college audiences by scientists, educators, and graduate students working together during RV Atlantis Cruise 15-23 that serviced CORKS near the Juan de Fuca Ridge in September, 2007. The exercises introduce or reinforce plate tectonics through a study of formation water pressures, temperatures, and chemistry; and are built around data downloaded during the cruise and collected in the past from CORKS placed during ODP Legs 139 and 168 and IODP Expedition 301. Video clips and photos from DSV Alvin dives to the CORKS, and venting of the Middle Valley will immerse students in the technical challenges of long-term in situ measurements. Other exercises feature geomicrobiological sampling and water chemistry techniques as carried out by scientists in shipboard laboratories after recovering osmosamplers from the CORKS. These activities offer an educational link between scientific ocean drilling and the Ocean Observing Initiative and a foundation for a School of Rock Expedition to the Juan de Fuca aboard the JOIDES Resolution in 2008. These activities incorporate the principles of inquiry learning and the use of authentic data.

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THE POTENTIAL OF AN AUTONOMOUS UNDERWATER VEHICLE (AUV) AS A MARINE SAMPLING PLATFORM.

In a collaborative effort with the Norwegian Defence Research Establishment and Kongsberg Maritime Ltd, an AUV (HUGIN), a 1.2m ADCP equipped with an Avviso Laser Plankton Counter (LOPC), a CTD and an ADCP. The platform can be pre-programmed as a fixed-grid surveyor or enabled for adaptive sampling strategies. In combination with the capability of deep-sea descent, this will provide unprecedented data, both with respect to physical parameters and biological communities. An example of an ongoing research effort along the Norwegian continental shelf is provided, addressing hibernating copepods.

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AN ASSESSMENT OF SPATFALL ON RESTORED OYSTER BARS IN THE SEVERN RIVER ESTUARY (MARYLAND, USA).

Crassostrea virginica restoration bars have been placed in Chesapeake Bay tributaries to improve water quality and enhance the oyster fishery. While recent spat-on-shell plantings have shown high juvenile survival, the cost of regularly replacing laboratory-reared spat on restored beds may prohibit large-scale restoration efforts. Therefore it is critical to know whether spat are recruited to the restored bars. Nevertheless, monitoring restored bars is expensive and logistically challenging, so many restored reefs are not regularly assessed. To address this problem we determined oyster mortality and spatfall at 3 restored bars (College Creek (CC), Weems Creek (WC), Lake Ogleton (LO)) in the Severn River system. Of the 3 sites, only CC had been monitored previously. In the fall of 2007 oysters were sampled via SCUBA dives on each bar. Oysters collected in 0.25m2-diameter quadrats were measured, and inspected for mortality and spatfall. While no spatfall was observed at any site, mortality rates in CC and WC were low. In contrast, samples recovered from LO consisted primarily of the shell foundation provided for the site, rather than live oysters. This may be attributed to illegal harvesting of C. virginica at LO site in a previous year. Though the data illustrated no spatfall of oysters planted in the Severn River, conditions were favorable for survival and growth, suggesting that new bars placed in the system may provide some benefit to the local ecosystem.

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CHANGES IN IRON SPECIATION CAUSED BY ZOOPLANKTON DURING THE IRON FERTILIZATION EXPERIMENT EIFEX

Zooplankton grazing of marine phytoplankton generates chlorophyll degradation products (Porphyrins) which complex iron. Porphyrin-chelated iron is bioavailable for marine eukaryotes and thus grazing may affect the bioavailability of iron in iron limited ocean regions. Grazing experiments with natural phytoplankton and different zooplankton grazers were conducted during the in situ iron fertilization experiment EIFE, to investigate the effect of grazing on iron ligand and phaeopigment production under light and dark conditions. We observed an increase in the relative amount of free ligands and a positive effect on phytoplankton biomass in the light treatments under copepod grazing. No such effects were observed in experiments using salps, which seem to have grazed beyond the maximum sustainable yield for phytoplankton growth. We conclude that after copepod grazing, more iron is complexed in a form that can be used by phytoplankton. This positive feedback mechanism increases the amount of bioavailable iron and may enable phytoplankton species to survive under unfavorable growth conditions such as iron limitation and moderate grazing pressure in the Southern Ocean.

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ESTABLISHING A REFERENCE MATERIAL FOR 'ACCURATE' ANALYSIS OF DISSOLVED ORGANIC NITROGEN (DON) IN SEAWATER SAMPLES

To evaluate consistency of analytical measurements, daily use of certified reference materials (CRM) gives greater comparability (accuracy) among laboratories. The use of dissolved organic carbon (DOC) CRM is established; we are experimenting with a DON reference. Since dissolved organic nitrogen (DON) is determined by measuring TDN and subtracting DOC (DIN: NO2, NO3 and NH4), it is critical for analysts to measure DIN accurately, especially low concentrations. We recently collected surface and deep water off the Mid-Atlantic shelf to use as DON references. Initial results from over 20 participating labs around the world will be discussed. With a good
DON reference, it will be possible to check TDN prior to analysis with high temperature combustion (HTC), by analysis by pycvolat or UV, and DIN in nutrient analysis. Different laboratories will have varied uses of the references, but all should benefit from regular use of references.

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MAPPING SEMI-REGULAR AUTONOMOUS UNDERWATER VEHICLE GLIDER OBSERVATIONS ONTO A CROSS-SHELF SECTION

Two Autonomous Underwater Vehicle Gliders have alternated continuous sampling of a 45-nautical mile transect line (the Newport Hydrographic Line) across the Oregon continental shelf since April, 2006. Strong currents (>25cm/s) push the gliders off their trac- tory and they slowly return to connect line, and the protocol will describe the methods developed to map the semi-regular glider data onto a cross-shelf line, a process which combines the binning of data along-isobaths and objective analysis. The mapping procedure is tested by comparison to moored observations on the Newport Line at 80m water depth varying the spatial and temporal averaging scales.

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OCEANOGRAPHIC VARIABILITY ALONG THE ALASKAN COAST

There is a dearth of observations in Alaskan waters that can be used to help understand the linkages between the climate change and the response by coastal ecosystems. We present oceanographic data from an under-utilized source, the temperature measure- ments at coastal tide stations and buoy, and examine the linkage with fisheries informa- tion from the Alaska Department of Fish and Game tide station data. We attempt to examine changes in oceanographic conditions back to the 1920’s. Using historical tide gauge data for long time series analysis requires careful evaluation of how variations in instrument location and sampling frequency intersect with local environmental conditions, such as the thermocline depth. Using the spatial variability we tease out potential local sources of variability from larger scale oceanographic changes, though the specific causes of those patterns cannot always be determined. We then examine how the variability is related to shrimp biomass in Kachemak Bay.

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USING SPATIAL PATTERNS TO INFERR ORGANIC CARBON UTILIZATION BY ESTUARINE BACTERIOPLANKTON

Microbial communities are thought to be important regulators of estuarine biogeochemical cycles through their processing of allochthonous and autochthonous organic matter. Since estuarine dissolved organic carbon is a complex mixture of different sources, it is difficult to determine which source drives microbial metabolism. We measured bacterioplankton pro- ductivity for four years along the salinity gradient in the Neuse River and Pamlico Sound, North Carolina. As has been shown in cross-system studies, mean annual bacterioplankton productivity showed a strong correlation with phytoplankton productivity, suggesting the importance of autochthonous organic matter as a substrate for microbial growth. Also, the mostly conservative mixing behavior of CDOM points to dilution rather than microbial utilization of allochthonous carbon. This is contrasted with discrete longitudinal transects of bacterioplankton productivity, which exhibited strong to no spatial coherence with phytoplankton productivity and biomass. The same range of coherence was apparent for bacterioplankton versus DOC, but not always in conjunction with phytoplankton, especial- ly after a major hurricane impacted the system. This variation in coherence indicates that alternating substrates fuel bacterial production, probably as a function of river discharge.

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ON THE GRADIENT RICHARDSON NUMBER IN ISOPYCNIC COORDINATES

The gradient Richardson number Ri in vertical coordinates (x,y,z) is the square of the ratio between buoyancy frequency N and vertical-shear amplitude S, Ri=N²/S², so that a decrease/increase in stratification brings a decrease/increase in dynamic stability. In isopycnic coordinates (x,y,p), however, it becomes the square of the ratio between the inverse of the buoyancy frequency, or buoyancy period, and the diapycnal-shear ampli- tude S, Ri=1/(NS²), where S²=∫(∂u/∂z)²+∫(∂v/∂z)²+∫(∂w/∂z)², so that a decrease/increase in stratification leads to an increase/decrease in dynamic stability. The apparently different role of stratification is the consequence that S and S² are related through the stratification itself. Here we use simple arguments to endorse the usefulness of the isopycnic approach, and the advantages of thinking in terms of S, rather than S. We use field data from three different situations (island shelf-break, Gulf Stream and Gibraltor outflow) to test these idealizations. We conclude that in frontal systems, such as the Gulf Stream and specially the Gibraltor outflow, the isopycnic Ri perspective has more physical significance than the vertical classical view.

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GLOBAL DISTRIBUTION OF PHYTOPLANKTON FUNCTIONAL GROUP ABUNDANCES USING PIGMENT MARKERS

The recognition of the importance of phytoplankton functional groups in controlling energy flow through marine ecosystems has led to the development of a new class of marine ecosystem models that explicitly consider such groups. The construction of a phytoplankton functional group climatology is not only critical for the verification of such models, but it also serves as an ecosystem-based tool for the management of phytoplankton class abundance, which are binned into functional groups. Since CHEMTAX output can be highly constrained by initial pigment ratios, we utilized this as a tool to evaluate the potential success of this approach. Furthermore, algal abundance was approximated iteratively to increase confidence in the program's output. The preliminary results will be discussed in the con- text of our current understanding of global phytoplankton distribution.

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VARIABILITY IN THE SLOPE WATER AND ITS REALIZATION TO THE GULF STREAM PATH

Sea Surface Temperature (SST) and Sea Surface Height (SSH) data for 1993-2007 for the Western North Atlantic are combined with hydrographic and mooring data at 69W to investigate the relation between fluctuations in the position of the Gulf Stream and the flow in the Slope Water. SST anomalies north of the Gulf Stream are correlated with tem- poral changes in its mean spatial pattern. The spatial distribution of the correlation suggests that SST anomalies move westward along the slope with speeds several cm/s, consistent with the observed velocities in this area. Joint EOF analysis of the anomalies shows cooling (warming) and strengthening (weakening) of the anomalies in phase over the Slope Water. The vertical structure of these fields at 69W agrees reasonably well with the surface patterns, and suggests that larger transports in the Deep Western Boundary Current lead to southward shifts of the mean path of the Gulf Stream. This relation between the Slope Water properties and the Gulf Stream position provides some predictability for the latter.

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RESPONSE OF NORTH ATLANTIC RIGHT WHALES TO REGIONAL-SCALE COPEPOD CONCENTRATIONS IN GULF OF MAINE: CLIMATOLOGICAL AND INTER-ANNUAL TRENDS

Each winter and spring a portion of the endangered North Atlantic right whale (Eubalaena glacialis) population enters Cape Cod Bay to feed and to nurse their young. Later in the spring, aggregations of right whales are found feeding and socializing in the Great South Channel. The right whale movements are thought to be driven in large part by their need to feed on ultra-dense patches of copepods, particularly Calanus finmarchi- cus. Using aerial sighting data of right whales and measurements of copepod concentra- tions from vessel-based oceanographic sampling in Cape Cod Bay and the Great South Channel, we tested the hypothesis that the regional-scale average copepod concentration is an indicator of right whale presence. In the Channel, right whales are most likely to be found when Calanus concentrations are anomalously high (r=0.62, p<0.05 during sum- mer). In the Bay, right whales are most likely to be found when Calanus concentrations are near seasonal mean values. We use these and other results to inform a conceptual model of right-whale habitat use in the Gulf of Maine.

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COMPARATIVE ASSESSMENT OF THE DRAKKAR MULTI-RESOLUTION 1958-2004 GLOBAL SIMULATION ENSEMBLE

The DRAKKAR consortium has performed a hierarchy of 1958-2004 global ocean/sea-ice simulations at 2, 1, 2/2, and 1/4-degree resolution, driven by the same hybrid forcing func- tion (reanalyzed + observed fields + bulk formulae). These simulations were processed identically to yield collocated equivalents of altimetric (AVISO sea-level anomalies) and hydrographic (INACT/ENSEMBLES in-situ profiles) observational databases. The global
and regional impacts of successive grid refinements are then quantified against these two
synoptic observational references using original measured magnitude, phase, correlation,
spacetime structure of sea-level variability modes in various wavenumber/frequency
ranges (almitetry); space-time structure of thermal and haline model biases and monthly
variability of various mixed layer characteristics (ARGO), etc. Simulated mean states and
seasonal/interannual variabilities get globally more realistic all the way from 2 to 1/4-
degree resolution, with resolution thresholds. We document how resolution improves
the timescale and structure of the forced oceanic response, but also how it enhances nonlinear-
early driven intrinsically interannual variability.

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MODELING LIGHT SCATTERING IN LAKE SUPERIOR THROUGH A TWO-
COMPONENT APPROACH

Particulate attenuation, scattering, and backscattering coefficients \( a_p \), \( b_p \), and \( b_{bp} \) were measured in situ in the littoral and pelagic sites of Lake Superior. Individual particle analyses
(IPA) of suspended material were performed for collected water samples. IPA provides information on light-scattering attributes (composition, size distribution) of minerogenic (inorganic) particle populations, thus allowing an analytical approach (Mie theory) to
model the minerogenic scattering component \( b_{bp} \). Adopting empirical equa-
tions for the organic scattering component \( bo \) and \( bbp \) based on measured chlorophyll a concentrations \( Chl(a) \), we represented the measured \( bp \) and \( b_{bp} \) by the summations of these two components. The estimated surmises approached equivalently both with measured \( bp(650) \) (range 0.2 – 1.35 m–1) and \( b_{bp}(650) \) (range 0.0015 – 0.0049 m–1). \( b_{bp} \) accounted for an average of 51% of \( bp \) in the pelagic, and 64% in the littoral sites. The backscattering ratio \( b_{bp} / bp \) was negatively correlated with log \( Chl(a) \) and the sum \( Chl(a) + cp \). Modeled backscattering ratio \( b_{bp} / bp \) was generally well with that based on in situ measurements [on average, 15% absolute relative error]. Size distributions
(a logarithmic-normal function), composition (clay minerals dominating), and
(backscattering efficiency factors of inorganic particles are presented.

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VARIABILITY OF THE FLORIDA CURRENT TRANSPORT AT 27N

Several GODAE (the Global Ocean Data Assimilation Experiment) products using
HYCOM are applied to a 1/25-degree South Florida coastal region HYCOM (SoFLA-
HYCOM) as nesting boundary conditions. High-resolution HYCOM output is applied to
a 1/25-degree South Florida coastal region HYCOM (SoFLA-HYCOM) as nesting boundary
conditions. The impact of the boundary conditions on variability of the Florida Current transport at 27N is examined using year 2004 simulations, compared with observations based on the cable data and in-situ data from research cruises. Sensitivity of the Florida Current transport to the resolution of local atmospheric forcing and the model vertical resolution will be discussed as well. Seasonal and decadal
variability of the Florida Current transport will be examined using the cable data from
1982 to 2005 and model output from a 1/3-degree North Atlantic free-running HYCOM
simulation from 1948 to 2003. Distinct annual cycles of the Florida Current transport
based on the cable data are found and shown to be associated with strong positive and
strong negative NA0 (North Atlantic Oscillation) regimes. Relationship between decadal
variability of the Florida Current transport represented in the model and the variability of gyres in the North Atlantic and NA0 (North Atlantic Oscillation) will be discussed.

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A NUMERICAL PROJECTION OF THE COASTAL FLOODING AND EROSION IN
CAROLINA COAST

Sea level rise due to global warming may alter coastal circulation, wave propagation, and
sediment transport processes. As a result, a tropical storm occurring at the end of
next century with a higher sea level as its initial condition may produce more severe coastal
flooding and erosion than the same storm occurring at present. In this paper, Carolina
coast is chosen as the test bed. A three dimensional coupled circulation (ROMS), wave
(SWAN), sediment transport and erosion model system is developed to evaluate the
flooding and erosion difference due to sea level change. In the modeling system, the sedi-
ment flux model is based on the approach of Sargsian and includes approximations for
both bed-load and suspended load. The bathymetry is then updated by computing the
divergence of the time averaged sediment fluxes. The process is then repeated using
the updated bathymetry in both SWAN and the circulation model. The modeling results indi-
cate that the ensemble maximum flooding area for a given category tropical storm along Carolin
coast is appeared larger at the end of the century than at present. The results also indicate that the sediment flux, bathymetry modification and erosion for a given
storm are also much different in this area.

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DECADAL INCREASE OF ANTHROPOGENIC CO2 IN THE OCEAN

Results of re-evaluation of GEOSECS carbon data in the Atlantic Ocean by examining
depth properties at crossover stations between GEOSecs and WOCE cruises show that
DIC measurements made in GEOSECS program are systematically higher than
those made during recent WOCE/DOE global CO2 survey. In the N Atlantic, the overall
average offset is estimated to be 27 ± 4 μmol/kg north of 15ºN. In the oceanic region between
15ºS and 15ºN, the model output from a 1/3-degree North Atlantic flow estimated to be 0.57 mol/m2/yr for the equatorial region, and 0.28 for 15º South Atlantic south of 15ºS. The anthropogenic CO2 increase using par-
ison of salinity normalized DIC after correction for AOU along the isopycnal shows that
the CO2 uptake rates are consistent with those derived from MLR method. Works are
underway for analyzing A16 and P16 using isopycnal DIC comparison.

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MODEL-DATA COMPARISON OF SEDIMENT TRANSPORT OVER EVOLVING
RIPPLED BEDS

The results of a three-dimensional, time dependent, live-bed, boundary layer flow and
sediment transport model are examined and compared with laboratory data. The model employs a mixture approach, with the fluid-particle system modeled as a continuum of two interacting mediums. It has been shown to predict bedform heights, lengths, and shapes similar to those found in the laboratory. Advancements to the model include the forcing from an arbitrary time series of random waves allowing for a close comparison with laboratory data of the modeled flow and concentration fields. A mean boundary current at oblique angles to the flow is added for the examination of ripple migration. We
investigate the transition of two- to three-dimensional ripple fields and the conditions under
which the-dimensional ripples form. The time scales of long term ripple development
are also compared with laboratory data. The results from the comparisons with
suspended sediment concentration and boundary layer flow data obtained at the CROSSTEX lab experiment indicate that the model can reasonably predict the sediment and flow dynam-
ics over an evolving ripple bed.

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INFLUENCE OF A MESOSCALE ANTICYCLONIC EDDY ON THE DISTRIBUTION
OF UNICELLULAR CYANOBACTERIA IN THE SUBTROPICAL NORTH PACIFIC

Ocean mesoscale eddies affect oceanic biological communities at micro- and macroscopic scales through the redistribution of heat, nutrients and salinity. As part of the CMORE (Center for Microbial Oceanography: Research and Education) activities we conducted a cruise in the North Pacific subtropical gyre in which we sampled inside and around a mesoscale anticyclo-
nic eddy to assess the microbial diversity associated with nitrogen fixation. The distribu-
tion and abundance of Groupb Crocosphaera-like diatrizoic unicellular cyanobacteria were determined in situ by whole-cell quantitative PCR (wecQPCR) and flow cytometry. Flow cytometric analyses yielded a 6 fold increase in abundance of Groupb cells in surface water near the center of the eddy relative to the periphery. Groupb cells were also more abundant at deep inside the eddy when compared to sites outside. These results were similar to estimates by nh14 wecQPCR asays. Thus, the anticyclonic eddy appeared to influence significantly the abundance of Groupb cyanobacteria suggesting that mesoscale features may play a critical role in the distribution and activity of cyanobacteria, thereby contributing to our present uncer-
tainties of nitrogen fixation budgets in the marine pelagic environment.

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THE IMPACT OF AN IOP-BASED UNDERWATER LIGHT PROPAGATION SCHEME
ON AN ECOLOGICAL MODEL OF THE CALIFORNIA CURRENT SYSTEM.
A coupled physical-ecological model of the California Current System (NCOM-CCS) includes a novel scheme for the attenuation of solar radiation in oceanic and coastal waters. This innovative approach is based upon the inherent optical properties (IOP), absorption, and backscattering of the water column. The circulation model component of NCOM-CCS receives boundary information from the global Navy Coastal Ocean Model (NCOM) and forcing from high-resolution surface fluxes determined by the regional Coupled Ocean-Atmosphere Mesoscale Prediction System (COAMPS). The NCOM-CCS temperature and salinity fields are relaxed to the daily fields derived from the Naval Research Laboratory’s Modular Ocean Data Assimilation System (MODAS). The location and timing of chlorophyll blooms along the US West Coast are well represented by NCOM-CCS. Using different statistical metrics to compare observed and predicted chlorophyll distributions, the impact of this new light scheme on the model (surface and sub-surface) chlorophyll dynamics is evaluated for the period 2001-2005. 

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SEASONAL VARIABILITY OF MASS IN THE ARCTIC OCEAN USING GRACE, THE PIOMAS MODEL AND IN SITU BOTTOM PRESSURE MEASUREMENTS

Ocean Bottom Pressure (OBP) measured by the Gravity Recovery and Climate Experiment (GRACE) shows excellent correlation with Arctic Bottom Pressure Recorder (ABPR) measurements near the North Pole. Both GRACE (2002-2007) and ABPR (2005-2007) OBP show a seasonal variability of about 6-10 cm of water equivalent peak to peak with a maximum occurring during the summer and a minimum during the winter. In situ OBP measurements from the Beaufort Gyre and from the Fram Strait are positively correlated with the North Pole OBP. The phase and amplitude of their seasonal variability suggest that the mass of the Arctic Ocean increases and decreases annually at basin scale. This is also supported by OBP simulated with the Pan Arctic Ice-Ocean Modeling and Assimilation System (PIOMAS). The PIOMAS model data is in general agreement with GRACE and is used to investigate the seasonal forcing in the Arctic Ocean.

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CHEMICAL PROPERTIES OF MARINE DISSOLVED ORGANIC MATTER ISOLATED USING THE COUPLED RO/ED METHOD - INSIGHTS FROM 13C NMR SPECTROMETRY AND FTICR MASS SPECTROMETRY

The coupled reverse osmosis/electrodialysis (RO/ED) method has been used to isolate 16 samples of dissolved organic matter (DOM) from seawater with an average yield of 75% ± 12%. Samples are concentrated 40-fold at sea, and pulsed ED has been introduced in the final desalting step to reduce conductivity to 50 µS cm⁻¹. The 13C nuclear magnetic resonance spectra of five representative samples, including one coastal sample, are similar in appearance, except for a stronger signal for aromatic carbon in the coastal sample. The RO/ED samples are enriched in aliphatic carbon and deficient in carbohydrate carbon, relative to DOM that has been isolated from surface ocean water using ultrafiltration. Fourier transform ion cyclotron resonance (FTICR) mass spectra of the five samples contain thousands of peaks, and chemical formulae can be unambiguously assigned to many of those peaks. For the coastal sample, 25% of chemical formulae have atomic H:C ratios of less than one, which is indicative of rather highly unsaturated compounds. In contrast, the four open-ocean samples do not contain significant numbers of such unsaturated compounds.

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SOUTHERN ANNUAL MODE RESPONSE AND ITS IMPACT ON THE WEDDELL SEA IN A EXPERIMENT FOR MINIMUM SEA ICE CONDITIONS AROUND ANTARCTICA

In this study the interaction between Antarctic sea-ice and the SAM on the Weddell Sea is investigated. To accomplish this satellite-observed sea-ice concentration (SIC) prescribed to the CCSM3 coupled model were employed. A 150-year simulation, with the minimum SEC repeat annual cycle was used to drive the CCSM3 run. The goal of the research is to evaluate the Weddell Sea response to positive SAM events with respect to observed minimum SEC. This study focuses on interannual timescales and uses EOF analyses to identify preferred perturbation pathways. The variability of sea surface temperature and sea surface salinity anomalies reveal a spatial pattern that characterizes the cold regime of the Weddell Gyre, associated with low Circumpolar Deep Water intrusion. The response of the oceanic circulation in Weddell Sea inflow and outflow regions, related to positive SAM events, show intensification with respect to the control (average SEC).

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NITROGEN SPECIATION AND DYNAMICS IN THE SAN JOSÉS AND PÁIONES LAGOONS OF THE SAN JUAN BAY ESTUARY, PUERTO RICO

The San Juan Bay Estuary (SJE) is a tropical estuary located in the San Juan Metropolitan Area in Northern Puerto Rico. For decades, the SJE has been affected by point sources of pollution and currently several locations within the estuary remain heavily polluted. To assess the current eutrophication levels we analyzed: (i) spatial and temporal patterns of inorganic nitrogen (NH₄⁺, NO₂⁻, and NO₃⁻) concentrations and (ii) explore spatial differences in the distribution of nitrogen species in the San Jor (SJ) and Páiones (PL) lagoons. Since N studies in tropical estuarine ecosystems are limited, our goals is to summarize available nitrogen data (present and historical) to develop a N budget for the SJL and PL. Our goal is to assess how nitrogen dynamics are impacted by human activities in an urbanized tropical coastal estuarine ecosystem.

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THE THREE-DIMENSIONAL STRUCTURE OF THE TROPICAL CIRCULATION CELL IN THE CENTRAL EQUATORIAL PACIFIC OCEAN

The surface limb of the mean tropical circulation cell in the central equatorial Pacific Ocean is characterized by strong upwelling near the equator, near-surface poleward divergence, and downwelling near 4 degrees latitude. Meridional and vertical velocity fluctuations associated with nonlinear tropical instability waves (TIWs) are much larger than those associated with the cell and may modify the background circulation through nonlinear oceanic mixing. The PIOMAS circulation is used to simulate the spin-up of the cell along 140°W in response to anomalous winds during various phases of the annual cycle. Equatorially-modified versions of geostrophy and Ekman theory are introduced to study the wind-driven response and zonal filtering separates the large-scale response of the cell from that of the TIWs. Weakening the Trades rapidly weakens the cell, decreases the shear of the zonal currents, and reduces the amplitude and propagation speed of the TIWs. Strengthening the Trades to first order produces the opposite response. However, the response of the tropical circulation cell is nonlinear and its meridional-vertical structure is sensitive to the strength of the background winds and TIWs.

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COMPARISON OF DOPPLER RADAR AND VIDEO DERIVED MEASUREMENTS OF SURF ZONE CURRENTS AND MORPHOLOGY

During the Fall 2003 Nearshore Canyon Experiment (NCEx) the University of Massachusetts Amherst deployed two X-band Doppler radars to estimate wave fields and surf zone properties including longshore surface currents and surf zone extent. Video cameras deployed by the Ohio State University observed the same region. Radar estimates of surface velocity in the surf zone are inferred from the Doppler shift of backscattered radiation, while video velocity estimates are produced using the Particle Imaging Velocimetry (PIV) technique. Comparisons of velocity estimates in the nearshore show strong correlation (0.9 and higher) within the central surf zone. Differences are observed at the outer edge of the surf where strong breaking occurs, and near the inner edge where the beach is frequently exposed in the swash zone. Surf zone extent is estimated from video data using time-stacking technique and contrast of visible features. The same parameter is inferred from radar data using edge detection on time-averaged radar backscatter images. The radar’s ability to observe in low visibility conditions and at night are particularly advantageous.

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COMPARISON OF DOPPLER RADAR AND VIDEO DERIVED MEASUREMENTS OF SURF ZONE CURRENTS AND MORPHOLOGY

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A TWO-SCALE APPROXIMATION FOR EFFICIENT SIMULATION OF NONLINEAR INTERACTIONS IN HURRICANE-GENERATED WAVES

We recently derived and presented a new method for estimating the transfer rates in wind wave, based on a two-scale approximation (TSA) to the full Boltzman integral (FBI) for quadruplet wave-wave interactions. In that presentation, the TSA method was tested for idealized spectral data. In this paper, we focus on observed wave spectral from...
field measurements. Comparisons are given of TSA, the full Boltzman integral, FBI, and the Discrete Interaction Approximation (DIA) which is presently used in almost all operational wave forecast models, using data collected in Currituck Sound, and in open ocean conditions. The latter data include directional wave rider observations off the Field Research Facility at Duck North Carolina during hurricane Wilma in 2005. These comparisons show that TSA compares favorably with FBI, and that it is a notable improvement over the DIA.

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COMBINING SATELLITE DATA SETS TO STUDY SOUTHERN CALIFORNIA COASTAL WATERS

In order to support the Southern California Coastal Ocean Observing System (SCCOOS), the Physical Oceanography Distributed Active Archive Center (PO.DAAC) at the NASA Jet Propulsion Laboratory has been providing Southern California researchers with regional near-surface and historical data from Jason-1, QuikSCAT and MODIS. However, data obtained from these instruments is problematic along the coast for a variety of reasons including inadequate spatial and temporal sampling and cloud contamination. By combining these NASA data sets with data available from NOAA and international agencies, improved data products can be produced for coastal research. The accuracy and effectiveness of these new products will be presented using observations of Los Angeles coastal waters during the Hyperion Treatment Plant's diversion of effluent from the 5-mile to the 1-mile outfall in November 2006.

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MULTIYEAR SEAGLIDER OBSERVATIONS OF NORTHERN CALIFORNIA CURRENT ECOSYSTEM: VARIABILITY IN PHYTOPLANKTON ANNUAL CYCLE IN DEEP WATERS OFF THE WASHINGTON SLOPE

Since September 2003 Seaglider, an autonomous underwater glider has been making physical, chemical and bio-optical measurements in the Northern California Current Ecosystem, in waters off the Washington coast. One goal of the program is to provide a climatological understanding of the oceanography in this region, and also to establish the relationship between physical forcing and phytoplankton response. Seaglider occupies a repeat survey transect beginning approximately at the shelf/slope break and continuing seaward about 250 km offshore. Here we focus on the most seaward region of the repeat transect, a region revisted on a monthly schedule. Measurements include temperature, conductivity, and dissolved oxygen from the surface to 1,000 m and chlorophyll fluorescence and optical backscatter in the upper 150 m. The depth of the winter pycnocline varied among years, between about 80 and 120 m, with the deepest pycnocline followed by the largest spring bloom while the timing of the transition between the deep winter and shallow pycnocline controls the timing of the spring phytoplankton bloom. Glider observations are proving a valuable tool for studying physical forcing and biological responses.

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COHERENT RESPONSE OF NORTHWEST ATLANTIC SHELF ECOSYSTEMS TO DECADECAL CLIMATE VARIABILITY

During the 1990s, a series of freshwater anomalies propagated down the Northwest Atlantic Shelf. Pelagic ecosystems on the shelf exhibited a complex response to the freshening. In general, the freshwater was associated with an increase in phytoplankton abundance, especially in autumn and winter, and an increase in many copepod species. However, both the seasonality of the response, as well as the species exhibiting the strongest responses, changed across the shelf. By examining the coherent signals in the plankton community, and those species that deviate from the signal, we develop a conceptual model for how the ecosystems of the Northwest Atlantic Shelf will respond to future climate variability and change.

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DEMONSTRATION MISSIONS IN ESONET NOE

ESONET is a Multidisciplinary European Network of Excellence (NoE) associating 50 partners from 14 countries and more than 300 scientists and engineers. The goal of this NoE is to facilitate the blending of European research on deep sea multidisciplinary observatories. Over the ﬁrst 4 years, the approach is to merge the programs of members organisations by managing marine research activities, addressing the common scientiﬁc objectives and by networking activities specially designed for Excellence integration and spreading. Amongst other actions, it works by establishing sea ﬂoor infrastructure that will provide platforms for instrumentation deployed throughout the water column and the seafloor below. These platforms will provide power for instruments and real-time two-way data communications. Firstly, some “demonstration missions” have been selected in November 2007 and are presented here. Demonstration actions are bringing technology excellence at high level for different development phases, implementing the standardisation and interoperability of the different platforms from the consortium. By acquiring relevant time-series of multidisciplinary data, they will be an input for integrated studies, common workshops and a material support to implement a data management plan.

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THE LANS-ALPHA TURBULENCE PARAMETRIZATION IN PRIMITIVE EQUATION MODELING

The Lagrangian-averaged Navier-Stokes-alpha (LANS-alpha) model is a turbulence parameterization that increases eddy activity near the grid-scale. We will review the implementation and results of LANS-alpha in the POP ocean model. Simulations with LANS-alpha in an idealized channel model domain produce turbulence statistics like a doubling of resolution, including kinetic energy, eddy kinetic energy, and temperature profiles. The cost of adding LANS-alpha is only 30%, versus a factor of ten for doubling the horizontal resolution. LANS-alpha, which is derived using Hamilton's principle, modifies the momentum equation with an extra nonlinear term and a smoothed advecting velocity. The alpha parameter controls the strength of smoothing in a Helmholtz inversion operator, and is equal to the strength of the turbulence model. We show that efficient filters can replace the Helmholtz inversion, with similar results. A linear dispersion analysis of LANS-alpha shows that it increases the effective Rossby Radius, thus allowing more eddy activity near the grid-scale in low-resolution ocean simulations. Preliminary simulations in a North Atlantic domain produce deeper and more realistic penetration of eddy kinetic energy in the North Atlantic Current.

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THE CONTRIBUTION OF ATMOSPHERIC ACID DEPOSITION TO OCEAN ACIDIFICATION OF THE NORTH ATLANTIC OCEAN AND CORAL REEF DOMINATED MARINE ECOSYSTEMS

We evaluate the influence of atmospheric acid deposition on the acidification of oligotrophic waters of the North Atlantic Ocean and coastal waters of the Gulf of Maine. We conclude that acid deposition led to a significant decrease in surface water pH. This decrease is the result of an increased effectiveness of these new products will be presented using observations of Los Angeles coastal waters during the Hyperion Treatment Plant's diversion of effluent from the 5-mile to the 1-mile outfall in November 2006.

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A TWO-EQUATION MODEL OF INTERNAL WAVE- AND SHEAR-DRIVEN TURBULENT MIXING

Turbulent mixing driven by internal waves and mixing driven by
a gas-exchange parameterization to estimate the new production along the transect. Continuing observations from 2002 to 2005 onboard of a ferry from Coos Bay (DE) to Harwich (GB) together with wind fields derived from a regional meteorological model were used to estimate the seasonal dynamic of oxygen production along the track. Together with the other variables continuously measured by the FerryBox (S, T, Chl-a, Turb) areas of high productivity, such as fronts, can be easily detected and quantified. The new production values obtained using the oxygen flux method will be compared with net production rates provided by traditional methods and models.

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BEAUFORT SEA WIND FORCING OF THE FLOW THROUGH THE NORTHWEST PASSAGE

Monthly mean volume transport estimated from current measurements at moorings across Barrow Strait and observations from 2001 to 2005, compared with Monthly mean volume transport at monthly to interannual time scales is significantly correlated with north-eastward winds 1000km from the west to the moorings in the Beaufort Sea, parallel to the western side of the Canadian Arctic Archipelago. The optimum wind direction and direction are consistent, suggesting a wind礼品赠送风-driven circulation. This study relies on the understanding of the Beaufort Current along the opposite ends of the Passage, and the difference being determined by setup caused by alongshore winds in the Beaufort Sea. Monthly alongshore wind anomalies account for 38% of the variance of the transport anomalies, and 50-60% of the variance in the annual cycle of transport is attributable to seasonal variations in wind.

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INTEGRATING NAGL APPROACHES TO CLASSROOM STRUCTURE WITH LOCAL OCEAN-SCIENCE MODELS THROUGH GRADUATE STUDENT-TEACHER PARTNERSHIPS IN WASHINGTON STATE

Partnerships pairing science graduate students with middle school science teachers in coastal Washington produced adaptations to existing science curricula and novel mechanisms to enhance student learning in local middle schools. Each classroom pairing, supported by GK-12 NSF funding, emphasized different scientific content, ranging from "Popular Culture and Ecology," to "Properties of Matter." Novel approaches redirected attention from whole-class, teacher-driven activities to a structure challenging students to be curious and practice scientific processes by emphasizing observation and continued reflection. Flowcharts, which broke the class into several student-groups, were utilized in multiple classrooms to move students through a strand of thematically tied activities at their own pace, combining individual focus with small group discussion and activities. Ocean science came to the forefront as a powerful example in three classrooms: using the movement of ocean currents to demonstrate the power of density, applying GIS to map sightings of local orca pods in northern Puget Sound, and employing Bellingham Bay, a local coastal area, to focus on securing ecological model. Students successfully applied fundamental scientific processes and content, learned through ocean-science examples, to multiple scientific disciplines.

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INFLUENCE OF A RECIRCULATING RIVER PLUME BULGE ON BIOGEOCHEMICAL PROCESSES ALONG THE OREGON/WASHINGTON SHELF

While most numerical and laboratory models of coastal river flows result in the generation of a large anticyclonic bulge near the month of the river, evidence of such a feature in field observations is remarkably scant. Recirculation features act to concentrate plankton, and therefore they hold significant implications for ecosystem function and trophic transfer. We report direct observations of bulge circulation resulting from a period of low wind stress near the month of the Columbia River as tracked by drifters and corresponding physical, biological, and chemical properties. The bulge had a core approximately 5 m deep and 22 km wide with a total diameter of 30-40 km and was characterized by elevated rates of primary production, chlorophyll, zooplankton, and river-derived nutrients. We suggest that such ephemeral features may have a disproportionately large impact on shelf ecosystems and may thus contribute significantly to enhanced production over river-influenced continental shelves.

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A TEN-YEAR RECORD OF PHYTOPLANKTON COMPOSITION AND BIOMASS IN
Phlips, E. J.

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A SUBMERSIBLE HOLOGRAPHIC IMAGING SYSTEM

an in-situ digital holographic recording system, capable of recording movies of marine organisms (resolution down to 4.11 μm), has been deployed as a drifter, moving with the ambient current and as a fixed system sitting on the ocean floor: Deployments have been conducted in Spain, France, and New Jersey. Biological samples were collected using plankton net tows and niskin bottle samples in conjunction with deployments. At times, a second holographic recording system was used on the vessel to image organisms in water samples at higher frame rates and magnifications than was obtained with in-situ recording. From the drifting deployments we observe zooplankton in-situ, studying swimming behavior, nearest neighbor distances and predator-prey relationships. The preserved biological samples are used to provide species-level identification and concentration measurements. In addition, the high-speed holograms of collected water samples allow us to directly compare confined and in-situ behavior. From the fixed deployments we correlate organism concentrations and behavior to flow properties (i.e. wave phase) measured with an Acoustic Doppler Velocimeter, using this information to understand how organisms are transported by and react to benthic boundary layer flow.

The NEPTUNE Canada Network The NEPTUNE Canada Regional Cabled Observatory is conceived as a "utility" for ocean science. Power and communications will be delivered over standard interfaces and the network design and operation will be largely transparent to end users. Providing this capability requires a network architecture that gives equal consideration to power, communications and ocean engineering. The NEPTUNE Canada network design consists of a resilient loop with six nodes at locations of primary science interest. Extensions and junction boxes allow instruments and sensors to be placed in close proximity to items of interest. Branching units and repeaters based on proven, commercial telecommunications designs provide expansion as required. A parallel powering arrangement working at up to 10V and 8Amps provides 10 kW to each node. The communications network utilized IEEE 802.3 Ethernet standards to provide up to 4 Gbps at each node. Ocean engineering considerations include burial to secure the cable and repeaters from external aggression, trawl resistant node frames, and the use of wet-mate connectors to permit recovery of nodes, junction boxes, and instruments.

A TEN-YEAR RECORD OF PHYTOPLANKTON COMPOSITION AND BIOMASS IN THE INDIAN RIVER LAGOON, FLORIDA
Philips, E. J.
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The Indian River Lagoon stretches across 350 km of the eastern shore of Florida. Historically, the watershed of the lagoon has been the site of extensive agricultural activity, but more recently has become one of the fastest growing population centers in the United States. Since the mid-1990s the lagoon has been extensively monitored for water quality, including phytoplankton populations, because of concerns about the potential conse-
quences of eutrophication for recreational activities and fisheries in the lagoon. In this study phytoplankton composition and biomass were determined on a monthly basis for 8 sites in the lagoon, along with associated water column conditions: including salinity, tem-
perature, dissolved oxygen, turbidity, light extinction coefficients, total nitrogen and total phosphorus. Over the course of the study there was a dramatic upsurge in the intensity and frequency of harmful algal blooms, particularly the saxitoxin-producing dinoflagel-
late Pyrodinium bahamense. The relationships between spatial and temporal patterns in phytoplankton populations and water quality parameters are explored to provide insights into the driving forces behind these bloom events.

WEST ANTARCTIC PENINSULA CIRCULATION AND IMPLICATIONS FOR BIOLOGICAL PRODUCTION
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Observations of the distribution and abundance of marine mammals and other predators, obtained as part of the Southern Ocean Global Ocean Ecosystems Program, showed that these animals concentrate in specific areas of the western Antarctic Peninsula (WAP) continental shelf. The relative contribution of circulation in producing these regions of enhanced predator abundance was investigated with Lagrangian particle tracking stud-
ies that used simulated circulation fields obtained from the Regional Ocean Modeling System (ROMS). Flows were derived from simulations performed at different seasons and depths. The simulated particle trajectories showed preferred sites for cross-shelf exchange and onshelf intrusions which related to areas where higher predator abundance was observed, such as inside and around Margarite Bay, and north of Adelaide Island. Also, trajectories of floats released along the southwestern portion of the WAP show inputs from the Bellingshausen Sea, particularly for the southern limb of Margarite Bay. The float trajectories suggest that the circulation is potentially important in develop-
ing localized areas of high predator abundance perhaps through facilitating aggregation of prey and/or providing areas of enhanced nutrient availability and biological production.

FLOW OF DENSE PACIFIC WATER INTO THE WESTERN ARCTIC OCEAN THROUGH HERALD CANYON
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Dense water of Pacific origin drains into the western Arctic Ocean from the Chukchi Sea via two routes: Barrow Canyon and the Herald Canyon in the west. The dynamics of the flow through the canyons and the associated mixing play important roles in determining the ultimate fate of the water in the Arctic Basin, including the flow of the upper halocline. In August 2004, as part of the Russia-US Long-term Census of the Arctic (ROSLI) program released along the outer shelf and mid-shelf regions were car-
ried out in Herald Canyon (the first such high-resolution survey of the region). Both dense and buoyant Pacific-origin water were flowing northward through the canyon, and both flows changed significantly from the the head of the canyon to its mouth. The evolution of the water masses and currents is described, including the possible role of hydraulic
control in influencing the character of the dense flow. A comparison is made between the canyon outflow and the resulting downstream boundary current.

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EFFECTS OF CONTINUOUS IRON, COPPER AND DOMOIC ACID SUPPLY ON SHAPING THE TRAJECTORY OF PHYTOPLANKTON ASSEMBLAGES IN NEAR AND OFFSHORE SUBARCTIC PACIFIC WATERS

The effect of iron addition on phytoplankton production in subarctic Pacific HNLC waters has long been studied using large, pulsed iron amendments in bottle and mesoscale experiments. Analogous natural events are rare, and the effects of low but continuous metal enrichment on subarctic phytoplankton assemblages is largely unknown. We used shipboard continuous cultures to measure the effects of iron, copper and domoic acid amendments in nearshore waters, young Haida Eddy transition waters, and oceanic waters at Ocean Station PAPA. Population responses differed sharply among these environments but in each case domoic acid, a comparatively weak iron and copper chelator, enhanced diatom growth more than iron additions alone. Domoic acid, a neurotoxin produced by Pseudo-nitzschia, has been measured in these coastal and offshore waters and its production and release can be attributed to both Fe and Cu limitation. Our findings indicate that dissolved DA may help alleviate metal stress in Pseudo-nitzschia and other phytoplankton, as might other weaker metal chelators. These findings demonstrate how continuous cultures can provide novel insights to the bottom-up control of phytoplankton community trajectories in these iron-limited systems.

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WARMING OF THE WEST SPITSBERGEN CURRENT AND SEA ICE EXTENTION NORTH OF SVALBARD

Extensive warming of the Atlantic Water (AW) layer in the Fram Strait has been observed since 2003. During summers 2004-2006 isotherm 5°C at 100 m has moved meridionally 4.5° northward. In summer 2006 temperature of AW core reached record-high values. Observations revealed large positive heat anomalies carrying northward heat surplus enough to melt 130,000 square km of 1 m thick ice sheet. It coincided with extensive northward shifting of the Barents Ice Edge. For long time the area was warmer and it was the main source of the Arctic Ocean ice-shrinking. Only recently influence of the ocean and its heat transport is more and more recognized as very important factor influencing changing of sea ice coverage. The IOPAS data on the West Spitsbergen Current temperature, heat content and transport are confronted with the sea ice extension north of Svalbard. Good agreement between the AW layer heat anomaly in July and sea ice extent north of Svalbard in next winter is presented. In summer 2007 the AW layer temperature has decreased, probably it could be the beginning of reversing trend in the AW temperature.

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AN OBSERVATIONAL STUDY OF THE RELATIVE IMPORTANCE OF WIND AND TOPOGRAPHIC FORCING ON OCEANIC EDDY SHEDDING BY TALL DEEP WATER ISLANDS (GRAN CANARIA).

In a recent numerical study (Jiménez et al., Ocean Modelling, accepted, September 2007) we have investigated the relative importance of wind and topographic forcing on oceanic eddy shedding by tall deep water islands. The main conclusion is that the wind shear at the island wake (topographic forcing) enhances eddy production by lowering the threshold of ocean incident flow speed (topographic forcing) required to shed eddies. Presently we are analyzing observational data to get evidences of this conclusion for Gran Canaria Island eddies. Eddies generation and shedding frequency was obtained from SST images and temperature anomalies of a two year mooring placed on the track of cyclonic eddies. Topographic forcing was inferred from the incident oceanic geostrophic flow calculated from altimeter and tide gauge data. Wind forcing (shear), was inferred form two meteorological stations, one located in the wind accelerating part of the island, and other at the island wake. Although we are still analyzing these data, preliminary results suggest that the main mechanism for eddies generation is the topographic forcing.

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QUANTITATIVE RELATIONSHIPS BETWEEN ZOOPLANKTON VERTICAL DISTRIBUTION AND OXYCLINE DEPTH: COMPARISONS BETWEEN REGIONS, SIZE CLASSES, AND TIME OF DAY

We developed metrics to quantitatively assess the effect of hypoxic (<2 mg ml⁻¹) bottom water on pelagic zooplankton vertical distributions. Data were collected in the northern Gulf of Mexico and the Chesapeake Bay on four summer cruises in each location. We used an Optical Plankton Counter mounted on a Scanfish to collect zooplankton and phytoplankton simultaneously along transects in each region that were subdivided into eight size classes ranging from 250 μm – 5 mm equivalent spherical diameter. The slope of the relationship between zooplankton median depth and the oxycline depth was positive for nearly all cases, and increased with increasing zooplankton size. In addition, die changes in vertical zooplankton distribution varied between size classes and regions, and not die vertical migration was observed for larger size classes at certain times. Increasing hypoxia decreases the available habitat for pelagic mesozooplankton, which can alter trophic dynamics in systems experiencing hypoxia.

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A COMPREHENSIVE COASTAL SURGE, INUNDATION AND FLOOD MODEL WARNING SYSTEM ARCHITECTURE

The Coastal and Inland Flood Warning System is presented. The model architecture is designed for the development and transition to operations of new river, estuary and coastal flood-forecast capabilities and products coupled with improved prediction of water quality and eutrophication. The Coastal and Inland Flood Warning System (CIFWS) model architecture captures and combines the most recent advances in modeling coastal, estuarine, and watershed zones utilizing state-of-the-art modeling systems and simulation infrastructure for real-time flood-forecast capabilities and products coupled with improved prediction of water quality. CIFWS is designed for the development and transition to operations of new river, estuary and coastal flood-forecast capabilities and products coupled with improved prediction of water quality and eutrophication.

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DEVELOPING TERRESTRIAL-LIDAR-BASED DIGITAL ELEVATION MODELS FOR MONITORING BEACH NOURISHMENT PERFORMANCE

Since the completion of a 398,000 m³ nourishment project along 2 km of Rehoboth Beach, Delaware in August of 2005, the subaerial volume and area of the northern 25% of the beach has been monitored through the use of terrestrial light detection and ranging (LIDAR) surveys. Traditionally, analyses of beach width from aerial imagery and volumes estimated from widely spaced profiles have been used to measure nourishment performance and determine renourishment quantities. However, these survey methods lack the spatial and temporal resolution often required for management decisions. This study investigates a method of monitoring beach nourishment performance using terrestrial LIDAR, which allows for high-temporal and spatial resolution models of subaerial beach topography on a monthly basis. Analyses of the digital elevation models created: 1) allow for a better understanding of the range in variation in beach area and volume, especially that due to storm events; 2) provide more accurate volume estimates than traditional profile surveys by as much as 8%, and 3) indicate that the area and volume do not covary, limiting the usefulness of aerial imagery in estimating volume.

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PARTICLE DYNAMICS AND BIOGEOCHEMISTRY OF THE GULF OF MAINE BENTHIC NEPHELOID LAYER

Considerable evidence indicates that the benthic nepheloid layer (BNL) is a distinctive and critical component of the coastal ocean, with major role in influencing the character of the dense flow. A comparison is made between the canyon outflow and the resulting downstream boundary current.

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extends 30-10 m above the bottom and is a pervasive feature throughout the region. Tidal mixing and the water inflow are at their highest levels and can be used to estimate the salinity and lateral movement. Elevated concentrations of total particulates, enhanced oxygen consumption levels, extracellular enzyme activity, and greater biota abundance are associated with the BNL as compared to overlying, relatively particle-free waters. Geochemical data from time-series sediment trap studies and optical measurements indicate that more organic- rich BNL particulate material, as well as previously associated, and as well as a temporal relationship between suspended particle composition and dissolved oxygen conditions. Trap results document enhanced labile particle delivery to the BNL during seasonal phytoplankton blooms, a diverse community of BNL zooplankton consumers, and the importance of time-varying BNL resuspension fluxes to the transport and fate of toxic dinoflagellate cysts throughout the Gulf.

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DISTRIBUTION, EGG PRODUCTION AND GROWTH OF EUPHASIAWDS IN THE VICINITY OF THE PРИБОЛ ISLANDS AND ON THE MIDDLE SHELF, SOUTHEASTERN BERING SEA

Distribution, egg production and growth of euphausiids near the Pribilof Islands and on the middle shelf of the Bering Sea were studied during August 2004. Thysanoessa longipes was abundant in the oceanic water, aggregations of T. inermis were observed both in the oceanic shelf water and shelf water, while T. raschii was found near the islands. Euphausiabundance es on the middle shelf were several orders of magnitude lower than in the cold summer of 1999. Juvenile T. inermis showed intensive growth (~8 % of dry body weight/day). In contrast, the somatic growth of T. inermis and T. raschii was slow (<1.5% of body weight/day) suggesting the investment of resources into lipid deposition and reproduction. Egg release corresponded to ~11% of female dry body weight/day for T. raschii indicating that enough resources were available for the animals to maintain reproductive activity. Our data suggest that the region near the Pribilof Islands, known for its high biological productivity, may provide a refuge for the shelf euphausiid population during warmer summers, when conditions on the shelf are unfavorable for their growth and reproduction.

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RESILIENCE AND RECOVERY OF LAKE PONCHTRAIN AFTER HURRICANE KATRINA

Floodwaters pumped into Lake Pontchartrain following Hurricane Katrina contained toxic chemicals, carcinogens, pathogens, and human waste as well as high nutrient concentrations. The rate of loading of these contaminants presented a unique opportunity to describe ecosystem responses to this catastrophic event. Changes in phytoplankton community composition was used as a sensitive bioindicator for quantifying shifts in ecosyst em structure. Water samples were collected weekly from 15 September to 15 December 2006 at several stations in Lake Pontchartrain. Photopigment concentrations and algal standing stocks were determined by HPLC and ChemTAX. Phytoplankton community structure. Water samples were collected weekly from 15 September to 15 December 2006 at several stations in Lake Pontchartrain. Photopigment concentrations and algal standing stocks were determined by HPLC and ChemTAX. Phytoplankton community structure. Water samples were collected weekly from 15 September to 15 December 2006 at several stations in Lake Pontchartrain. Photopigment concentrations and algal standing stocks were determined by HPLC and ChemTAX. Phytoplankton community structure. Water samples were collected weekly from 15 September to 15 December 2006 at several stations in Lake Pontchartrain. Photopigment concentrations and algal standing stocks were determined by HPLC and ChemTAX. Phytoplankton community structure. Water samples were collected weekly from 15 September to 15 December 2006 at several stations in Lake Pontchartrain. Photopigment concentrations and algal standing stocks were determined by HPLC and ChemTAX. Phytoplankton community structure. Water samples were collected weekly from 15 September to 15 December 2006 at several stations in Lake Pontchartrain. Photopigment concentrations and algal standing stocks were determined by HPLC and ChemTAX. Phytoplankton community structure. Water samples were collected weekly from 15 September to 15 December 2006 at several stations in Lake Pontchartrain. Photopigment concentrations and algal standing stocks were determined by HPLC and ChemTAX. Phytoplankton community structure. Water samples were collected weekly from 15 September to 15 December 2006 at several stations in Lake Pontchartrain. Photopigment concentrations and algal standing stocks were determined by HPLC and ChemTAX. Phytoplankton community structure. Water samples were collected weekly from 15 September to 15 December 2006 at several stations in Lake Pontchartrain. Photopigment concentrations and algal standing stocks were determined by HPLC and ChemTAX. Phytoplankton community structure. Water samples were collected weekly from 15 September to 15 December 2006 at several stations in Lake Pontchartrain. Photopigment concentrations and algal standing stocks were determined by HPLC and ChemTAX. Phytoplankton community structure. Water samples were collected weekly from 15 September to 15 December 2006 at several stations in Lake Pontchartrain. Photopigment concentrations and algal standing stocks were determined by HPLC and ChemTAX. Phytoplankton community structure. Water samples were collected weekly from 15 September to 15 December 2006 at several stations in Lake Pontchartrain. Photopigment concentrations and algal standing stocks were determined by HPLC and ChemTAX. Phytoplankton community structure. Water samples were collected weekly from 15 September to 15 December 2006 at several stations in Lake Pontchartrain. Photopigment concentrations and algal standing stocks were determined by HPLC and ChemTAX. Phytoplankton community structure. Water samples were collected weekly from 15 September to 15 December 2006 at several stations in Lake Pon...
their periplasm and feeding on degraded macromolecules. The Nudix hydrodrolases catalyze the hydrolysis of a nucleoside diphosphate linked to different moieties, X (NUDIX). They have in common the signature sequence GXSEX/REUXEXXGU. The phenotypes associated are diverse, e.g. GdPTases are involved in preventing mutations by removing damaged nucleotides (MutT). The BALOs are mainly represented by two groups which genome were recently sequenced, Bdeilovibrio bacteriovorus HD100 (freshwater) and Bacteriovorax marinus SJ (salwater). Sequence analysis shows that the HD100 genome has five ORF with the nudix consensus sequence and HDS contains three. The objective of this work is to identify which of the nudix hydrodrolases in the BALOs present the MutT phenotype. To test the MutT activity, a complementation assay was performed using a hydrolytic enzyme gene cloned in the plasmid pT3909A. Escherichia coli MutT was transformed and plated in media supplemented with streptomycin and nalidixic acid, to check for mutations. Further enzymatic analysis will be performed to complete the characterization.

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EVALUATION OF QUIKSCAT ULTRA-HIGH RESOLUTION WIND RETRIEVAL IN THE GULF OF MAINE

The QuikSCAT scatterometer is widely used to retrieve ocean winds at 25 km and now 12.5 km resolution. Currently, a 2.5 km resolution product is also being created. These higher resolution wind field estimates offer the potential to resolve physical processes that the lower resolution fields do not. This study investigates this ultra high resolution (UHR) QuikSCAT product in the Gulf of Maine for the month of October 2006, using in situ measurements from the large network of buoys in the gulf. The comparison of UHR and collocated buoy winds indicates interesting trends regarding near-shore wind retrieval, spatial cross-swath differences, and the UHR winds are evaluated both with and without a land contamination compensation routine. Comparison with mesoscale meteorological model winds and other types of satellite data, including the lower resolution QuikSCAT products, Envisat ASAR imagery, and MODIS data allow further insights into physical processes that may be resolved within the UHR wind fields. This research has potential industrial, commercial and climate-related applications.

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MOLECULAR APPROACHES FOR CATEGORIZING MARINE BIODIVERSITY OF CORAL REEFS

Although they represent less than 0.2% of the ocean area, coral reefs may be the most diverse of all marine ecosystems. However, we don’t know to even the nearest order of magnitude how many species are associated with coral reef ecosystems. The only two published estimates are based on extrapolations from rainforest and aquarium diversity measurements. Coral reefs are also among the most threatened of all ecosystems. Unfortunately we lack the taxonomic expertise and the time needed to characterize this diversity, as well as the extent of biodiversity loss related to human impacts, using traditional methods. However, the revolution in molecular genetics dramatically changes the potential for reef scientists to make progress in this area. Molecular techniques appear particularly useful for groups less well-characterized for which taxonomic expertise is very shallow (especially small organisms). In this study, we employed a DNA barcode approach to standardized samples of marine invertebrates in Moorea (French Polynesia) and the Line Islands to assess biodiversity associated with coral reefs. Our results provide meaningful comparisons between different regions.

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REANALYSIS OF OCEANIC REMINERALIZATION STOICHIOMETRY BY SIMULATED ANNEALING APPLIED IN A WATER MASS ANALYSIS FRAMEWORK

We use the tool of water mass analysis together with a global non-linear optimization algorithm to investigate the spatial distribution and variability of remineralization ratios in the ocean. We apply the simulated annealing scheme to the GLODAP data set and compute the remineralization stoichiometry and the mixing fractions of the water masses contributing to each sample for each sample individually. Our results support previous claims that the C:N:P stoichiometry is constant below 2000m, with proposed values of 106:7:14 ± 11. We observe positive deviation from the Redfield values in the Mode and Intermediate waters, however. Although some of this variability may be associated with preformed definition issues, we curtail rule out the influence DOM remineralization or unresolved mixing processes. We propose a deep S:N:P of 9 below 4000m and 5 in the upper 2000m and a C:O:P that increases with depth from 140 at 2000m to 180 below 3000m. Although our results represent path-integrated remineralization signals, they may be useful for model diagnostics as they are sensitive to the circulation and the remineralization history of water parcels.

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DISTRIBUTION OF BIOACTIVE TRACE METALS IN LARGE PARTICLES (>53μM) AROUND THE CROZET ISLANDS, SOUTHERN OCEAN

CROZEX is a large multidisciplinary study performed during the austral summers 2004-2005 and 2005-2006 in order to examine the effect of natural iron fertilization on carbon sequestration. Large particles (>53μm) that were sinking out of the mixed layer were collected at 20 stations around the islands using in situ pumps (Challenger Oceans). The particles were categorized into several discrete biomass metal traces (AlMn, FeCu, and Zn) in a variety of biogeochemical environments. Systems were deployed around the Crozet Islands. A two step sequential leaching technique has been applied on each particulate sample to distinguish the labile fraction from the more refractory fraction. The distribution of bioactive metals in both phases will be presented. There is a very strong correlation between POC concentrations for some of these bioactive metals. The differences between the sites under the influence of the islands, and the true HNLC sites will be as well investigated revealing a greater concentration of all elements at close proximity of the islands, consistent with the

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NEW TECHNIQUES FOR LOW LEVEL AMMONIUM MEASUREMENTS IN THE OLIGOTROPHIC OCEAN

Much of the productivity in the oligotrophic ocean is fueled by ammonium. Despite this fact analysis is difficult at nanomolar concentrations. Using a gas diffusion technique coupled with conductometric detection we were able to measure ammonium down to 5 nM during a transect from Monterey Bay, California to an oligotrophic site 800 km to the west in July of 2007. Discrete samples from CTD casts were measured using a bench top system with a detection limit of 5 nM. In addition a drifter was released with an in situ autonomous ammonium analyzer which measured surface ammonium concentrations every 30 minutes for four days with a detection limit of 10 nM. Surface concentrations were at or near detection limits while profiles exhibited a distinct subsurface peak coincident with the chlorophyll maximum.

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BAYESIAN-PREDICTION APPROACH APPLIED TO COASTAL MORPHODYNAMICS

The processes that drive coastal evolution (i.e., morphodynamics) are extremely sensitive to small changes in bathymetry and topography. This is particularly true for barrier island response to large storms. In this case, key morphodynamic variables include dune height, dune width, beach slope, inlet widths and inlet depths. Even if we had perfect models for predicting flows due to waves and winds and correspondingly perfect models for predicting response to large storms. In this case, key morphodynamic variables include dune height, dune width, beach slope, inlet widths and inlet depths. Even if we had perfect models for predicting flows due to waves and winds and correspondingly perfect models for predicting response to large storms. In this case, key morphodynamic variables include dune height, dune width, beach slope, inlet widths and inlet depths. Even if we had perfect models for predicting flows due to waves and winds and correspondingly perfect models for predicting response to large storms. In this case, key morphodynamic variables include dune height, dune width, beach slope, inlet widths and inlet depths. Even if we had perfect models for predicting flows due to waves and winds and correspondingly perfect models for predicting response to large storms. In this case, key morphodynamic variables include dune height, dune width, beach slope, inlet widths and inlet depths. Even if we had perfect models for predicting flows due to waves and winds and correspondingly perfect models for predicting response to large storms. In this case, key morphodynamic variables include dune height, dune width, beach slope, inlet widths and inlet depths. Even if we had perfect models for predicting flows due to waves and winds and correspondingly perfect models for predicting response to large storms. In this case, key morphodynamic variables include dune height, dune width, beach slope, inlet widths and inlet depths.
tends to lead to CO₂ outgassing nearshore and biologically-driven CO₂ uptake offshore. Yet, the net air-sea CO₂ balance of EBCs remains unresolved. High nearshore productivity coupled with filamentous and other meso- and submesoscale phenomena cause a substantial lateral export of organic carbon. We investigate these coastal processes in the California Current (CalCCS) and the Canary Current Systems (CanCCS), on the basis of the eddy-resolving, physical-biogeochemical model ROMS. First results confirm the onshore-offshore trends in the air-sea fluxes, with substantial spatial and temporal differences due to topography, upwelling strength, and eddy activity. The CalCCS is modeled to be a very small source of CO₂ to the atmosphere, consistent with a recent data-based estimate by Chavez and Takahashi, while for the CanCCS this is not clear yet. Regarding offshore transport, the CalCCS appears to be stronger than the CanCCS. Further analyses of the processes that determine the carbon fluxes and the differences between the two systems will be presented.

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The Coastal and Global Scale Nodes of the Ocean Observatories Initiative

The National Science Foundation is presently implementing the Ocean Observatories Initiative (OOI), an outgrowth of several years of community-wide scientific planning efforts. The OOI will use advanced technology and integrated cyberinfrastructure (CI) to provide, the research and education communities with a new, interactive view of the oceans and offer innovative approaches to the examination and discovery of oceanic processes. The Coastal and Global Scale Nodes (CGSN) of the OOI Network include a coastal Pioneer Array in the Middle Atlantic Bight, a coastal Endurance Array in the Pacific Northwest, open-ocean sites at high latitude in the Atlantic and Pacific Oceans, and a mid-latitude Atlantic site. The CGSN will be integrated with the Regional Scale Node and CI component of the OOI. The science drivers for the CGSN have been evaluated by a variety of community panels and committees, and the CGSN design has been under continuous review and refinement since the publicly vetted Conceptual Network Design of March 2007. This presentation will describe the CGSN science priorities and summarize the current status of the CGSN network design.

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LIGHT AND PHOTOSYNTHESIS OF PHYTOPLANKTON IN KUWAIT WATERS

The annual variability of the photosynthetic parameters by phytoplankton studied in the waters of Kuwait, northwestern Arabian Gulf. Waters in that part of the Arabian Gulf strongly vary in underwater light climate and seasonal changes in light availability also considerable. Turbidity changes from the highly turbid and productive northern waters off Bubiyan Island to the clearer southern offshore waters. Therefore, primary productivity is highly variable in space and time, due to the complex physical and chemical conditions, which vary seasonally in this arid climate. Estimations of the main physiological parameters were evaluated in a two-year study, using a PI incubators and C-14 technique, to identify periodic patterns and their causes. Correlation of physiological parameters of the phytoplankton with temperature, solar irradiance, and underwater light indicate significant differences along turbidity gradient. The results of the measurements and the quantitative regularities obtained rather correctly represent the spatial distribution of the photosynthetic and bio-optical characteristics in the waters of Kuwait.

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GLOBAL TEMPORAL TRENDS IN THE QUIKSCAT WIND VECTOR AND IN THE AMPLITUDE OF ITS VARIABILITY

In situ observations, numerical models, and satellite altimeter data agree that the global sea level has increased in the past 14 years. This increase can be of eustatic or steric origin, and the latter can be separated into halosteric and thermosteric components. Thermosteric changes in sea level imply that the heat content of the ocean has changed and thus there may be significant changes in the amount of heat exchanged with the atmosphere. Momentum transfer depends on the stability of the planetary boundary layer. The heat exchange that takes place at the sea surface creates convective turbulence, and therefore has a potential impact on the momentum transfer between air and water. Scatterometer measurements are based on Bragg scattering by capillary--gravity waves which is empirically associated with the wind through its stress. This makes the satellite scatterometer particularly well suited to detect changes in the global rate of momentum transfer through the air-sea interface. The rates of change are estimated for the wind magnitude and direction and for its derivatives: divergence and curl. In addition, if more energy enters the ocean--atmosphere system, an increase in wind variance is expected. This study aims to quantify the changes in the amplitude of this variability associated to large and meso--scale dynamics.
ANAEORIC DEGRADATION OF ORGANIC MATTER IN AN INTERTIDAL SEDIMENT HARNESSING NATURAL C ISOTOPES TO UNDERSTAND ORGANIC MATTER TRANSFORMATIONS

Coastal and continental margin sediments supply dissolved organic carbon (DOC) to the overlying water at rates similar to riverine DOC fluxes. The biogeochemical role of benthic DOC flux in the marine C-cycle is nonetheless unclear, because porewater DOC remains one of the least chemically resolved pools of organic carbon. To better understand the nature of DOC that accumulates in marine sediments, an intertidal sediment was incubated in sealed vessels for three months during which the concentrations of porewater dissolved inorganic carbon (DIC) and DOC were monitored. By further determining the Δ13C and δ18O signatures of these pools, the goal is to determine the isotopic signature of the fraction of particulate OC (POC) that extends earlier steady solutions. After non-dimensionalisation and assuming the forcing to be time periodic, the solution depends on the topography, the horizontal distribution of the wind stress, the ratio of the oscillating viscous boundary layer thickness to the characteristic times for eddies that are shed are long compared to tidal timescales.

UNDERSTANDING ACOUSTIC WAVE SAMPLING IN THE NEARSHORE: ADVANTAGES AND LIMITATIONS

Recent addition of acoustic surface detection techniques to Doppler current profilers makes it an attractive option for measuring wave field in the near shore. Acoustic surface detection (ASD) works in a similar way to a common echo sounder and was in use since mid 1980 for measuring surface and internal waves. ASD requires that there is a sharp contrast between reflectors, which can be from the water and the surface in order to reliably detect surface. Hence, AWS method does not fare well in the presence of acoustic reflectors such as seaweed and bubbles, due to breaking waves that are commonly found in the nearshore environment. We describe field test results conducted off of the Scripps Pier, under varying wave conditions. Our data show that acoustic wave detection works fairly well (97.5% detection success rate) in the absence of breaking waves and moderate wave conditions (Hs<2m). However, its performance rapidly deteriorates as waves grow in strength and breaking starts to dominate wave dynamics. Potential augmentation techniques are discussed aimed at improving reliability of acoustic wave measurements in the near shore.

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riRNA-derived. Taxonomic binning of the sequences showed a dominance of genes expressed by Proteobacteria and Cyanobacteria. Expressed gene bins representing several taxa of heterotrophic bacteria including the Roseobacter and SAR11 groups indicated a significant representation of predicted highly expressed genes, as identified by genomic analysis of cultured relatives, in the metatranscriptomic libraries. Statistical comparisons of the day vs. night libraries revealed differences in relative representation of COGs and KEGG pathways, reflecting the conditions at the time of sampling. Our results demonstrate the application of environmental metatranscriptomics to the examination of dominant and differential gene expression in marine microbial communities.

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CAN FISH FARMING CHANGE MICROPLANKTON COMMUNITY COMPOSITION?

Eutrophication involves increased growth of aquatic primary producers leading to an undesirable disturbance to the balance of organisms. Eutrophication can be induced by sewage discharge of fish, which is increasing in fjords in northern and southern hemispheres. We have made a physical-biological model to simulate the impact of fish farmers on microalgae plankton plus pelagic microphytoplankton and sealochs, aiming to find a safe limit to the lochs’ capacities to assimilate farm waste. The model simulated seasonal cycles during 1975 and 2003 in loch Cりaran (western Scotland). In 1975, prior to fish-farming, Loch Cりaran had low nutrient levels but a long growth season with high chlorophyll and a diatom-dominated phytoplankton. In 2003 a salmon farm was added significant N and P to the loch, but maximum chlorophyll was lower than in 1975 and the growth season was shorter. The explanation seems to be a shift from diatoms to flagellate dominance greater than expected from the shift in the N:Si ratio. We used our model to test hypotheses about the possible causes of this change.

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PROCESSING HIGH FREQUENCY RADAR SPECTRA IN THE PRESENCE OF SEA ICE

During the open water seasons of 2005 and 2006, the University of Alaska Fairbanks deployed two High Frequency (HF) Radar systems manufactured by CODAR Ocean Sensors on the Prudhoe Bay Oil Fields in Alaska. These systems monitored the nearshore Beaufort Sea and were able to have their frequency switched remotely. During the spring breakup season, while the ice was nearshore, the system ran at 25 MHz, and as the ice moved further offshore the frequency was switched to 13 MHz. One of the goals of this deployment was to see how well the HF Radar worked in varying ice conditions. This was challenging because the presence of ice causes the normally single first-order peak to be split into multiple first-order peaks. Having multiple valid peaks means that the first-order line settings need to be optimized depending on environmental conditions (i.e. whether there is enough fetch and/or wind for second order echo to be present). Results and examples of this optimization as well as surface current data from the field seasons will be presented.

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ANALYSIS OF DIURNAL VARIATION WITH THE GHRST HIGH RESOLUTION DIAGNOSTIC DATA SET

The GODAE High Resolution Sea Surface Temperature Pilot Project (GHRST-P) has commissioned the construction of a High Resolution Diagnostic Data Set (HR-DDS) in order to better understand the variability in SST data sets from satellite, model and in situ observations and analyses. The HR-DDS system is an interactive web based framework intended for user-defined real time analysis of multiple data sets, in the form of high resolution regional subsets and analyses. The HR-DDS system is an interactive web based framework intended for user-defined real time analysis of multiple data sets, in the form of high resolution regional subsets and analyses. The HR-DDS system is an interactive web based framework intended for user-defined real time analysis of multiple data sets, in the form of high resolution regional subsets and analyses.

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AN EVALUATION OF VIABILITY ASSAYS USING A CONTINUOUS IMAGING PARTICLE ANALYZER (FLOWCAM®) FOR BALLAST WATER ANALYSIS AND REGULATORY COMPLIANCE.

A major source of invasive species in aquatic environments is ballast water discharge from vessels as they travel from port to port. A Ballast Water Convention has been adopted by the International Maritime Organization that will require vessels to treat discharged ballast water limiting the number of viable organisms from entering the environment. The FlowCAM is an instrument used for rapid plankton detection and analysis, with the ability to detect auto-fluorescence (chlorophyll) or stain-induced fluorescence in organisms. The fluorescence is used as a “trigger” for a camera to capture images of target organisms within a sample. The FlowCAM adds a unique capability to the ballast water monitoring process by using different stains to determine the viability of organisms in ballast water. Compared to traditional microscopic methods which are laborious and plagued by operator error, the value of FlowCAM lies in the feedback the user receives with regard to viability. We present results of different viability assays using the FlowCAM, using both fluorescent and visual stains, in order to determine how effective these assays are at detecting viable organisms in ballast water.

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MODELING THE TRANSPORT PATHWAYS OF TROPICAL TEL EEL LARVAE IN INDIAN OCEAN

The potential migratory routes of tropical eel larvae in the Indian Ocean are assessed through the use of a quarter-degree global ocean model ORCA025 implemented by the DRAKAR modelling Group. The eddy-permitting model reproduces mesoscale activity and seasonal to interannual variability of main dynamic features consistently with observations. A Lagrangian model, ARIALE, recalculates off-line the pathways of anguillid leptocephalus larvae represented as passive particles. Qualitative analysis of backward and forward calculations allows us to identify a possible common spawning area for eels recruited in Islands of Mayotte, Mauritius and Reunion, which is consistent with biological information on leptocephalus migration behaviour issued from otolith microstructural analysis. However the depth of the particles strongly influences the migration pathways of eel larvae in the Mascarene region. The choice of the spawning date is also crucial, as strong variability exists in the intra-seasonal and interannual time-scales. Statistical analysis of several simulations will be presented in addition to these qualitative results to propose most robust hypothesis on spawning areas and migration depths in anguillid leptocephalus larvae.

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DATA ASSIMILATION AND REAL-TIME ENSEMBLE OCEAN FORECASTING IN THE INTRA AMERICAS SEA

Using the Regional Ocean Modeling System (ROMS), we have developed a real-time 4DVAR data assimilation system for the IntrAmericas Sea combining in situ velocity measurements from the Explorer of the Seas along with satellite surface observations (temperature and dynamic height) to generate best estimates of the ocean state for the current day. Utilizing the numerous tangent-linear solutions from the data assimilation system, we generate a set of orthonormal perturbations applied to the initial conditions to generate two-week ensemble predictions. This automated assimilation/prediction system is now running in an experimentally operational mode aboard the Explorer of the Seas. We will discuss the use of the Explorer of the Seas as a platform for real-time modeling experiments.

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AQUARIUS REEF BASE: ADVANCED UNDERSEA TECHNOLOGY NOW AND FOR THE FUTURE

The Aquarius undersea research station has evolved from the programs of the past into a state-of-the-art saturation diving facility for science along with a synchronous ocean observing test bed for technology development, and advanced communications that now allows for telepresence education and outreach events. The habitat program has expanded into Aquarius Reef Base, which is composed of the undersea lab, an ocean observing station with real-time access via the Internet, and a shorebase. Our partners, such as NASA and the Navy, have helped make advanced technologies at Aquarius Reef Base available for research, training, and education, and new collaborations with the media are providing exciting avenues for outreach. We plan to enhance and encourage the use of Aquarius Reef Base for underwater technology development, coral reef research, training, and education, and to direct our programs to support research and research needs along with management issues in the Florida Keys National Marine Sanctuary and topics of national importance, such as outlined in the nation’s Ocean Research Priorities Plan.

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The study of the ocean on scales of less than a meter is intrinsically important to understanding plankton ecology, since these are the scales at which individual organisms live, move, and perceive their environment. We have developed a bi-spectral planar laser imaging fluorometer (PLIF) system to acquire two-dimensional images of planktonic particles that scatter light or contain chlorophyll a. The 9.8 x 13 cm images have 100 µm spatial resolution, allowing us to localize individual particles. The PLIF system is mounted on an autonomous free-falling vehicle, generating profiles of images as it descends through the euphotic zone. Connecting these overlapping images, we will describe the distribution of phytoplankton on a continuous range of scales from millimeters to tens of meters. We show that the particles are randomly distributed at the smallest scales, but show persistent gradients at larger scales. The scale at which this transition occurs has important implications for the biological and physical mechanisms that drive phytoplankton distributions in the euphotic zone.

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ON THE MECHANISMS OF EPISTODIC SALINITY OUTFLOW EVENTS IN THE STRAIT OF HORMUZ

Observations in the Strait of Hormuz (56.08°E, 26.26°N) during 1997-1998 showed substantial velocity fluctuations, accompanied by episodic changes in the salinity outflow events with amplitude varying between 1 and 2 psu on time-scales of several days to a few weeks. These events are characterized by a rapid increase in salinity following by an abrupt decline. Mechanisms behind these strong pulses of salinity events are investigated in a high-resolution (~1 km) Hybrid Coordinate Ocean Model (HYCOM) with special reference to the year 2005. In accordance with the observations the simulated salinity events are characterized by strong coherence between the enhanced flows in zonal and meridional directions. We infer that most of the simulated and observed outflow variability is associated with the continuous formation of strong mesoscale cyclonic eddies; their origin can be traced upstream to around 55.5°E, 26°N. These cyclonic eddies have a diameter of about 63 km and have a remnant of Persian Gulf water (PGW) in their core, which is eroded by lateral mixing as the eddies propagate downstream at a translation speed of 4.1 cm s⁻¹. The primary process that acts to generate mesoscale cyclones results from the baroclinic instability of the exchange circulation through the Strait of Hormuz induced by fluctuations in the wind-stress forcing.

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LAGRANGIAN STUDIES OF WARMWATER PATHWAYS IN THE NORDIC SEAS

Past studies suggest that Atlantic water reaches far into the Nordic Seas along two distinct pathways: the Shetland Current (SC) which feeds the Norwegian Coastal Current (NCC) that flows north towards the Barents Sea and Svalbard, and the Norwegian Atlantic Current (which connects the Iceland-Faroe Front) which feeds the Norwegian Basin to its west and the Fram Strait in the north. Examination of 2100 depth RAPOS floats deployed in Atlantic waters south of the Icelan and the Faroes reveals comparable exchange between these two branches, specifically from the NAC to the NCC. Significantly, this exchange manifests itself all along the currents, starting already south of the Iceland-Svalbard Ridge. Five floats drift southeast of the Faroes to join the NCC via the Shetland Current. In the Norwegian Sea many floats leaked out of the NAC to join the IIF, even over the imposing topographic relief of the Voring Plateau. A total of eight of the 2100 floats entering the Nordic Seas drifted north along the expected NAC path towards Jan Mayen and the Mohn Ridge.

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CIRCULATION AND EXCHANGE IN CHOKED MARGINAL SEAS

A simple theory for circulation and exchange in a buoyancy-forced marginal sea with a narrow connection to the ocean is developed and tested numerically. Consistent with the overall heat and volume balances for the marginal sea there exists a continuous family of hydrodynamically confined states with critical flow at the most constriction section of the strait. Included in this family is a limiting ‘maximal-exchange’ solution that has the minimum temperature difference and maximum volume exchange of all possible solutions. In principle, forcing the flow beyond the limit of maximal exchange results in an ‘overmixed’ state in which no further changes in the properties of the exchange occur. The exact state of exchange for a given forcing, whether maximal or submaximal, can be predicted using a theory that assumes energy conservation over a certain path connecting the strait to the marginal sea or, in some cases, the ocean. Numerical tests of the prediction for the temperature difference and the state of exchange are described. The analytical model is an alternative to the Price and Yang (1998) model of marginal sea outflow.

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CORAL REEFS IN OAHU, HAWAII: RELATIONSHIPS AMONG WATERSHEDS, CHEMICAL POLLUTANTS, AND CORAL DISEASE

To date, only a few of the stressors and pathogens responsible for coral diseases have been identified or showed possible causes of coral diseases may be linked to freshwater input from runoff contaminated with pharmaceuticals, pesticides, metals, introduced microorganisms, and antibiotics. From surveys of 27 sites around the island of Oahu, we provide preliminary results that suggest the prevalence of coral disease is higher in enclosed bays where chemical contamination appears to be elevated. Previous studies recorded high levels of Dieldrin and Chlorodane in some bays as well. The recent preliminary studies of sediments from enclosed bays and harbors found polynuclear aromatic hydrocarbons (PAH) in concentrations ranging from 0.01-0.05 µg/g, Chlorodane (0.03 µg/g), and Irgarol (40 ng/L). Diseases were observed in Porties sp. more commonly than in Montipora sp. or Pocillopora sp. (p < 0.002). These preliminary studies will assist in understanding which pollutants are currently present at coral disease study sites, which pollutants may lead to higher levels of disease in Hawaiian corals, and if these pollutants alter biofilms and coral associated microbial communities, possibly decreasing coral settlement and recruitment.

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HYDRODYNAMICS AND THE DISPERAL OF SUBMARINE GROUNDWATER DISCHARGE IN KALOKO-HONOKOHAU NATIONAL HISTORICAL PARK, HAWAII

The impending development for the west Hawaii coastline adjacent to Kaloko-Honokohau National Historical Park (KAHO) may potentially alter coastal hydrology and water quality in the marine portion of the park and its associated 590 acres of land. SGD is a major contribution to local surface water discharge on the Hualalai mountains and can be traced upstream to around 55.5°E, 26°N. These cyclonic eddies have a diameter of about 63 km and have a remnant of Persian Gulf water (PGW) in their core, which is eroded by lateral mixing as the eddies propagate downstream at a translation speed of 4.1 cm s⁻¹. The primary process that acts to generate mesoscale cyclones results from the baroclinic instability of the exchange circulation through the Strait of Hormuz induced by fluctuations in the wind-stress forcing.

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ZOOPLANKTON GRAZING ON TWO ECOLOGICALLY IMPORTANT HARMFUL ALGAL SPECIES IN THE CHESAPEAKE BAY

Dinoflagellates Prorocentrum minimum and Karlodinium venicicum are two harmful algal bloom species (HABs) of increasing importance in the Chesapeake Bay, yet little is known about the grazers that can control their recurring blooms. We investigated the grazing rates on two non-bloom and bloom concentrations of these two HABs by various zooplankton including the copepod Acartia tonsa, and two heterotrophic dinoflagellates - Oxyrrhis marina and Gymnodinium dominans. All zooplankton had 5-33 times higher ingestion rates when fed bloom concentrations of the HABs compared to non-bloom concentrations. Heterotrophic dinoflagellates had the highest weight-specific ingestion rates on P. minimum, averaging 0.4 (non-bloom) and 8.9 (bloom) µgC prey/µgC predator/day compared to copepods (0.4 and 2.3, respectively). While K. venicicum was ingested by A. tonsa (0.3 and 1.2 µgC prey/µgC predator/day), this species was not ingested by the heterotrophic dinoflagellates, and grazer mortality occurred. These results suggest that copepods can easily ingest these two harmful algal species and are likely important in controlling these blooms. However, protozoan grazer-HAB dynamics are more complex, suggesting heterotrophic microzooplankton may be differently affected by various harmful species.

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GROUNDWATER INPUTS OF NUTRIENTS TO COASTAL ZONES OF SOUTH FLORIDA

Coastal areas are often regions of fresh and brackish groundwater discharge. This groundwater discharge may be important for not only the delivery of water but also nutrients to coastal areas. Along the coastlines of Everglades National Park, seawater intrudes into the underlying unconfined aquifer as far inland as 6 to 28 km of the coastline. This results in brackish groundwater to discharge to the overlying freshwater of the Everglades. Elevated concentrations of phosphorus in the brackish groundwater represent a previously
The Rhône River is the major source of freshwater and terrigenous material to the PRODELTA (GULF OF LYONS, FRANCE). Origin and quality of sedimentary organic matter in the Rhone River were collected in the river mouth and the distal region. The origin and quality of sedimentary organic matter (OM) were assessed using biochemical properties (pigments, fatty acids, total amino acids and bioavailable amino acids...). These biomarkers indicate a strong terrestrial signature in the surface sediments from the river mouth. Despite a marked offshore decrease of the river inputs, biochemical signatures of terrigenous OM were also present in surface sediments of the distal sites. The downcore profiles confirmed the rapid mixing and/or burial of terrestrial OM inputs in the sediment. The quality of the OM river inputs for the benthic fauna will be discussed.

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GENETIC SIGNATURE OF THE SPATIAL SCALE OF DISPERSAL MEDIATED BY CORAL REEF FISH LARVAE.

The assessment of marine dispersal is a notoriously challenging task, owing notably to the difficulty to track dispersing larvae directly. Genetic isolation by distance (IBD) is the indirect signature of localized dispersal by excellence, yet population genetics theory shows that IBD provides limited information on the scale of dispersal with an additional estimate of density over the area where IBD is detected. Here, we use the barred hamlet (Hypoplectrus pella, Serraniidae) as a model species to assess the scale of dispersal in coral reef fishes. Ten hypervariable DNA markers analysed on 854 fish from 15 locations show that IBD emerges at a scale of 200 km and is maintained until the regional scale despite lower levels of genetic structure overall. Furthermore, we provide population density estimates from both genetic data and SCUBA surveys, allowing an estimation of mean squared parent-offspring axial dispersal distance. Our results, complemented with individual-based simulations, indicate that coral reef fish larvae tend to disperse within tens of kilometres or less, and that this pattern is compatible with low levels of genetic structure over thousands of kilometres.

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INTRASEASONAL FLOW IN MAKASSAR STRAIT.

Makassar Strait is the primary path for Pacific water to enter the Indian Ocean as part of the Indonesian Throughflow. Intraseasonal variability (<90 days) are energetic features within the Makassar throughflow. Here we investigate the nature of the intraseasonal variability by analysis of along-channel currents observed near 3°S within Makassar Strait and at its northern boundary with the Sulawesi Sea. We find that the dominant 50-day variability within Makassar Strait is ampliﬁed at all depths relative to the upstream location at the southern entrance to the Strait. The first two EOFs indicate transition of the thermal structure at the southern entrance to the Strait, with a depth-dependent structure that is due to contour-following mixing and/or intrusions from the Sulawesi Sea. The second EOF indicates transition of the thermocline followed by the more complex flow regime in downstream marked by a depth dependent phase shift. Baroclinic events of the Sulawesi Sea are thought to be the forcing of 50-day oscillation within thermocline layer while the deep layer variability is related to the topographically controlled subflow flow.

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AIR-SEA DYNAMICS DURING THE PHILIPPINES MONSOON.

During the summer and winter of 2007 a comprehensive suite of ONR-sponsored observations focused on the dynamics of straits was deployed in the Philippines region. Measurement platforms included moorings, gliders and drifters. Our companion high resolution coupled ocean-atmosphere simulations focus on concentrating the summer and winter monsoon conditions and the associated circulations in the ocean. In particular, intense wind jets during the winter monsoon drive a field of coastal eddies that migrate offshore and reform in the lee of islands. The signature of these eddies is evident in the intraseasonal variability by analysis of along-channel currents observed near 3°S within Makassar Strait and at its northern boundary with the Sulawesi Sea. We find that the dominant 50-day variability within Makassar Strait is amplified at all depths relative to the upstream location at the southern entrance to the Strait. The first two EOFs indicate transition of the thermal profile from the thermocline intensified flow toward the more complex flow regime in downstream marked by a depth dependent phase shift. Baroclinic events of the Sulawesi Sea are thought to be the forcing of 50-day oscillation within thermocline layer while the deep layer variability is related to the topographically controlled subflow flow.

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ADAPTIVE WATER SAMPLING FROM AN AUTONOMOUS UNDERWATER VEHICLE BASED ON UNSUPERVISED CLUSTERING.

Autonomous Underwater Vehicles are widely used for oceanographic surveys, during which data is collected from a multiple sensors. At MBARI we have developed a water sampler for our AUVs, called the Gulper, that can acquire and return samples for laboratory analysis triggered based on sensors detecting features of interest. For example, scientists interested in studying the mobilization and transport of shelf sediments would like to detect intercalibrating nepheloid layers. To do so we must extract a model that can identify the feature in-situ since we are generally dealing with multiple sensor data. We propose to use unsupervised clustering techniques from Machine Learning to extract features from past missions that will then be used for onboard classification to automatically trigger the
RATES OF PRIMARY PRODUCTION IN THE OCEAN: A COMPARISON OF TRADITIONAL IN-VITRO AND NEW IN-SITU METHODS

The rate of primary production (PP) at the ALOHA time-series station in the subtropical North Pacific has been estimated using three methods: triple isolopes of oxygen and bottle incubations using both 18O-labeled water and 14C-labeled CO2. Monthly measurements for more than a year by each method provide the opportunity to evaluate an in-situ PP method with more traditional in vitro PP methods. Monthly measurements of the dissolved oxygen as a gas ratio at ALOHA yield direct estimates of the rate of net community production to gross primary production rates and the export rate of organic carbon. We examine the monthly variability and annual means in PP at ALOHA estimated by the three methods in order to evaluate bottle versus in-situ PP estimates and compare these results to satellite-based PP estimates.

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PRIMARY PRODUCTIVITY ESTIMATES IN GULF OF MEXICO WATERS: COMPARING IN SITU METHODS (FRR, FIRE, FIRE) WITH TRADITIONAL TECHNIQUES.

In situ active fluorescence techniques provide rapid estimates of phytoplankton physiology and photosynthetic activity, and the ability to make measurements across comprehensive spatial (horizontal and vertical) and temporal scales. Fast Repetition Rate Fluorometers (FRRFs) have both light and dark chambers, a PAR sensor and are deployable. The Fluorescence Induction and Relaxation (FIRE) system can only be used as a bench-top instrument, has no PAR sensor, and may be used in continuous underway mode (dark chamber only). On two cruises in the Gulf of Mexico (May and August 2007), parallel FIRE, FRRF and traditional 14C primary productivity measurements were made across the Louisiana-Texas coastal shelf. Fv/Fm, the ratio of variable to maximum fluorescence, sigma PSI, the functional cross section of PSI and other derived photosynthesis and production parameters were compared. Most FRRF-derived values for Fv/Fm were less than 10% different from the corresponding FIRE derived Fv/Fm values. Theoretical and empirical calculations were used to characterize phytoplankton community properties in situ. These provide useful estimates of primary production that are comparable to measurements made using 14C traditional techniques.

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ECOSYSTEM KNOWLEDGE LEADS TO SOUND POLICY, OR DOES IT?

Coastal hypoxia research programs provide an ideal opportunity to explore how ecosystem research informs management decisions. Long-running studies have been conducted in the Chesapeake Bay and Long Island Sound. The studies in the Gulf of Mexico were initiated by the scientific curiosity of a few, then efforts by NOAA in a concerted peer-reviewed external research effort under NECOP (Nutrient-Enhanced Coastal Ocean Productivity). Subsequent legislation to study hypoxia and HABs (HABHRC, or Harmful Algal Blooms and Hypoxia Research and Control Act, 1998) asked for assessments of hypoxia in the Gulf of Mexico and nationwide. Competitive ecosystem research programs led us from early hypotheses concerning increased nitrogen loads in the Mississippi River (circa 1973), nutrient enrichment and Gulf of Mexico productivity, followed by nutrient over-enrichment and the potential negative effects, including hypoxia. Ecosystem research helped inform management of nutrient inputs and their mitigation, forecasting capabilities and considerations under climate change. The links among science, policy and management decisions are tempered, as always, by stakeholder interests.

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RECYCLING OF ORGANIC MATTER IN ARCTIC MARINE SEDIMENTS: INVESTIGATIONS AT THE DEEP-SEA LONG-TERM OBSERVATORY HAU/GARTEN

The past decades have seen remarkable changes in the Arctic, a key region for the global climate. Due to the lack of observations, impacts of these changes on biogeochemical cycles and Arctic marine ecosystems are largely unknown. During an expedition to the deep-sea long-term observatory HAU/GARTEN in July 2007, we investigated the biogeochemical cycling of organic matter by performing in-situ and shipboard measurements of oxygen profiles, bacterial activities, and the total sediment oxygen demand. Shipboard measurements across the continental margin showed a classical bathymetric pattern in biogeochemical recycling with overall low fluxes except for the deepest station.
(Molyo Hole, 5000 m), which concentrates deposited organic matter produced in the
HAUGAARDEN area. In-situ oxygen microprofiles were taken by a ROV-operated micro-
profile at two experimental sites at 2500 m water depth; inside/outside an in-situ flume
increasing near-bottom current and around a whale carcass deposited to study the effect
of large food-fall in the deep sea. Perturbation experiments showed interesting and partly
unexpected pattern, e.g. with the persistence of high organic matter turnover near the
whale carcass even two years after deposition.

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TRANSPORT AND DEPOSITION OF PARTICULATE MATTER AND
PARTICULATE METAL ON THE GULF OF LION SHARK SHELF: NEW FINDINGS FROM
LARGE MULTIDISCIPLINARY EXPERIMENTS

New findings were obtained during the last five years on particulate matter and particulate
heavy metal transport, deposition and export on the Gulf of Lion's continental margin
(France, Mediterranean Sea). This talk will summarize these results from several French
(PNCE, ORME) and European (REMOTRANS, EUROSTRATAFORM) programs
combining in-situ and multidisciplinary observations (sedimentology, hydrodynamic,
geochemistry) and numerical modeling. The presentation deals with: suspended particulate matter and metal
inputs by the Rhone (one of the two largest river of the Mediterranean sea) and smaller mountainous rivers, accumulation rates on the shelf, resuspension processes and fluxes
induced by trawling or natural events, export of particulate matter and metal to the contin-
ental slope. The role of eddies as primary sinks of fluvial material, and that of extreme events
-such as floods, storms and deep water cascading - on the particulate matter exchanges
between the different interfaces of this coastal system will be emphasized.

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OCEANIC SEASONAL VARIABILITY NORTH OF PAPUA NEW GUINEA: AN
INTEGRATED APPROACH

SeaWiFS chlorophyll imagery suggests that advection of nutrient- and phytoplankton-rich
waters from the west may explain the chlorophyll increase in the warm pool during the
2002 El Niño event. A potential source is from the upwelling north of Papua New Guinea.
In order to determine its structure and variability, we used multiple satellite data to infer
the response of surface chlorophyll, sea surface temperature, and sea level anomaly to sea-
sonal wind reversal. The RUMS (Regional Oceanic Modeling System) has been coupled to the
biogeochemical model PISCES (Pelagic Interaction Scheme for Carbon and Ecosystem
Studies) to assess biological processes at work and to evaluate the relative contributions
of horizontal and vertical processes. Results highlight two seasons. The surface current is
north-westward when south-east trade winds prevail and advection of nutrient-rich water
 toward the equator may enhance phytoplankton growth downstream. It reverses during the
north-east monsoon (December-March) which favors upwelling along the PNG coast and
may also result in enhanced phytoplankton in the warm pool. Additional interannual experiments are performed during the QuickSCAT period to understand such chlorophyll
variations during El Niño.

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ORIGIN AND DYNAMICS OF THERMOHALINE STAIRCASES

This study explores the dynamics of thermohaline staircases, frequently formed in the
regions of active double-diffusive convection. We separately consider two distinct, double-diffusive regimes: (i) diffusive layering, which is generally observed in high-lati-
itude regions, particularly in the Arctic and (ii) salt finger staircases, more common in the
mid-latitude oceans. In both cases, we discuss the mechanism for the formation and
maintenance of thermohaline staircases in terms of a combination of the direct numeri-
cal simulations, analytical considerations, and data analysis. It is argued that steps in the
vertical temperature and salinity profiles are caused by the parametric variation of the
heat/salt flux ratio, which leads to an instability of the equilibrium with strong stratifica-
tion. We explain the evolutionary patterns of the numerically simulated staircases by
considering the secondary instabilities of a series of identical interfaces. A simple theoreti-
cal model is developed which predicts the average step height in fully developed staircases and its dependencies on the large-scale environmental parameters. We find that the key
aspects of the theoretical model are consistent with the observations of diffusive staircases
in Beaufort Gyre and salt finger staircases in tropical Atlantic.

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ESTIMATING REAERATION RATES IN TROPICAL SALT-WEDGE ESTUARIES: A
COMPARISON OF METHODS

Estuarine metabolism studies are extremely scarce in tropical developing islands. Some
estuaries in densely populated tropical islands such as Puerto Rico are affected by sewage
discharges, most with some level of treatment. The effects of these sewage discharges on
the fluxes of oxygen and particulate organic matter are largely unknown, particularly in
the tropics. Precise measurements of reaeration rates in salt-wedge estuaries are ex-
tremely important in order to develop acceptable estimates of the estuarine metabolism.
The size of the estuary, depth, wind velocity and tidal amplitude are important factors
that control gas exchange across the air-water interface. In this work we report reaeration
rates of three salt-wedge tropical estuaries measured with the chamber method described
by Kremer (2003) and the estimation method of Caiffery (2003); an initial step in meta-
bolism studies being conducted in tropical estuaries in Puerto Rico.

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POSSIBLE HYDROCARBON-DEGRADING ENDOSYMBIONT IN
BATHYMODIOLUS HECKERAE, A MUSSEL FROM CHAPOPOTE, AN ASPHALTIC
SEEP IN THE GULF OF MEXICO

Chemosynthetic life was recently discovered at Chiaopote, in the southern Gulf of
Mexico at 3000 m water depth. At this site, lava-like flows of solidified asphalt cover a
large area that also includes oil seeps and gas hydrate deposits. In this study, molecular
methods were used to characterize the symbioses of the mussels and tubeworms col-
lected from this site. We identified one of the two mussel species found at Chiaopote as
Bathymodiolus beckeriae based on its cytochrome oxidase sequence. Using comparative
16S rDNA sequence analysis and fluorescence in situ hybridization, we found that this
host harbors the well known sulfur- and methane-oxidizing symbionts commonly found in
many other Bathymodiolus species. Unexpectedly, we discovered a novel third symbi-
ont phytoyte that is closely related to hydrocarbon degrading Cycloclastius bacterium.
The discovery of a novel symbiont that may be able to use hydrocarbons as an energy
source is particularly intriguing because until now only methane and reduced sulfur compounds
have been identified as energy sources in chemosynthetic symbioses. The large amounts of
hydrocarbons available at Chiaopote would provide these mussel symbioses with a rich
source of nutrition.

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SI-BASED RECONSTRUCTION OF THE CARBON BIOLOGICAL PUMP

Our ability to understand and predict the role of the ocean in the global carbon cycle and
its response to climate change strongly depends upon our capacity to model the function-
ing of the biological pump at the global scale. The complexity of the processes that take
place in the mesopelagic zone and the difficulties in flux measurement at these depths
complicate this capacity. Here, we combine in vitro diatoms-silica dissolution experiments
with regional budgets of Si and C fluxes to reconstruct at global scale, the efficiency of the
biological pump. We show that this efficiency increases with seasonality rather than pri-
mary production and is strongly modulated by the depth of the winter wind mixed layer.
An algorithm is applied to Longhurst's biogeochemical provinces to derive a global esti-
mate of the biological pump, therefore based on a semi-mechanistic approach. The general
applicability of such a semi-mechanistic algorithm is discussed, emphasizing the need
to understand better Si and C interactions in sinking particles, and the role of the meso-
epycic food web in modifying these interactions and the associated Si and C fluxes.
TURBULENT MIXING IN THE MIXED LAYER/THERMOCLINE TRANSITION LAYER

The oceanic mixed layer is the dynamically active boundary layer linking atmospheric forcing to the circulation of the ocean interior. By its very definition, the mixed layer is a region of intense mixing, where turbulence supplied by wind and wave energy homogenizes the vertical distributions of temperature and salinity down to depths of O(100) m. Below the mixed layer, in the upper layers of the stratified thermocline, turbulent energy levels are greatly reduced. The transition between these regions is usually marked by a take-place abruptly at the mixed-layer base. However, observations suggest that enhanced turbulence penetrates significantly into the stratified water just below the mixed layer. Here, we present an examination of turbulence data collected during 30-days of steady wind-forcing in the sub-tropical North Atlantic. These data will allow for direct estimates of diffusivity and diapycnal flux occurring in the mixed layer/thermocline transition layer. This analysis establishes statistics for turbulence dissipation levels occurring just below the mixed layer, which have not been previously documented. A preliminary analysis suggests that the transition layer often extends 30 m below the mixed layer base, and that diabatic fluxes in this region are 3 times greater than in the thermocline under normal surface forcing conditions. Exceptional forcing events, such as the passage of storms, likely lead to an even stronger enhancement of fluxes.

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BENTHIC-PELAGIC COUPLING IN THE BAY OF BREST (FRANCE): NEW INSIGHTS FROM A COUPLED PHYSICAL-BIOLOGICAL MODEL.

Functioning of the ecosystem of the Bay of Brest (France) is controlled both, by hydrodynamical processes as the bay is a macrotidal system, and by biological processes which are dominated by the activity of an invasive benthic filter feeder, a slipper limpet (Crepidula fornicata). A coupled physical-biological model is used to represent the influence of these interactions on the phytoplankton dynamics, with a focus on benthic-pelagic coupling. The selected spatial resolution allows resolving the heterogeneous density distribution of the slipper limpet in the Bay and its implication for spatial variations of benthic fluxes. This heterogeneity is not reflected in the pelagic dynamics because transport and mixing homogenize the distributions of nutrients and biomasses. Validation of the model is done on stocks and in, in an original way, on rates (benthic recycling, carbon and silicon uptake). In a prognostic scenario which forecasts the impact of removing the invasive benthic filter feeders, the silicic acid efflux at the sediment-water interface is reduced by 63% and a pronounced algal bloom of dinoflagellates, potentially harmful, develops in late summer.

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EFFECTS OF BULKHEADS ON ESTUARINE BEACH SWASH ZONE CHARACTERISTICS

Bulkheads are common structures on estuarine shorelines. These structures fragment and truncate the shoreline causing wave and swash reflection that alters swash zone dynamics and beach morphology. Topographic profiles, sediment cores, and sediment activation depth measurements were taken at two bulkhead sites and a control site 9-22 June 2007 at Fortescue, New Jersey to characterize beach changes. Video records of swash-bulkhead interactions are used to provide process explanations. Results reveal the topographic variability in front of bulkheads that occur when the wave and swash energy becomes concentrated in a narrower zone than on unobstructed beaches.

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EVOLUTION OF THE NORTH PACIFIC SUBTROPICAL MODE WATER DURING KESS

The mooring and float observations collected during the Kuroshio Extension System Study (KESS) show that the formation of Subtropical Mode Water (STMW) is a highly variable process in both space and time. Global high-resolution numerical simulations confirm that the strength of atmospheric air-sea heat fluxes are the dominant factor controlling the volume of STMW formed for a given year, but the formation is dominated by episodic events with time scales of days that can be directly related to wind storms frequently coming from the northwest. One-dimensional mixed-layer models also suggest that enhanced vertical diffusivity values in the upper ocean are necessary during the summer to fall to accurately simulate the evolution of the mixed layer depth and top of the STMW layer. Our observations elucidate the causes of this enhanced mixing and the impacts it has on the evolution of the STMW.

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SALT FLUX AND TURBULENT MIXING IN AN ESTUARY WITH STRONG TIDAL FRET AND HYPSELM BATHYMETRY AND FORCING.

Strong tidal and river forcing in the Merrimack River (MA) estuary makes conditions highly unstable at tidal timescales, and along- and across-channel bathymetric variability presents significant spatial complexity: constriction at the mouth, bedrock constraints upstream, and broad, intertidal shoals surrounding a narrow, deep channel in between. A sharp salinity front advects tidally from the coastal ocean through a series of silts and constructions, and strong stratification inhibits vertical mixing. Because of the complex bathymetry and strong salinity gradients, the Merrimack offers significant challenges for numerical modeling. We have applied the Finite Volume Coastal Ocean Model (FVCOM) to simulate conditions in the estuary, and compare model results against extensive field observations that include salinity and velocity time series and intensive hydrography. We evaluate observed and modeled estuarine salt flux mechanisms, and find that results compare favorably. We also evaluate turbulence and buoyancy fluxes in regions of intense mixing, and compare with observations from an instrument array that measures turbulence at multiple elevations above the bed. With the model, we relate local mixing measurements to integrated changes in potential energy in the estuary.

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MODELLING UNDERWATER LIGHT FIELDS IN SHELF SEAS: IMPLICATIONS FOR PRIMARY PRODUCTION MODELLING.

Absorption and scattering by dissolved and particulate materials in shelf seas influence the attenuation of light in the water column. These effects are most pronounced in coastal regions where the light available for phytoplankton absorption may be limited by the presence of sediment and coloured dissolved organic matter. Quantification of the underwater light field is therefore a key element in primary production modelling. Most existing models were devised for oceanic conditions and make simplifying assumptions about the underwater light field leading to inaccuracies in primary production calculations. Consequently a forward model has been devised for optically complex shelf seas which allows prediction of the underwater light field from constituent concentrations and specific inherent optical properties. This model was applied to the Irish Sea where an extensive data set and a regionally tuned ocean colour algorithm were available. Chlorophyll concentrations and diffuse attenuation coefficients for downward irradiance were determined from satellite measurements of water leaving radiance and an empirical relationship was established between Kd490 and euphotic depth which allowed euphotic depths to be estimated from space.

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A COMPARISON OF TAXONOMIC AND ALGAL ACTIVITY FROM THE BBE FluOROPROBE WITH DIRECT TAXONOMIC AND GAS FLUX MEASUREMENTS IN THE CANADIAN COASTAL BEAUFORT SEA

In July and August of 2007, as part of our ongoing work on the ecosystem of the Mackenzie Shelf we conducted surveys near Cape Bathurst and Herschel Island on board the CCGS Nahidik. As part of the program, continuous measurements were made at the 2 m depth using: (1) a bbe Algal Online Analyzer (ACOA) fluoroprobe; and (2) a “gas box” designed and built in our laboratory. The ACOA was used to determine total chlorophyll concentration, concentration of five algal groups, activity of these algal groups and the detection of “yellow substance” or dissolved organic matter. In the “gas box,” water was pumped through a permeable, water impermeable exchange that allows a gas-filled loop to come to equilibrium with the gases in the water. The partial pressure of these gases circulated past the various detectors: a non-dispersive IRGA for CO2, an O2 sensor, and a CH4 sensor. These data can be used for subsequent flux estimates. Material was collected for taxonomic algal identification. The results, strengths and weaknesses of using these instruments in the Beaufort Sea will be discussed.

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DETERMINATION OF INTERNAL WAVE PROPERTIES FROM X-BAND RADAR OBSERVATIONS

As part of the Nonlinear Internal Wave Initiative (NILW) a variety of instrumentation were deployed on the continental shelf offshore New Jersey in summer of 2006. The
experimental effort was aimed to understand the impact of nonlinear internal waves on acoustic propagation and scattering in shallow water. Two surface sampling V-Band radar (WaMoS) systems were installed on board the research vessels R/V Knorr and the R/V Oceania that were tracking internal waves in the area during the experiment. The R/V Knorr sampled in short-pulse mode, while the R/V Oceania sampled in medium-pulse mode. Both ships measured several internal wave events. The estimated properties from these measurements are compared to theoretical values and evidence of changes in these properties as the solitons propagate into shallower water is explored.

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SEASONAL VARIABILITY OF THE NONLINEAR INTERNAL WAVE (NLW) FIELD IN THE NORTHEASTERN SOUTH CHINA SEA

The Windsy Islands Soliton Experiment (WISE) was conducted from April 2005 - May 2006 in the northeastern South China Sea. The cross-basin transect included one mooring in the Luzon Strait, two in the deep basin, one on the continental shelf, and two on the continental shelf. CTD transects were collected on five deployment and recovery cruises to map the seasonal variability of the stratification. Sampling was conducted at 3 minute intervals or less to resolve the large-amplitude, high-frequency motions. The most striking feature of the annual time series was the complete absence of NLW motions during December - February. Individual wave packets could be traced rigorously back to specific beats of the Luzon Strait tide. Since the winter tide was as strong or stronger than the rest of the year, the lack of propagating waves is attributed to seasonal changes in the stratification at the generation sites and/or along the propagation path. There were no other obvious seasonal signals, the monthly wave amplitude variability being dominated instead by large-scale north/south advection of the northwestward-propagating wave packets imbedded in the mesoscale currents.

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ASSESSING THE INTENSITY OF A STRATIGRAPHIC SEQUENCE USING PAIRED AMS RADIACON Dates on PLANKTONIC FORAMINIFERA: DEVELOPMENT OF A HIGH-RESOLUTION CHRONOLOGY

Downslope transport is a risk in areas with high sedimentation rates such as Orca Basin. One hypothesis suggests robust tests would preferentially survive resedimentation processes and dissolution compared to more fragile species, leading to anomalous age dates [Broecker et al., 2006]. Core MD02-2550 is a 9.09n gravity core from Orca Basin, ideally suited to test this hypothesis and to record decadal meltwater pulses into the Gulf of Mexico. Anomalous bottom water prevents bioturbation, resulting in laminated sediments. AMS radiocarbon ages on relatively fragile and dissolution susceptible Globorinoides rubber samples were compared with the more robust species Neogloboquadrina dutertrei, using the same reservoir age correction. Except for one interval, the paired ages showed no significant differences, indicating analytical error is a small correction to AMS radiocarbon dates taken every 10cm; the sedimentation rate is ~50cm/ky which demonstrates a continuous record. Using paired AMS radiocarbon dates and generating a high-resolution chronology verifies the integrity of the stratigraphic sequence from 290-616cm.

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TEMPERATURE EFFECTS ON EARLY LIFE HISTORY TRAITS AND POPULATION REPLENISHMENT OF A REEF FISH

Temperature is a primary factor influencing growth during the early life of fishes, and growth-related processes can affect the magnitude and composition of recruitment events and early juvenile survival. To elucidate the effects of temperature and growth-related processes on recruitment and post-settlement survival, 16 monthly cohorts of newly settled bicoral damselfish Stegastes partitus were sampled in the upper Florida Keys, USA over multiple years. The domain is characterized by highly variable wind fields with significant influence on the upwelled front appears to relax back towards the shore on a time scale of ~2 days after the wind relaxes. We argue that the observed relaxation of the upwelled front south of Chesapeake Bay is in part governed by the buoyant estuarine plume from the bay using a simple numerical model and observations from the CoOP Duck Project. Observations show the Chesapeake plume has an alongshore propagation speed of 0.55 m s⁻¹ and the plume front reaches the study area in ~2 days. We examine this using 3 arrays of cross-shore CTDs and numerical analysis to show the relaxation time scales for each array is dependent on the plume propagation speed and alongshore distance from Chesapeake Bay. A simplified numerical model will define the mechanism by which the plume leads to apparent frontal relaxation.

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LARVAL CONNECTIVITY IN A DYNAMIC DOMAIN: LIMITATIONS AND ADVANTAGES OF A COMBINED MODELING-FINGERPRINTING APPROACH

To assess population connectivity of many coastal species, models must extend into dy- namic inner shelf regions and simulate processes forced by small-scale variations in topo- graphy, wind fields, and source inputs. This zone typically falls between the domains of most nearshore and coastal studies, despite its importance for biological connectivity and sustainability. We present an interdisciplinary study employing a small-scale circulation model developed to test mussel larvae transport hypotheses and conduct sensitivity analy- sis of physical parameters that may affect connectivity on scales of order 10-100 kilome- ters. The domain is characterized by highly variable wind fields with significant influence from remote winds, and we explore effects and limitations of available forcing products on circulation and connectivity results. Model experiments are also combined with local demographics and elemental analysis of juvenile mussels which show distinct spatial pat- terns. Combining modeling and elemental fingerprinting enables more detailed analysis of connectivity in a dynamic area and better identification of modeling and data gaps.

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THE PERFORMANCE OF A REGIONAL COUPLED OCEAN/SEA ICE MODEL IN THE NARES STRAIT
A simulation of the climate around Greenland has been made with HIRHAM (The Danish Meteorological Institute’s atmospheric climate model) for a period of 100 years. The result from this simulation has been used to force a regional coupled ocean and sea ice model (HYCOM+CICE) at the surface. The region considered is Nares Strait, Lincoln Sea and the Baffin Bay. The lateral boundaries of HYCOM and CICE have been relaxed towards a global model. The purpose of this study is to investigate the coupled systems ability to model the hydrography and the sea ice distribution and to investigate the freshwater flux through the Nares Strait. The Nares Strait is expected to be a demanding test case for both the ocean and sea ice model with mixing of different water masses, building up an ice bridge, and formation of polynias. This talk will focus on the flux of water and sea ice through the Nares strait. The sea ice fluxes will mainly be compared to satellite images. The implementation of boundary conditions in CICE will also be discussed.

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ELECTROCHEMICAL PRODUCTION OF OCEAN ALKALINITY FOR CARBON DIOXIDE AND ACID MITIGATION, AND HYDROGEN GENERATION

Absorption of CO$_2$ by the ocean can be increased by the addition of alkalinity, e.g., Ca(OH)$_2$, derived from the thermal calcination of limestone (Kheshgi, 1995). Diluted in the ocean (to pH~9) this alkalinity will react with excess CO$_2$ to form primarily calcium bicarbonate: Ca(OH)$_2$ + 2 CO$_2$ -> Ca(HCO$_3$)$_2$. However, thermal calcination is very energy and carbon intensive. A potentially more efficient alternative is to generate CO$_2$ directly in seawater via electrolytic splitting of limestone. Using DC current, the acidity generated by an anode submerged in seawater can be used to decompose limestone, forming Ca(OH)$_2$, that will enhance CO$_2$ absorption by the ocean and restored its pH. If produced, H, gas generated at the cathode can be used to recover/storing energy, helping defray process costs. Chlorine generation may be avoided via the use of certain current densities, or the use of O$_2$, selective anodes. Thus wind-, wave-, tidal-, or solar-powered, fixed/floating platforms could be actively increased ocean alkalinity. Such platforms could then help: 1) absorb and reduce atmospheric CO$_2$, 2) neutralize ongoing ocean acidification, and 3) generate hydrogen.

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ADJOINT BASED ERROR ESTIMATION AND CORRECTION – A SHALLOW WATER CASE STUDY

We propose to apply adjoint methodology to derive both error estimates and error correction for geophysical flow problems. In each case an appropriately defined adjoint problem is solved to obtain an error estimate for the flow field itself and a reduction of the error in the computation of quantities derived from the flow field. Our adjoint error estimation and correction approach is evaluated in the framework of the standard SWE Williamson test suite for the ICON model, a newly developed semi-implicit shallow-water model on a cospherical grid. The adjoint ICON shallow water model is part of the dynamical kernel of a future general circulation model. This will lead to adjoint error correction in more realistic scenarios.

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ENERGY EXCHANGE AT THE AIR-WATER INTERFACE

A direct numerical simulation (DNS) is performed to study velocity distribution and energy exchange at air-water interface in the intermediate depth and deep water waves. In the present investigation, average air velocity is kept as 1) $U_{air} < 0.5 \text{ c}$, 2) $U_{air} = 0.5 \text{ c}$ and 3) $U_{air} = c$. Here, $c$ is the wave speed. The shape of wave water and associated orbital velocities evolve dynamically under the action of the airflow. Numerical simulation results show the presence of recirculation just above the trough of the wave water. Momentum exchange between air and water increases the kinetic energy in the water. A region of closed streamlines is observed above the trough of the wave which is dynamically important and significantly affecting velocity and pressure in the air above the water surface. Energy density variation along the length shows the energy exchange between air and water in the viscous, nonlinear wave waves.

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ANTARCTIC OCEAN TIDES FROM GRACE INTERSATellite TRACKING DATA AND HYDRODYNAMIC ASSIMILATION

Long-wavelength components of the oceanic tides surrounding Antarctica are estimated from over four years of GRACE satellite-to-satellite ranging measurements. An inversion is performed for the major constituents M2, O1, and S2, parameterized as localized average mass anomalies relative to a prior tidal model. Satellite state adjoint is made simultaneously. These long-wavelength anomalies are then assimilated into a high-resolution regional hydrodynamic tidal model. Comparisons to independent in-situ tide measurements show that the resulting assimilation solutions result in improved agreement, for all three constituents.

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DISTRIBUTIONS OF CHROMOPHORIC DISSOLVED ORGANIC MATTER DURING THE GULF OF MEXICO EAST COAST BARRIER (GOMEC) CRUISE SUMMER 2007

Chromophoric Dissolved Organic Matter (CDOM) is responsible for light attenuation in the ocean, provides the basis for oceanic photochemical processes and is important for remote sensing applications. Understanding CDOM variability in the ocean is important for quantifying UV-dependent processes such as photochemistry. CDOM is characterized by its absorption spectrum with the “amount” of CDOM present defined by absorption at certain wavelengths. The absorbance spectrum shape, commonly reported as a total slope coefficient (S), relates to the aromaticity and chromophoric diversity of CDOM. CDOM samples were taken within and below the mixed layer in coastal waters from Texas to Maine as part of the GOMEC cruise (July 10 to August 4, 2007). Samples were 0.2 μm filtered and refrigerated until spectrophotometric measurement of absorbance spectra. S values ranged from 12-28 (avg = 20). Concurrent samples were taken for studies of CO and CO$_2$ photochemical production efficiency. These data represent a unique “snapshot” of CDOM spatial variability along the Gulf of Mexico and US East Coast that will prove useful for verification of remote sensing CDOM estimates and as a driver for regional-scale photochemical models.

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HISTORICAL RECORD AND DECADAL-SCALE TRENDS OF NUTRIENT CONCENTRATIONS OF SLOPE WATERS IN THE GULF OF MEXICO

Nutrient supply to the Gulf of Maine (GoM) is from offshore, as nutrient rich slope waters enter the bottom. The slope waters that enter the GoM are a mixture of two types: warmer, saltier warm slope water (WSW) of Gulf Stream and Central Atlantic origin, and cooler, fresher Labrador Sea slope water (LSSW) from the north. Our analysis of over 100,000 nutrient samples from 1932–2007 in the GoM region shows that the GoM has undergone fluctuations in slope water types leading to varying nutrient concentrations in the deep basins. The 1960s were characterized by LSSW and had lower temperatures and nutrient concentrations, followed by the warmer, higher nutrient WSW through the 1970s. Recently, the years of 1995–present have shown decreasing temperature, salinity, and nutrient concentrations at depth. While the slope water shifts of the 1960s and 1970s have been attributed to shifts in the North Atlantic Oscillation (NAO), the more recent trend seems unrelated to the NAO Index and instead is affected by a larger volume of water from the Labrador Sea traveling southward along the continental slope.

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SELF-ASSEMBLY OF DISSOLVED ORGANIC CARBON: INSIGHTS FROM LAKE WATERS

The spontaneous assembly of dissolved organic carbon (DOC) leads to particulate organic carbon (POC) formation with significant consequences for carbon export to sediments and/or transfer to food webs. Assembly occurs when inter-polymer distances allow chemical or physical bonds and, consequently, depends on pH, ionic composition, and dielectric properties of the solvent. Lake waters exemplify a diverse array of DOC and chemical environments that could be helpful to untangle the mechanisms and self-assembly contribution to DOC-POC dynamics in natural waters. We performed extensive lake samplings in Northern temperate and Mediterranean biomes covering wide DOC (12-3750 μM) and chemical (conductivity 9.6-61,500 S) gradients to determine polymer size and the fraction of total organic carbon assembled using homodyne dynamic laser scattering and a fluorescence quenching assay. In addition, we performed several experiments to corroborate the role of calcium and iron as promoters of DOC assembly.

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OPERATIONAL FORECASTS OF RIGHT WHALE DISTRIBUTIONS FROM SATELLITE AND OCEANOGRAPHIC DATA USING DYNAMICAL MODELS

Recovery of the North Atlantic right whale is limited by high mortality due to ship strikes and entanglements in fishing gear. All management options depend on knowing where whales are likely to be. We have developed a system that can produce useful forecasts of right whale distributions on their feeding grounds in the Gulf of Maine. Our system uses satellite-based measurements of sea surface temperature and chlorophyll to determine the developmental and reproductive rates of Calanus finmarchicus, the preferred prey of right whales. The rate information then drives a population dynamics model of Calanus.
though for the oligotrophic oceans both iron and phosphate are often present in limiting quantities and consequently their relative availability may determine nitrogen fixation rates. The variance in nitrogen fixation rate was examined along a meridional transect in the Atlantic. In addition large scale (~25 km2) in situ enrichment experiments were performed to investigate the impact of phosphate and iron availability in surface waters in the eastern Mediterranean (CycloSIPS) in 2002 and the north-eastern sub-tropical Atlantic (FeEP) in 2004. During each study 15N natural abundance of the particulate nitrogen and nitrogen fixation rate measurements were made over periods of up to 10 days following addition. Iron availability had minimal impact on nitrogen fixation in both addition experiments, whereas phosphate addition appeared to stimulate diazotrophy in both. Unprecedented high rates of nitrogen fixation were found in the Mediterranean Cyprus Eddy, which appeared to be supported by dissolved organic phosphorous.

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WAVE MODELING AROUND SUBMERGED BREAKWATERS/ARTIFICIAL REEFS

Submerged breakwaters have been developed as a successful alternative or assistance to beach nourishment projects. By dissipating wave energy in the nearshore, a submerged breakwater can be designed to minimize beach erosion and maximize accretion. Also, submerged breakwaters that double as artificial reefs are designed to include structural aspects to meet marine life requirements (e.g., Reef Balls). Considering the complexity of coral reefs, fabricated reefs that attempt to mimic aspects of natural habitats can further complicate the hydrodynamics. Due to the changes in wave dynamics, submerged breakwaters/artificial reefs could also have an effect on the adjacent shorelines and bathymetry in surrounding areas. Using the fluid modeling program, SWAN, this study will explore erosional "hot-spots" due to the wave dynamics around a submerged breakwater/artificial reef composed of Reef Balls.

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ACOUSTIC INTENSITY FLUCTUATIONS RESULTING FROM PULSE PROPAGATION THROUGH TIDAL AND SUPER-TIDAL INTERNAL WAVES ON THE SOUTH CHINA SEA SHELF

Conducted in the northeast South China Sea from April 13-15, 2005, the shallow-water component of Windy Island Soliton Experiment (WISE) was designed by Taiwan and U.S. scientists to study the physics of low-frequency sound propagation through nonlinear, internal waves in shallow water, and to quantify the associated sound intensity fluctuations. Previous studies in this region revealed a highly dynamic environment where internal waves of varying temporal and spatial scales dominate the sound-speed field. The acoustic receiver was an eight element, vertical-line hydrophone array that recorded signals transmitted from a moored source. This paper discusses and contrasts the sound intensity fluctuations resulting from a transmitted signal through a complex, nonlinear internal wave field at two different times, one where the internal tide has rapidly repositioned the thermocline vertically, and one where the thermocline was slowly reeling up. Using temperature time-series collected along the transmission path, a space-time continuous wave field at two different times, one where the internal tide has rapidly repositioned the thermocline vertically, and one where the thermocline was slowly reeling up. Using temperature time-series collected along the transmission path, a space-time continuous empirical sound-speed model is combined with a coupled-mode acoustic model to explain the observed phenomenology and statistics of the sound intensity fluctuations. The research is sponsored by the Office of Naval Research.

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IMPACTS OF CLIMATE WARMING ON ARCTIC PELAGIC METABOLISM: AN EMPIRICAL ASSESSMENT

The rapid current loss of the ice cover of the Arctic Ocean implies that it is now becoming active in gas exchange with the atmosphere. The role of the Arctic Ocean on gas exchange depends, partly, on the net metabolism of the planktonic communities. We will provide evidence, derived from comparative analysis across gradients of water temperature and ice melting, that gross primary production is suppressed by ice-melt waters and that community respiration increases with temperature, suggesting a shift towards a heterotrophic metabolism.

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INTERACTION ON A BROAD AND SHALLOW SHELF

With a few exceptions, little effort has been made to understand the mechanisms of storm surge interaction with the tide over a broad and shallow shelf, which is also dependent on the trajectory of the hurricane. Recent numerical studies on storm surge have mainly focused on representation of hurricane winds, inundation schemes, hurricane track and its effect on specific estuaries or ports. We conduct an investigation of storm surge on the Louisiana coast by using the state-of-the-art UnStructured-grid Finite Volume Coastal Ocean Model (US-FVCOM) introduced by Chen et al. (2003). Field observations and data from existing platforms along the coast are used in the validation of the model for some of the 2005 hurricanes. In addition to this application, we also conduct experiments with idealized model setup within different parameter space. These experiments provide some insight about the effect of the hurricane parameters and the broad and shallow shelf on the interaction between storm surge and tides as well as the development of storm surges on the coast of comparable slope of topography and width of the shelf.
THE HUMAN HEALTH EFFECTS OF MARINE TOXINS: CURRENT AEROSOLIZED FLUX AND RED TIDE RESEARCH

Karenia brevis, the Florida red tide organism, produces the potent neurotoxin, brevetoxin. In addition to the health effects associated with the ingestion of contaminated shellfish, there have been widespread anecdotal reports of respiratory irritation and possibly immunologic effects associated with the inhalation of aerosolized Florida Red Tides. An interdisciplinary team of scientists is investigating the human health effects from environmental exposures to Florida red tide toxins. When a red tide moves onshore, the team rapidly assembles to collect environmental conditions and samples (air, water, particulates) and epidemiologic data (pre/post-exposure questionnaires, pulmonary function tests, and personal monitoring) in normal workers and asthmatic (>12 yrs) residents in endemic areas. Acute and chronic respiratory effects of red tides and brevetoxin are also evaluated in rodent and asthmatic sheep models, as well as toxin exploration (including natural antagonists). These models are being used to refine and validate biomarkers of brevetoxin exposure and effect, as well as explore the pathophysiology of health effects from aerosolized brevetoxins. This research has demonstrated acute and possibly sub-chronic effects in animals and humans with asthma, as well as providing an environmental model for public health interventions and the discovery of new medications based on the natural antagonists.

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X-BAND RADAR MEASUREMENTS OF DIRECTIONAL SURFACE WAVES

The Wave Monitoring System WaMoS II is based on a standard marine X-Band radar which is generally used for navigational and ship traffic control. Each X-Band radar produces 'sea clutter' which is suppressed for its standard application. By analysing the sea clutter the directional wave spectra from the sea surface are obtained in real time. From there all spectral sea state parameters such as significant wave height, peak period, and peak direction both for wind sea and swell are derived. Remote sensing for waves on board vessels and harbor entrances is gaining a bigger interest with ships becoming larger and some port entrances allowing only smaller time windows for them to enter. Accurate knowledge of the actual waves and currents in the area of interest some times is difficult to get, as moored devices might be in the way of operation. In this paper the focus is on spatial inhomogeneities in both, the topography and the wave field. Effects of strong tidal currents on the wave data and how they are reflected in the radar data will be shown. Examples from determined sea surface elevations from radar data will be given. Data containing high individual waves will be analyzed and discussed. Those maps of remotely measured sea surface elevations, showing individual waves have a huge potential in all applications that need to include the individual wave profile. An overview of related ongoing activities will be given.

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EFFECTS OF SEQUENTIAL INCREASES IN SEA TEMPERATURE IN THE NORTH ATLANTIC AND BERING SEA ON PLANKTON AND BENTHIC BIOAVAILABILITY, THE BIOLOGICAL PUMP AND THE ARCTIC

Results from the Continuous Plankton Recorder (CPR) and other surveys have shown that rapid changes have occurred in chlorophyll and the composition of plankton and benthos in the North Atlantic and Bering sea in recent decades. These changes have been linked to rising temperatures. For European shelf seas the increases have been correlated with Northern hemisphere temperature and thus linked to global warming. In the eastern North Atlantic the changes have been related to variability in the subpolar and subtropical gyres and in the western Bering Sea to changes in the subarctic gyre. An interesting observation is the increase in red tide blooms in both regions. It has been found that this increase is the result of changes in both, the topography and the wave field. Effects of strong tidal currents and peak direction both for wind sea and swell are derived. Remote sensing for waves on board vessels and harbor entrances is gaining a bigger interest with ships becoming larger and some port entrances allowing only smaller time windows for them to enter. Accurate knowledge of the actual waves and currents in the area of interest some times is difficult to get, as moored devices might be in the way of operation. In this paper the focus is on spatial inhomogeneities in both, the topography and the wave field. Effects of strong tidal currents on the wave data and how they are reflected in the radar data will be shown. Examples from determined sea surface elevations from radar data will be given. Data containing high individual waves will be analyzed and discussed. Those maps of remotely measured sea surface elevations, showing individual waves have a huge potential in all applications that need to include the individual wave profile. An overview of related ongoing activities will be given.

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FEEDING DETERMINANTS IN THE CRUISING HYDROMEDUSE Aequorea VICTORIA

Medusae have been found to be capable of significantly impacting and restructuring the pelagic ecosystem in regions where they are found. It is primarily median species which forage as cruising predators that have the greatest impact. However, little work has been done to identify and quantify the mechanisms that determine feeding rates in cruising medusae. We examined the predator-prey interactions of Aequorea victoria, a hydromedusae which swims via rowing propulsion and forages as a cruising predator. We quantified the flow around swimming A. victoria using particle image velocimetry (PIV) and compared these results to the actual tracks of prey in the fluid around the swimming medusae. In addition, we quantified the encounter, capture and retention efficiencies of these prey as they interacted with the medusae. The regions around the swimming medusae where captured prey originated, based on prey tracks, were consistent predictions based on PIV data. Encounter, capture and retention efficiencies varied depending upon prey type and size. Predicted rates of feeding will be discussed in light of these findings.

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INVERTING LIGHT WITH CONSTRAINTS

Long-term deployments of autonomous platforms present challenges for the direct measurement of the inherent optical properties (IOPs) of seawater due to weight and power considerations. However, measurement of hyperspectral radiometric quantities as well as a few select IOPs fits within the weight and power budgets of some autonomous platforms. Here we investigate the use of easily measured IOPs, such as beam attenuation c and backscattering b, at a small number of wavelengths to constrain the inversion of easily measured radiometric data E(λ) and L(λ) to order to obtain estimates of IOPs (a(λ), b(λ) and c(λ)). We use Ecological, the azimuthally-averaged version of the Hydrolight radiative transfer model, as our forward model. First, we consider optimal methods for the constrained non-linear inverse problem. Next, assuming we can measure radiometric data throughout a homogeneous, well-mixed Case I water column (e.g., such as a Lagrangian float in a N. Atlantic spring mixed layer), we investigated the quality of the inverted IOPs without IOP constraints. Finally, we investigated the quality of inverted IOPs when a small number of constraints, e.g., b(470), b(700) and c(660), are applied. We examine both the final goodness of fit as well as the rate of convergence. Results for various chlorophyll and CDOM concentrations are considered.

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SIMULTANEOUS ESTIMATES OF LONGITUDINAL DISPERSION WITH TRACER STUDIES AND ACOUSTIC DOPPLER CURRENT PROFILER MEASUREMENTS

To compare methods for estimating the longitudinal dispersion coefficient, simultaneous tracer and acoustic Doppler current profiler (ADCP) measurements were conducted during four field experiments in the Kissimmee and Ocklawatchee Rivers in southern Florida. When mixing is controlled by shear dispersion, the dispersion coefficient can be estimated with a theoretical formula that uses measurements of velocity and bathymetry. In comparisons using previous tracer studies and ADCP measurements, the ADCP method was at least as accurate as empirical formulas at matching the tracer result (Carr and Rehmann 2007). However, since the previous tracer studies and ADCP measurements were usually separated by several years, we conducted simultaneous measurements to evaluate the ADCP method. The ADCP method performed better at higher flows and in cases with less area in dead zones. Reach averaged ADCP estimates of the dispersion coefficient matched tracer values more closely than local estimates, and the ADCP method outperformed the empirical formulas in many cases.

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THE INFLUENCE OF BOTTOM TOPOGRAPHY ON BOUNDARY LAYER MIXING AND THE SEDIMENT-WATER INTERFACE

In many stream ecosystems, nutrient cycling is predominantly controlled by microbial and algal activity occurring along streambed sediments. How nutrients are transported and exchanged depends upon the combined dynamics of turbulent transport through the water column and diffusive transport across the sediment-water interface. We conducted fine-scale measurements of boundary layer flow and nutrient transport within a 25m by 0.60-m laboratory flume. Three flow rates were studied along with three different bed topographies, composed of sand, gravel, or gravel with large cobbles. Fluorescein dye, containing dissolved nitrate and phosphate, was injected at the bed surface and concentration was measured 1m from the source using planar laser induced fluorescence (PLIF). Particle image velocimetry (PIV) was used to simultaneously calculate velocities. PLIF/PIV images were obtained at 50 Hz, enabling nutrient flux calculations throughout the water column, by using an eddy-correlation technique. Pore-water concentrations were measured using a flow-through fluorometer and ion-exchange membranes. Our results suggest the larger
bedroughness elements increase turbulent mixing and nutrient exchange across the sedi-
ment-water interface. However, depending upon the size of the roughness elements, this
exchange became spatially more heterogenous.

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THE EFFECTS OF A WASTEWATER PLUME ON PHYTOPLANKTON IN THE COASTAL OCEAN

Major cities discharge treated wastewater to coastal oceans contributing significant
amounts of dissolved nutrients. The Hyperion Wastewater Treatment Plant in Los
Angeles, for example, pumps 300-350 million gallons of secondary-treated wastewater per
day into Santa Monica Bay. From November 28-30, 2006, wastewater was diverted from
the primary outfall (57 m depth, 5 miles offshore) to a nearshore outfall (15 m depth, 1
mile offshore). We tracked the evolution of the surfacing plume using optical and physical
measurements (spectral optical absorption and scatter, temperature, salinity) and moni-
tored its effects on local phytoplankton populations. Plume waters were characterized
by low salinity, high CDOM, and measurable nutrient concentrations relative to ambient
waters. Elevated concentrations of several dinoflagellate species occurred after the event.
Localized blooms of a Cochlodinium-like dinoflagellate and Akashiwo sanguinea (chloro-
phyll a up to 100 mg/m² and densities between 100-200 cells/ml) occurred several days
after the diversion in low-salinity, high CDOM waters characteristic of the wastewater
plume. These species do not typically form blooms in southern California and may repre-
sent new nuisance species and/or an unusual response to the surfacing effluent plume.

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SCALES OR OTOLITHS: AN AGE-OLD QUESTION

Fisheries management has long relied on age-assessed structures. Knowing fish ages
allows for use of population dynamics of a fishery. Fish ages are mainly determined from
otoliths (ear bones) and scales. Studies have shown that scales systematically underd
their ages compared to otoliths, particularly older fish. Reasons for these problems include loss and regeneration of scales as well as scale deterioration, causing a loss of annual bands. Since the early 1980's, we understood that otoliths provide more accurate ages compared to scales. Nonetheless, important fisheries, such as striped bass (Morone saxatilis) are still managed by otoliths based on scale ages. Otoliths, like scales, have annual layers that are counted to age.
The Center for Quantitative Fisheries Ecology at Old Dominion University currently
compares scales versus otoliths in striped bass, an important commercial and recreational
fishery. The implications of this work may improve stock assessment of the species, allow-
ing for more accurate estimations of growth, life history traits, mortality and year class
strength. Our results show Chesapeake Bay striped bass stock is rebuilding faster than
recognized by stock assessments which rely upon scale ages.

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A BENTHIC MICROBIAL FUEL CELL FOR SANDY SEDIMENTS

A benthic microbial fuel cell (BMFC) has been designed for harvesting energy from sandy
sediments in the littoral zone. This BMFC utilizes a pair of domed chambers placed
over carbon-brush anodes at the sediment-water interface, and a common carbon-brush
cathode in the surrounding seawater. The combined footprint of the two chambers is one
square meter. The shape of the fuel cell and its interaction with flow create local pres-
sure gradients that are intended to cause the passive upwelling of anoxic reducing-rich porewaters into the chambers. Check valves limit flow to one direction (from sediment into chamber), and a timer circuit switches energy harvesting between the two chambers on a 24-h cycle. We will present the results of tests of this design at field locations on the Oregon Shelf and within San Diego Bay. In both experiments harvested energy is being passed to a DC-DC converter that operates as a potentiostatic power transformer. The converter steps up the output to 3.5V to recharge a lithium-ion battery for the long-term powering of sensors such as a commercial ultrasonic receiver.

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OPTICAL CLASSIFICATION OF LAKES FOR REMOTE SENSING APPLICATIONS

Operational classification of waters in countries with high number of lakes which varies
greatly by their properties is often based on physical and chemical parameters. By re-
 mote sensing techniques some of the variables used in the classification can be measured
(Chlorophyll, Secchi depth, turbidity). Remote sensing offers advantages such as good spa-
tial and temporal coverage for estimation changes in certain parameters. In order to study
the usability of satellite sensors for lake water classification, we have compared optical
classification of lakes with their measured remote sensing reflectance spectra and limno-
logical classification of lakes. Optical classification is based on the concentrations of three
VARIABILITY OF NEAR-SURFACE CURRENTS NEAR THE TIP OF THE ANTARCTIC PENINSULA AND IMPLICATIONS FOR THE TRANSPORT OF NUTRIENTS AND ANTARCTIC KRILL

The highest concentrations of Antarctic krill (Euphausia superba) in the Southern Ocean are found in the Scotia Sea. It is assumed that to maintain these populations krill larvae are advected from spawning grounds along both sides of the Antarctic Peninsula. The pathways of the surface currents and the frontal system in that region are not yet fully understood. In February 2000, 40 surface drifters were deployed in the northwest Weddell Sea as part of the ADELIE project and provided the first Lagrangian observations east of the Peninsula. They revealed new information about the velocity field by resolving narrow frontal currents and standing eddies both controlled by topography. To analyse seasonal and interannual variability of the currents, we deployed virtual drifters in the velocity output of ORCA05, a global coupled sea-ice-ocean model with a resolution of 1/4°. First results indicate a high variability. Depending on deployment location and time, drifters can reach South Georgia within six months, while others need two years. On average, 10 to 15% of the drifters get advected westward around the Peninsula.

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ANALYSIS OF HIGH-SPEED STEREO-PHOTOGRAMMETRY OF OCEAN SURFACE WAVES

The stability of a ship can be disrupted by large amplitude motions resulting from interactions with wave groups larger than the nominal sea state. A novel technique using high-resolution stereo-optic photogrammetry was deployed with the cameras mounted near the bow of the USS SeaFighter during an ONR sponsored field test. This system provided a detailed 3D characterization of the incoming wave field over 24 hour periods and ship moving at constant speed. The ocean surface height field over an area covering 20 to 120 m forward of the ship and 30 to 70 m cross-track was captured at 15 Hz. These unique 3D timeseries allowed an analysis of the incoming wave field propagation and evolution over a range of both spatial and temporal scales. The stereo-optic waves were obtained simultaneously with 6-DOF measurements of ship motion as well as accelerometer data indicating the structural response of the hull to wave slamming events. The characteristics of wave patterns that excite large ship motion in moderate sea state are examined. In addition, the use of stereo wave measurements to validate computational phase-resolved wave models is discussed.

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IMPLICATIONS OF RECENT OBSERVATIONS ON THE ROLE OF WAVE BREAKING IN WIND WAVE SPECTRA

Recent observations show a transition in wave spectra from a form in frequencies for 1.8 - 3.5 times the spectral peak. The transition location is consistent with the existence of a dynamic equilibrium between nonlinear fluxes into this region and wave breaking within the region. This interpretation suggests that energy loss due to wave breaking predominately occurs at high frequencies. The physical mechanism for the breaking in this region of the spectrum appears related to the orbital velocities due to longer waves; thus, this new hypothesis is quite consistent with observations showing that wave breaking is concentrated at the higher frequencies. We discuss two aspects of this new formulation. First, the new hypothesis substantially reduces the number of “tuning” coefficients in wave model source terms, since the integrated losses are fixed to be equal to the total nonlinear flux rate through the equilibrium range. Second, because energy is lost from the wave field at higher frequencies than presumed in current wave models has a dramatic effect on nearshore radiation stresses, yielding substantially increased wave set-ups at the coast.

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SUBMESOSCALE VARIABILITY OF PCO2 IN THE NORTHEAST ATLANTIC

A high resolution 3D bio-physical model is combined with high resolution observations to study the submesoscale variability of sea surface partial pressure of CO2 (pCO2) and its impact on air-sea CO2 fluxes in the northeast Atlantic Ocean during winter and spring. The model was validated against the extended data set of network stations and 5 Caricau floats collected during POMME (Programme Océanographique Multidisciplinaire Moyenne Echelle). The model shows that the large scale pCO2 distribution is highly modulated by submesoscale filaments where pCO2 gradients are more than 20 times larger than the large scale meridional gradient. The mean CO2 air-sea flux estimated by the model is much larger than the flux estimated from the Caricau measurements. The discrepancy is attributed to undersampling by the floats. Moreover, comparison of simulations with and without submesoscale resolution shows a limited impact of submesoscale stirring on the regional CO2 flux budget derived from the model.

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MULTIPLE EFFECTS OF COLORED DISSOLVED ORGANIC MATTER ON UNDERWATER PHOTOSYNTHESIS IN A WARMING CLIMATE

Permafrost thawing and vegetation shifts caused by global warming will release increasing concentrations of allochthonous CDOM into northern aquatic systems. This highly light absorbing component will alter the biogeochemical cycling and photosynthesis of high latitude estuarine species. We partitioned the optically active components affecting PAR in the Great Whale River and its associated estuary and coastal Hudson Bay, subarctic Canada, and found that CDOM currently exerts the dominant control on the underwater light field throughout the system. We evaluated the optical effects of increased CDOM loading on phytoplankton by way of experiments using a CDOM filter incubation system to measure photosynthesis, in combination with modelling analyses. The results showed effects on the depth of the euphotic zone, spectral matching between phytoplankton absorption and in situ irradiance and a substantial decrease in maximum photosynthetic rate. This combination of multiple effects reduced the integrated primary production throughout the estuarine ecosystem, by more than 60% at the highest CDOM concentrations. These results imply that future climate change could result in greatly reduced primary productivity that in turn may impact on higher trophic levels.

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HABITAT CHARACTERISTICS OF HARBOR SEAL (PHOCA VITULINA) FORAGING LOCATIONS IN THE GEORGIA BASIN

The marine resource distribution throughout the San Juan Islands, Washington, is expected to increase rockfish abundance, with a consequent increase from predators. To predict the impact of predators on marine resources one must understand their current foraging behavior. We used satellite telemetry and TDRs to characterize the foraging locations of harbor seals in the Georgia Basin. We tagged 20 seals at three haul-out sites: Padilla Bay Estuary (n = 6) and Bird Rocks (n = 6) in Puget Sound and the Belle Chain Islets in the Strait of Georgia (n = 8). Harmonic mean analyzes were used to identify core foraging areas for the study animals. The average water depth of these areas was between 10-60 m, and the average dive depth of seals was 30.1 ± 32.24 m; suggesting that seals foraged at intermediate water depths. Characterizing seal foraging habitat is important when considering the location of marine reserves, as the placement of a reserve in or near core foraging areas may inhibit rockfish recovery and the realization of reserve goals.

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POMME A SUBDUCTION PROCESS EXPERIMENT IN THE NORTH-EAST ATLANTIC

POMME investigated the formation of mode waters in the north-east Atlantic. The processes studied were both dynamical and bio-geochemical. The field experiment took place in 2000-2001 between 38°N and 45°N in the eastern Atlantic. The experimental strategy relied on a mix of meso-scale sampling during four cruises, and in situ instrumentation. Dedicated air-sea flux fields were produced consistent with the observed in situ T and S variability. The analysis involved both combining the data in order to provide major components of the budgets, and trying to realistically model dynamics at the meso-scales or analyse satellite imagery, in order to derive information on the unresolved scales of variability of the system. This revealed a large range of dynamical scales playing a role in the formation or the subsequent evolution of mode water in this supposedly relatively quiescent region. One mode water eddy was well observed, indicating the presence of new Atlantic mode water not formed locally. Sub-meso scale processes clearly also play a role in modulating subduction during spring, but might not have a major contribution once integrated spatially. The data also clearly reveal primary production and export before the subduction starts (in 2001, this did not happen before March 6), and that phytoplankton involved in the primary or regenerated production presents a large seasonal evolution. The area was also found to be a net sink of atmospheric CO2.

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A PARADOX IN THE GLOBAL SI CYCLE MASS BALANCE

There are problems with our understanding of the oceanic Si cycle that may be related to the importance of the Southern Ocean on the global budget of re-mineralized nutrients in the deep-sea. Basic geochemical box-models of the oceans are poor at capturing marine C and Si cycles together. One potential solution is to investigate the Si geochemical cycle via the use of stable Si isotopes, but initial results led to a paradox in our conceptual model of the Si cycles.
model results suggest that there should be no measurable Si isotope difference between the deep-water composition of the Atlantic and Pacific Oceans, but results demonstrate a relatively large isotopic gradient between the ocean basins. Reasons of the stable-isotope paradox will be explored and potential mechanisms discussed, with particular stress on the biogeochemical divide separating the Antarctic from the Subantarctic.


SOURCES OF TERRIGENOUS SEDIMENT IN HANALEI BAY, KAUA‘I, HAWAI‘I: COMPARISON OF MAGNETIC AND CS-137 PROPERTIES IN MARINE SEDIMENT AND UPLAND SURFICIAL DEPOSITS

Magnetic and cesium-137 properties of sediments in the reef-watershed system of Hanalei Bay and River, Kaua‘i, Hawai‘i, provide information about sources of terrigenous sediment and land-surface stability of these sources. Magnetic iron-oxide minerals in the Bay sediments originate in upland basaltic rocks and soils; thus, magnetic properties of these sediments characterize detrital input from the watershed. Magnetic property variations in Bay sediments indicate many sources of upland sediment. In contrast, recent flood deposits (2006) collected from a bathymetric depression offshore of the Hanalei River contain magnetic and cesium-137 properties that imply flood deposit-source(s) from one or a few landscape settings and sufficient land-surface stability to provide sediment containing the 40-60-years old cesium-137 tracer. The results suggest that a significant component of recent flood deposits in the Bay was derived from tilled floodplain in the lower watershed where sediment from many upland sources is mixed and widely exposed. Fine-grained fluvial sediment of similar origin may that be stored between floods in the deep parts of the lower river might be another source of flood sediment.

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A DAILY BLENDED ANALYSIS FOR SEA SURFACE TEMPERATURE - VERSION 2

Sea surface temperature (SST) analyses have been produced daily on a 1/4-degree spatial grid using in situ and satellite data. The analyses are done by optimum interpolation (OI) with a separate step to correct any large scale satellite biases relative to the in situ data. Because microwave data can be retrieved under cloudy conditions as long as there is no precipitation, the coverage of microwave SST data is greater than infrared data. Thus, one analysis uses both infrared and microwave satellite SST data, while the other uses only infrared data. The latest version (version 2) uses 3 days of satellite and in situ data instead of 1 to reduce the day-to-day noise. This version also smooths the 7-day satellite bias correction to reduce a strong 7-day period in the correction. In addition, version 2 includes a step to reduce ship SST biases with respect to buoy SSTs. Daily error fields show larger errors in bias, sampling and random errors. These daily OI analyses are evaluated by intercomparison with other SST analysis products. Version 2 will be available before January 2008 at http://www.ncdc.noaa.gov/oa/climate/research/st/oi/daily.php.

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AUTONOMOUS MOORED PROFILING SYSTEMS FOR COASTAL OBSERVATIONS

High resolution, 4-D environmental characterizations of the physical and biogeochemical structure of the near shore and coastal oceans are needed to assess the state of the coastal ecosystem and for monitoring changes due to natural and anthropogenic forcing. To address these needs, we have been developing a series of Autonomous Moored Profilers (AMP) to support a variety of long-term coastal applications, where real-time, high vertical resolution physical and biogeochemical data are required. The AMP includes a self-contained, winch-driven profiling platform with integrated control and power systems, a suite of environmental sensors, and a telemetry system. To provide a complete top-to-bottom ocean/atmosphere observing system, we have also been developing the Coastal Autonomous Profiling and Boundary Layer System (CAPABLE). CAPABLE consists of the extended endurance AMP, the Shallow Coastal Upward Looking Profiler Integration Mode (SC-137) to sample the ocean boundary layer and facilitate docking/recharging of the AMP, and the Surface Boundary Buoy (SBB) for making detailed meteorological and upper ocean observations. We present an overview of the AMP and CAPABLE systems as well as data collected from recent field deployments.

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PROSPECTS FOR IMPROVING STANDARDS USED FOR CALIBRATION AND VALIDATION OF INFRARED SENSING SYSTEMS

We review a few key developments that have emerged at NIST and other national measurement institutes that enable ever-improved radiometric calibration and validation standards. We first discuss how radiant power scales are established at NIST and other standards laboratories through cryogenic electrical substitution radiometers, and how NIST propagates this scale to the other radiometric scales at the Spectral Irradiance and Radiance Calibrations with Uniform Sources (SIRCUS) facility. We then discuss the filter radiometers and interferometers that NIST has developed for radiometrically checking the blackbody standards in use by the sea-surface temperature and atmospheric temperature validation communities. The importance of independently arriving at radiometric scales through completely different physical means will be highlighted by discussing the comparison of electrical substitution-based scales to blackbody-based scales. We conclude with preliminary results of a project focused on verifying current absolute uncertainty claims of 0.1 K, 3 sigma, in the spectrally-resolved thermal-infrared radiance. Finally, we discuss the recent development at NIST of a Hyperspectral Image Processor (HIP), which propagates electrical-substitution-based scales to complex, realistic spectra and even to realistic hyperspectral spatial scenes, and its proposed application to infrared sensor system calibration and validation.

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USING 2,4,6-TRIMETHYLPHENOL AS A SCAVENGER TO EVALUATE THE CONTRIBUTION OF HUMIC TRIPLET EXCITED STATES IN THE NOM-MEDIATED PHOTODEGRADATION OF POLLUTANTS

Natural organic matter is known to promote organic pollutants photodegradation in illuminated surface waters. Humic triplet excited states have been recently shown to be the main species involved in the phototransformation of phenolic compounds. For this purpose, we studied the competetive humic substances-mediated oxidation of two molecular probes: fururfural alcohol and 2,4,6-trimethylphenol. The former reacts with singlet oxygen while the latter is supposed to react with humic triplet excited states. The strong inhibiting effect of 2,4,6-trimethylphenol on the photooxygenation of fururfural alcohol confirmed this hypothesis. This scavenging technique using 2,4,6-trimethylphenol as a scavenger was extended to other systems. We present here examples of pollutants photodegradation in which using this phenol can help to delineate the role of humic triplet excited states in the reaction.

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NASA DEVELOP PROGRAM: STUDENTS UTILIZING EARTH SCIENCE RESEARCH RESULTS TO ADDRESS COMMUNITY NEEDS

DEVELOP is a NASA Science Mission Directorate Applied Sciences Program that fosters human capital development to extend NASA science research to local communities. With advisers and mentors from NASA and partner organizations, graduate, undergraduate and high school students incorporate NASA science measurements and predictions into prototype projects that address local policy and environmental concerns. Students demonstrate the benefits of NASA’s Applied Sciences Program by presenting project results at scientific and public policy forums such as the American Geophysical Union (AGU), the American Meteorological Society (AMS), and the Southern Growth Policies Board (SGPB). Overall, students strengthen leadership and research skills, experiment with novel technology, and engage in cooperative interactions with colleagues and mentors. DEVELOP fosters students human capital development focus affords students real world experien- ence, enabling them to become a valuable asset to the scientific and global workforce. NASA’s DEVELOP Program is more than scientific exploration and valuable results; DEVELOP fosters human capital development by bridging the gap between NASA science research and federal, state, local and tribal policy decision makers.

Richards, D., Dalhousie University, Halifax, Canada, clark.richards@dal.ca; deYoung, B., Memorial University, St. John’s, Canada, bdeyoung@physics.mun.ca; Sub-TIDAL EXCHANGE IN BONNE BAY, NEWFOUNDLAND

We present and discuss current data from the sill of Bonne Bay, a fixed in western Newfoundland, Canada. ADCP data collected between 2002 and 2004 are used to examine the transport over the sill, in an effort to determine the response of the fjord to local and remote forcing. EOF analysis indicates a primarily two layer structure to the exchange. The dominant mode is strongly correlated with the local wind stress. Discrepancies are accounted for by topographic steering of the wind in different parts of the bay using a simple two layer numerical model.

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VERTICAL MIXING IN THE EASTERN TROPICAL PACIFIC

Vertical mixing is known to have a large impact on the dynamics of the tropical ocean. Because of the strong coupling between the ocean and atmosphere, particularly in the eastern tropical Pacific, we need to consider the coupled system in studies of the sensitivity of the ocean to changes in the forcing. There is a need to have consistency across the ocean/atmosphere interface. Here we investigate the role of vertical mixing in the ocean and its impact on both the ocean and...
atmosphere in the eastern tropical Pacific in the context of a regional coupled model. A useful diagnostic is the distribution of the diapycnic velocity (the diapycnic component of the overturning circulation) which allows the pathways of transport to be thoroughly examined and which gives a very different picture to that implied by the Eulerian vertical velocity. Changes to the level of the ocean vertical mixing affect the atmosphere through changes in SST which in turn can feedback to the ocean through the surface wind, precipitation and cloudiness. To illustrate the issue, increasing the vertical mixing in the coupled system produces a much larger change to SST than an ocean-only model, an increase in the strength of the EUC (as opposed to a decrease in an ocean-only model), and significant reductions in the NECC and height of the Costa Rica Dome. We need to go beyond stand alone ocean models in testing ocean mixing parameterization schemes.

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SAILFISH (ISTIOPHORUS PLATYPTerus) SPAWNING AND LARVAL ENVIRONMENT IN A FLORIDA CURRENT FRONTAL EDY: RESULTS FROM A LAGRANGIAN STUDY

Fronts and eddies are widely hypothesized to be critical spawning habitat for large pelagic species, and to increased spawning success and/or adult feeding opportunities at these features. An ichthyoplankton study examined sailfish spawning around a cyclonic sub-mesoscale (126 km) Florida Current frontal eddy. The temporal progression of eddy dynamics over a 65 h period was determined from satellite imagery, continuous surface measurements along the cruise track, and non-linear least-squares fitting of the positions of three drifters deployed within the eddy. Early stage (1-4 d old) larval sailfish (n=4245, stations=49) were most abundant at the eddy frontal zone, relative to the eddy interior and exterior. Their first-feeding prey items (Farranula and Corycaeus copepods) were most abundant in the interior and frontal zone of the eddy. Ongoing work is using egg densities to indirectly assess the distribution of adult prey items (small carnagids and scounarchs) relative to the eddy. Ultimately, the consistency of occurrence of these small-scale features within a region may be equally if not more important than larger regional-scale processes in structuring the broader spawning patterns of sailfish and other large pelagic species.

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ACOUSTIC CHARACTERIZATION OF TIME-DEPENDENT MIXING AT THE SEAFLOOR

Biological (bioturbation) and physical (wave and currents) processes dominate the time-dependent evolution of small-scale (mm to m) roughness at the seafloor. Recent experiments (SAX99 and SAX04) have used high-frequency (40 kHz and 300 kHz) acoustic backscattering and stereo-photography to quantify the changes in natural and artificially-created seafloor roughness in sandy substrates. A time-evolution equation with a random forcing term that creates roughness and a diffusion term that degrades roughness will be described. When compared to acoustic data this model yields values of horizontal diffusivity in the range of 10 to 80 cm yr⁻¹. (Supported by ONR)

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TAXON-SPECIFIC DISSOLVED ORGANIC PHOSPHORUS UTILIZATION BY ESTUARINE PHYTOPLANKTON DETERMINED USING AN ENZYME-LABELLED FLUORESCENCE APPROACH

River-transported dissolved organic phosphorus (DOP) may comprise a substantial fraction of total dissolved phosphorus in coastal ecosystems. The chemical composition of this DOP pool and its utilization by estuarine phytoplankton communities are largely unknown. We investigated the taxon-specific utilization of DOP in phytoplankton collected from upstream (river) and downstream (ocean) sites in Winyah Bay, SC, using combined nutrient addition bioassays and an enzyme-labelled fluorescence assay for expression of alkaline phosphatase (AP). AP expression was highest in phytoplankton collected from the ocean location (up to 33% of total cells were labeled). Labeling was detected only in some dinoflagellates and diatoms. AP expression was significantly lower in bioassay containers with added inorganic P. Overall AP expression was species-specific, site-specific and varied with month of collection. Chemoac characterization of the bulk DOP pool may provide insight into the observed variability. Characterization of DOP using liquid 31P NMR is currently underway. (Supported by ONR)

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ESTUARINE CIRCULATION AND NEW PRIMARY PRODUCTION IN THE STRAIT OF GEORGIA USING AN INVERSE METHOD

The circulation of the Strait of Georgia estuary is obtained from an inverse box model based on 48 surveys carried out over the years 2002-2005. We discuss seasonal and interannual variability in the circulation, and show that the effect of storage terms in the budgets is due to the superposition of the strait circulation from variations in freshwater inflows. By combining the circulation model with observations of nutrient concentrations we find that a nutrient sink exists in the surface water. We use this to estimate new primary production, which is different in winter, summer, and during the spring bloom. In addition we speculate on the strength of recycled production by examining the Si:N ratio of this sink.

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INTERPRETING DYNAMIC SIGNATURES OF LAND-WATER COUPLING AND IN STREAM PROCESSES IN THE AMAZON FROM SMALL STREAMS TO THE WESTERN TROPICAL ATLANTIC

The spatial and temporal distributions of dissolved CO2 in surface waters of tropical river systems is the product of a long sequence of complex biological, hydrological, and geochemical processes. A key gap in our knowledge is how these distributions vary with the hydrograph across a broad range of landscapes and river size. Recent data from the Rede Beira Rio work are extensive, with roughly 20 sites characterizing a wide range of Amazon environments and river orders, from small streams to the Amazon mainstem, with a broad suite of measurements over the period 2004-2006. Systematic variations in pCO2 relative to other chemical parameters were observed, including O2, DOC, and FPOC, suggesting an environmental “coherence” across scales, which ultimately governs the export of the Amazon end member to the WNTA, with subsequent marine implications.

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IMPACT OF MODEL REPRESENTATION ERROR ON OCEAN CLIMATE FORECASTS

Knowledge of the structure and magnitude of errors in both observations and models is critical for successful data assimilation. We have developed a reduced state space scheme to estimate model representation error using long term model forecasts and time series of remotely sensed sea surface temperature and sea surface height obtained from satellites. The long term forecasts are used to create the reduced state space; the complement of the reduced state space is shown to be indistinguishable from noise. The model representation error can be estimated from the null space of the projection of the model and observation linearizations into the reduced state space, using the techniques described by Richman, Miller and Spitz (Geophys. Res. Letters, 2005). The technique is applied to the ocean forecasts from the NCEP Climate Forecast System (CFS) at present the CFS uses data assimilation to provide an improved initial condition of the ocean for the coupled forecast. The resulting representation error does not dominate the model-observation misfits. The climate model has significant errors in the equatorial cold tongue and the western Pacific warm pool. A simple reduced state space optimal interpolation can not assimilate these errors. We include realizations of the representation error as an ensemble of annual forecasts of the ocean to characterize its impact on the probability distribution for temperature and sea surface height, and thus derive an enhanced data assimilation system.

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WATERSHEDS AND CORAL REEFS: CONSERVATION SCIENCE, POLICY AND IMPLEMENTATION

Coral reefs worldwide are being degraded by human-induced disturbances, resulting in ecological, economic and cultural losses. Runoff and sedimentation are among the greatest threats to coastal reefs surrounding high islands and adjacent to continental landmasses. Scientific data exist that identify key stressors, synergisms, and outcomes at the coral reef ecosystem, community and population levels. These data demonstrate that marine protected areas alone may be insufficient for coral reef protection, and that integrated watershed management practices are also needed. Gaps in the effectiveness of environmental policy, legislation and regulatory enforcement have resulted in the continued degradation of U.S. reefs. Several Pacific Islands, with intact resource stewardship and traditional leadership systems, have been able to apply research findings to coral reef management policies relatively quickly. These case histories in Micronesia provide insight into how biophysical data can be applied to manage human behaviors responsible for coral reef destruction, through the social sciences.

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INVESTIGATING EXCHANGE BETWEEN THE KUROSHIO AND MARGINAL SEAS OF CHINA USING MODEL SIMULATIONS OF FLOATS AND DRIFTERS

Simulated drifters and floats are seeded in the East Asian Seas Navy Coastal Ocean Model (EAS NCOM) to investigate exchange between the Kuroshio and marginal seas of China. Drifters follow surface currents, while floats remain at selected depths. Fidelity of short-term model prediction is assessed by comparing paired simulated and observed drifter trajectories, while accuracy over longer time scales is evaluated using model and historical transports in various straits. Distributions of trajectories over multiple years reveal long-term exchange patterns with interannual and seasonal variability. The EAS NCOM, driven with real-time atmospheric forcing and tides, has been running daily at the Naval Oceanographic Office for several years. Modeled annual transports in the Luzon strait are 7.2 Sv, 4.9 Sv and 5.4 Sv for 2004, 2005 and 2006 respectively. East of Luzon, the transport is 15 Sv in 2004 and about 30 Sv for 2005 and 2006. EAS gives reasonable transports for other straits in the region as well. Thus realistic flow exchange between the Kuroshio and adjacent marginal seas is expected.

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THE FAROE BANK CHANNEL OVERFLOW: COMPARISON BETWEEN SIMULATIONS, SIMPLIFIED OVERFLOW REPRESENTATIONS, AND HYDRAULIC JUMP THEORY.

High-resolution regional simulations of the Faroe Bank Channel overflow, carried out using the MITgcm, are used to evaluate a simplified representation of the transport and mixing within the overflow, the Marginal Sea Boundary Condition (MSBC). This representation has recently been implemented in a global climate model as part of the Gravity Current Entrainment Climate Process Team. A key discrepancy between the simulations and the MSBC is shown to be the rapid widening of the overflow plume in the simulations which is not captured by the MSBC approximations. A possible cause of this widening, also indicated by observations, is a lateral hydraulic jump. Comparison between model results and hydraulic jump theory supports this hypothesis.

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EFFECTS OF CO2-DRIVEN REDUCTIONS IN SEAWATER CACO3 SATURATION STATE ON ARAGONITE AND LOW-TO-HIGH Mg CALCITIC MARINE INVERTEBRATES AND ALGAE

Elevated atmospheric pCO2 decreases seawater pH and [CO3=], reducing seawater saturation with respect to aragonite and calcite, the primary shell-building minerals of marine calcifiers. We are conducting long-term laboratory experiments to determine the effect of reduced seawater CaCO3 saturation state on biocalcification by 21 aragonitic and calcitic (low-high Mg) taxa representing eight of the major marine calcifying groups: Chlorophyta; Rhodophyta; Crustacea; Bivalvia; Gastropoda; Annelida; Cnidaria; and Echinodermata. The CaCO3 saturation states of the experimental seawaters, constrained by intercalibrated determinations of pH, alkalinity, and DIC, are achieved via air-CO2 mixtures of 380 (ambient), 560, 840, 2240 ppm CO2, yielding Ω-arag of 3.2 (ambient), 2.4, 1.8, 0.8, respectively. Isotope spikes (137Ba) and buoyant weighing are employed to constrain rates of calcification/dissolution. Using a newly developed CT scan we are able to assess changes in bimineral morphology, trace element geochemistry, and shell density. Initial results indicate significant and taxonomically-varied responses to reduced seawater saturation states. At lowest Ω-arag (0.8), new CaCO3 continues to be accreted within the calcifying zones of many of the organisms. Significantly, these same organisms are simultaneously undergoing net CaCO3 dissolution.

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INFLUENCE OF FIELD TEMPERATURE VARIATIONS ON PELAGIC LARVAL DURATION IN THE INVASIVE GASTROPOD CREPIDULA FORNICATA: IMPLICATIONS ON POPULATION CONNECTIVITY

Pelagic larval duration (PLD) is a key characteristic of marine benthic species with pelagic larvae, especially for invasive species as it strongly influences their potential for sustainable settlement and spread. Understanding how climate affects an invader's PLD is thus crucial. By combining field studies (bay of Morlaix, English Channel), experimental data and mathematical computations, we investigated the effect of temperature variations on the PLD of the larva of the slipper limpet Crepidula fornicata, invasive along the European coasts. In the range of field temperatures faced by larvae during a three-year survey (9-18°C) our results suggest a great range of PLDs, suggesting that larvae released during early spring, if they can overcome mortality, might contribute more to spread than to local settlement, the opposite occurring for larvae released at warmer temperature. Analysing similar patterns along the European distribution of C. fornicata allowed us to suggest that in some cases the potential ocean temperature increase might increase population connectivity.

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AUTONOMOUS IMAGE SELECTION FOR BENTHIC CLASSIFICATION

Modern technology now allows vast numbers of images of the seabed to be captured and stored. Before this data can provide any meaningful information the images need to be classified by benthic ecologists. This can be a time consuming process, and often only a subset of the original data can be considered. We provide a computerised method to automatically select this subset. Using a Gaussian process approach, we consider the spatial variation of the benthos and autonomously select the subset which provides the maximum information about the underlying distribution.

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THIN LAYERS AND HARMFUL ALGAL BLOOMS IN MONTEREY BAY, CA

As part of ONR’s interdisciplinary Layered Organization in the Coastal Ocean program, we studied the species-specific distribution of phytoplankton inside and outside of thin
layers in Monterey Bay, California during the summers of 2005 and 2006. Monterey Bay is home to an extraordinarily diverse community of phytoplankton, including many taxa implicated in Harmful Algal Blooms. A remarkable feature in 2006 was the prevalence of HAB species, including Alexandrium catenella, Dinophysis fortii, Pseudo-nitzschia spp. and Chaetoceros concavicornia. Harmful Algal Blooms are frequently dominated by a single taxon. However, during our experiment multiple HAB taxa co-occurred. In some cases they were concentrated in thin layers, while in others they were more broadly distributed throughout the water column. Dinophysis fortii co-occurred with its putative prey, Myrionecta rubra. Species-specific vertical distribution patterns have implications for both the impacts of HABs, and for their ecology. Thin layers contain enhanced concentrations of cells, so their waters may be more inimical than other regions of the water column. They may also contribute to the ecological success of specific taxa, by concentrating in close proximity interdependent organisms.

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AEROBIC MICROBIAL FUEL CELLS FOR OPERATION IN THE OCEAN COLUMN
Microbial fuel cells (MFCs) harvest energy from a wide variety of carbon sources to produce electricity at neutral pH and ambient temperatures. Because most environments on Earth are exposed to significant levels of oxygen, we believe the transition from sediment based MFCs to oxygen-tolerant MFCs is necessary. Our specific focus is on the powering of ocean water column sensors by an oxygen-tolerant mini-MFC. We isolate the desired electron-producing microbes in the anode chamber with membranes that contain pores sizes smaller than the microbes of interest (< 1 μm). Selected nanoporous polymer filters can be used effectively in place of standard PEMs in the mini-MFC (device cross-section: 2 cm²). Exposing the anode to air also creates unique growing conditions for the microbes themselves compared to the standard anerobic anode conditions used in MFCs. We found that significant power was generated from glucose using Shewanella species in the mini-MFC design under aerobic conditions. In addition to glucose, other carbon fuels including fructose, sucrose, acetate and ascorbic acid were tested. The power produced from glucose decreased considerably if strictly anaerobic conditions were maintained. The design of the mini-MFC has expanded the breadth of potential electron donors for Shewanella MFCs and demonstrates the importance of studying microbial species under diverse environmental conditions.

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HIGH-RESOLUTION SURFACE SALINITY AND TEMPERATURE MEASUREMENTS FROM ARGO FLOATS
With the coming of the Aquarius satellite mission there is an increased interest in the surface salinity field of the global ocean. Validating the Aquarius measurements and interpreting them in terms of the underlying salinity field will be an important task. The global Argo array of profiling floats provides one way to carry out such an exercise, although Argo floats do not generally measure temperature and salinity above depths of 5 meters in the ocean. In order to extend the Argo measurements to the sea surface, we have added auxiliary CTD sensors to several floats that can collect high-resolution (depth intervals less than 20 cm) temperature and salinity data along their profiles through the upper 50 m of the water column. We show examples of these near-surface profiles, discuss their precision and accuracy, and examine the broader implications of such work for the upcoming Aquarius mission.

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ALGAL NATURAL PRODUCTS MEDIATE MULTIPLE ECOLOGICAL INTERACTIONS ON CORAL REEFS
How algal species can proliferate in reef habitats and how they can maintain these phase shifts are critical questions to managing coral reef habitats. On two Caribbean reefs we show that some common reef algae (but not all) use chemical defenses to deter reef fishes. In Belize, the sea urchin Diadema antillarum was less discriminating than reef fishes and consumed some of almost all species of algae offered to them. For example, fish were strongly deterred by some brown algal extracts, while the urchins readily consumed them. Herbivorous reef fishes and D. antillarum have different algal preferences (often driven by chemical defenses) and can have differential effects on algal community composition. Algal natural products also mediate competitive interactions with scleractinian coral larvae. Some species of Lyncbya and Dictyota are as well as extracts of some of these spe1. View all higher resolution images for this article cies caused either recruitment inhibition or avoidance behavior in coral larvae. Natural products protect some algae from herbivory (allowing increased space occupation) and reduce coral recruitment, both of which may perpetuate a phase shift from coral to algal dominated communities.

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A CASE STUDY DESCRIBING AN OFFSHORE WARM FILAMENT OF THE FLORIDA CURRENT NEAR 30N
Aspects of a surface layer filament flowing eastward of the Florida Current during February-March 2007 are described. The evaluation is based on comparisons between 49 aircraft-deployed xbt profiles and the filament location interpreted from satellite images of sea surface temperature. Using temperatures greater than 23°C to indicate filament waters, the surface thickness varies from 150 m within the Florida Current to 50 m toward the east. The xbt data also reveal a cyclonic eddy coincident with the filament such that the filament was located on the southern flank of the eddy. The filament is sufficiently thick and broad (~50 km) to modify the acoustical properties for Navy training applications. Some speculation is also presented on the potentially significant role of eddies to divert mass and heat from the western boundary surface flow into the subtropical central gyre.

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VARIABILITY OF THE DIFFUSE DOWNWELLING IRRADIANCE IN GULF OF MEXICO HYPONIC AND NON-HYPOXIC WATERS
Light availability is a key factor regulating water-column oxygen concentration. In the shallow waters of the Louisianat continental shelf, light availability below the pycnocline may determine the vertical distribution of hypoxia. A 166-channel (350 - 800 nm) Atlantic HyperPRO was used to derive in-situ time-series measurements of diffuse attenuation coefficients, Kd, from a station in hypoxic waters and an in-shore non-hypoxic station. Kd(490) in hypoxic water was 0.08 +/-0.05 m-1 between surface and 15m depth. Kd(490) below 15m started at 0.20 m-1 and increased to a maximum of 0.94 m-1 at the 24 m bottom. Kd(490) in non-hypoxic water was 0.02 +/-0.11 m-1 at surface decreasing to 0.28 +/-0.11 m-1 at 6m depth. Comparisons will be made with supporting physical measurements to understand dynamics of Kd(490) in hypoxic and non-hypoxic waters.

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HOW TO RECONCILE CONTRADICTING FORECASTS IN THE COASTAL OCEAN?
Multi-model Super-Ensemble (SE) aiming at combining optimally different models have been shown to improve significantly atmospheric weather predictions. In the coastal ocean, complex, yet poorly understood dynamics, the presence of small-scale processes, the lack of real-time data and limited reliability of operational models so far prevented the proper application of SE methods. Here, we report results from state-of-the-art super ensemble techniques based on dynamic combinations of SEPT [a (t)rew-train-tom-bottom mounted platform transmitting in near real-time] data and a series of eight operational models ran during an experiment in a coastal area in the Adriatic Sea. Kalman filter and
Particle filter based methods which allow for dynamic evolution of weights and associated uncertainties are shown to increase flow speeds (10%) as compared to single models. The latter method copes with non-Gaussian error statistics and reduces the uncertainty by a further 30%.

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HIGH FREQUENCY RADAR NETWORK WITHIN THE MID-ATLANTIC REGIONAL COASTAL OCEAN OBSERVING SYSTEM

High Frequency (HF) radar has been established as an important component of Mid-Atlantic Regional Coastal Ocean Observing System (MARCOOS). The HF radar network currently consists of 26 sites with multi-pulse and nested coverage from Cape Hatteras to Cape Cod with high-resolution coverage of the four major estuaries in the region. This network provides regional surface current maps to improve United States Coast Guard search and rescue operations, mitigate hazardous material spills as well as improve rip current forecasting. The radial current files are aggregated into the national data archival system. Specific applications include assimilation into a statistical model and three dynamical models with the goal of improving surface current forecasts for search and rescue. Test bed activities will routinely compare these forecasts with drifters released into the coverage area to determine the parameters necessary for inclusion into the Coast Guard search-planning tool, SAROPS. The MARCOOS HF Radar network has moved from small isolated systems to a single integrated regional system, a model that is being scaled around the world.

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DISTRIBUTION OF TRANSPARENT EXOPOLYMER PARTICLES ALONG AN ESTUARINE SALINITY GRADIENT

Transparent exopolymer particles (TEP) play an important role in organic matter sinking fluxes in marine ecosystems. Little is known about the importance of TEP in estuaries, however. We examined the distribution of TEP along a salinity gradient in North Carolina’s Neuse R. Estuary (NRE). In summer 2007, TEP was positively correlated with salinity. Even though several large phytoplankton blooms, which are a source of TEP were found in the upper NRE, TEP did not deviate from a conservative mixing line at those locations. We hypothesize that estuarine features, like salt plumes, could play a determining role on the formation and distribution of TEP. The formation may be inhibited by the lack of cations. This inhibition of TEP formation in the lower salinity regions of estuaries may have important implications for phytoplankton sinking fluxes and estuarine oxygen dynamics, as it is in these regions of estuaries where large blooms often form and where phytoplankton-fueled bottom water hypoxia can be problematic. Results will be presented from the in situ TEP monitoring as well as from time-course experiments in which TEP concentrations were observed in mesocosms with and without added cations.

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FLUID – GAS EXPULSION ON THE DEEP GULF OF MEXICO CONTINENTAL SLOPE: GEOLOGIC FRAMEWORK FOR CHEMOSYNTHETIC COMMUNITY SITES

Massive sediment input to the Gulf’s northern continental slope and associated salt wedge formation events can also be detected in ocean color satellite imagery, providing a regional perspective complementing the observatory results. These events do not happen at all locations equally, but form distinct geospatial patterns primarily related to the patterns of forcing, namely wind and insolation. Attempts have been made to model diurnal warming events as seen over a region through use of remote sensing techniques. Comparison of these modeled events to those as seen from space will be presented. Also, comparison of model results to ship and other in situ platforms will be shown. Use of modeling parameterizations allows for an examination of global fields of diurnal warming and its variability over a variety of temporal and spatial scales.

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CFAMS: A NEW RADIOCARBON MEASUREMENT TOOL FOR MARINE GEOCHEMISTRY

Continuous-Flow Accelerator Mass Spectrometry (CFAMS) is a new analytical tool that will open new research doors in measuring radon. Carbon, and other diagenetic gases. The CFAMS uses samples by cesium sputtering, this new technique involves direct measurement of CO2. Advantages to this approach include more rapid and less expensive measurements, lower blank, and simpler chemistry. More importantly, this approach allows direct interfacing of the resulting gases and liquid chromatographs, laser ablation/combustion systems, progressive pyrolysis combustion units, and Kiel devices. The first group permits radionuclide analysis of individual compounds with unprecedented rapidity and accuracy, illuminating carbon flow in the environment, and environmental forensic and opens the door to radionuclide analysis of sub-microgram samples. The second group permits detailed spatial mapping of radionuclides in structures like oil spills, speakerboxes, and tropical (ring less) trees. The third group allows operational separation of individual

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PARTICLE MOBILIZATION FROM MID-SHELF SAND SEDIMENTS OF THE SOUTH ATLANTIC BIGHT IN RESPONSE TO PHYSICAL FORCING

The BOTUMS-UP project established a pilot benthic observational on the continental shelf off Georgia (~26 m depth), building on existing offshore monitoring infrastructure, and offshore Navy tower. Shelf sediments in this area are predominately permeable sands. Light at the bottom is often sufficient for benthic microalgae photosynthesis. One aspect of the study examines the role of physical disturbance in resetting the benthic system, removing fine particles and contributing to high permeability and high biogeochemical activity in surface sediments. Initial results from spring- fall 2007 are presented, focusing on fine particle export from the sands in response to physical forcing, and subsequent settling. Turbidity and chlorophyll fluorescence measured near-bed (0.5-2.0 m above the bottom) and in the water column track changes in suspended particles and chlorophyll (the latter potentially including suspended benthic microalgae). These data are combined to yield observations (including wind, surface waves) and results from other benthic packages (including near-bed velocities and bed form evolution). Major particle suspension events can also be detected in ocean color satellite imagery, providing a regional perspective complementing the observatory results.

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LOCAL AND SURFACE INTENSIFICATION OF TIDAL CURRENTS AND MIXING IN THE INDONESIAN SEAS

In the Indonesian Seas, North and South Pacific Waters are transformed by mixing into Indonesian Throughflow Water with much of the mixing attributed to tides. To investigate barotropic and baroclinic tides in the Indonesian Seas, they were simulated using the Regional Ocean Model System (ROMS) with forcing by four tidal constituents, M2, S2, K1, and O1. The intricate topography of the region along with interactions between the Pacific and Indian Ocean tides resulted in strongly depth dependent velocities and internal tides were generated by all constituents. Extensive interactions occurred in the internal tidal fields between a beam and its own reflections, between internal tides generated at different locations (i.e. different sides of a channel, or beams generated nearby), between the barotropic and baroclinic tidal beams, and between beams of the different constituents. Extremely complex internal tidal fields resulted with high variability, both spatially and during a tidal cycle. Additionally, propagation was often trapped in the surface layer. Regions away from topography showed a Garrett-Munk (G-M) dependency in spectral levels. However, spectral density was elevated at higher frequencies in regions of high
internal tide generation. And the elevated spectral density persisted well away from the topographic features near the surface, but not deeper in the water column. Intense mixing was also found to be localized over topographic features.

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HURRICANE-INDUCED DEPTH OF CLOSURE Derived FROM AIRBORNE LASER BATHYMETRY INDICATES HYDRODYNAMIC AND GEOLOGIC CONTROLS IN SOUTHEAST FLORIDA

Reported here is a method that identifies an event-dependent depth of closure (DOC) using airborne laser bathymetric data. The measured DOC was compared horizontally and vertically to DOC positions that were calculated in the traditional manner (Hallermeyer, Birkemeier, and Nicholls equations) and to geomorphic units at 1046 locations spaced 100 m along the coastline. Calculated DOC values were on average 2.8 m deeper than the measured DOC in the northern end of the study area. Diachastic channel fields match the measured DOC to the north, with a vertical difference of 0.3 m and a horizontal difference of 161 m, on average. Because diachastic channels are hydrodynamically formed, the northern study area appears to be hydrodynamically controlled. To the south, small horizontal differences (90 m, on average) between hardgrounds and measured DOC suggest geologic control south of Hillsboro Inlet. Because this study measured an event-dependent DOC where waves generated by two hurricanes were larger than normal, the measured DOC represents a deeper DOC that rarely changes over time.

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COSEE OCEAN LEARNING COMMUNITIES: COLLABORATIVE PARTNERSHIPS START AT HOME

The core mission of the Centers for Ocean Sciences Education Excellence (COSEE) is to promote partnerships between research scientists and educators through a national network of regional hubs and centers. This network fosters collaborative initiatives that benefit the network and beyond. To address the challenging issue of ocean sciences education informed by scientific research, COSEE supports partnerships between research institutions, formal, and informal education institutions. COSEE Ocean Learning Communities, a collaborative experiment between the UW College of Ocean and Fishery Sciences and College of Education, the Seattle Aquarium, and The College of Exploration. The theme of COSEE OLC is to study how to foster Learning Communities that cultivate ocean sciences-literate citizens aware of the ocean’s impact on their life. To facilitate educational efforts with disparate regional contexts, the OLC leadership team provides a collaborative approach within its structure. This presentation will highlight some of the management, and team-building strategies adopted by the center. The authors will discuss the challenges of the first few months of operation and the approaches that have improved communication, and started the development of a common language, and a better understanding of the various cultures involved in the center. How each culture strengthens and enriches the goals of the center fosters the emergence of an Ocean Learning Community.

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ADVANCED SYSTEMS FOR PREDICTING COMPLEX FEATURES OF REGIONAL OCEAN CIRCULATION

Large-scale, mesoscale and small-scale features constitute the generally complex circulation and flow of the regions of the ocean. The identification of the dominant currents, meanders, eddies and waves and their efficient description in terms of critical parameters, both in physical and phase spaces is essential to facilitate regional dynamical studies, simulations, and real-time forecasting. The role of feature models in advanced ocean observing and prediction systems is extremely important. The concept of such systems for field and parameter estimations has three major components: (i) an observational network: a suite of platforms and sensors for specific tasks, (ii) a suite of interdisciplinary-dynamical models and (iii) multivariate data assimilation schemes. Model-model, data-data and data-model compatibilities are essential. Systems are becoming increasingly modular, based on distributed information providing shareable, scalable, flexible and efficient workflow and management functionality. Multi-scale examples using the Harvard Ocean Prediction System that are presented in this tutorial include: the Gulf Stream, the Brazil Current, upwelling in the California Current System off Monterey Bay, and nested regional climate change modeling of the Gulf of Maine.

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A FRAMEWORK FOR ASSESSING THE REPRESENTIVITY OF FISH DIVERSITY IN NATIONAL MARINE CONSERVATION AREAS AND NATIONAL PARKS OF CANADA

In Canada, zoning is used in National Marine Conservation Areas (NMCA) and Coastal National Parks (NPs) to conserve biodiversity that is representative of a greater natural marine region. In this study, 3 elements of species diversity (richness, evenness and relatedness) were used as a measure of biodiversity, and they were evaluated to assess the representivity of protected zones. In this poster, I test the assumption of equivalent species diversity among examples of the same habitat, and discuss a framework for selecting habitats in order to fully protect and conserve representative regional species diversity. I have used fish species and abundance data collected by beach seine for eelgrass meadows (Zostera marina) and gravel beaches from Pacific Rim National Park Reserve of Canada, located on the west coast of Canada. Two questions were addressed in this poster: 1) Are eelgrass meadows equivalent to gravel beaches in the fish species diversity elements that they represent? and 2) Do all examples of eelgrass meadows or gravel beaches equally represent fish species diversity of the greater natural region?

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INTERACTIONS BETWEEN PHYTOPLANKTON, MICROCOOZOOPLANKTON AND MESOZOOPLANKTON IN NEARSHORE SYSTEMS ALONG THE WEST COAST OF PENINSULAR FLORIDA, USA

The fates and impacts of nutrients transported by rivers represent critical drivers of coastal ecosystems. One conceptual model for large rivers with discharges bearing sediment and nutrients predicts that phytoplankton production controls to yield i) lower phytoplankton biomass, phytoplankton production, zooplankton abundance, and zooplankton grazing in low light environments near river mouths; ii) highest phytoplankton biomass and production in partially mixed zones where settling improves light availability, nutrients remain available, phytoplankton production species microzooplankton grazing and mesozooplankton abundances remain low; and iii) lower phytoplankton biomass and production further offshore where higher mesozooplankton abundances raise grazing pressure and nutrients become depleted or diluted (Dagg & Breed 2003). The generality of this model was tested in three systems along Florida’s Gulf coast using field samples and 24-h incubations of phytoplankton with and without zooplankton. Results differ from predictions, with phytoplankton biomass normally peaking near river mouths, phytoplankton production following a similar pattern or remaining constant, mesozooplankton abundance and grazing being similar across zones, and mesozooplankton abundances remaining constant. Patterns are attributed to scale-dependent, spatiotemporal interactions among processes.

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HISTOPATHOLOGICAL ANALYSIS OF THE LIVER OF FLATFISH ACHIRUS LINIATUS IN A POLLUTED ESTUARY IN BRAZILIAN COAST

The Santos estuarine system, in Brazilian southeast coast, is an intensely populated area and contains an industrial pole and the major harbor of Latin America. Two estuaries of low hydrodynamic and bordered by mangroves, flows into a bay, adjacent a continental shelf. In the 50 and 60’s decade, this region showed high contaminants index because of they multiples resources. The local fauna showed bioaccumulation of hydrocarbon and PCBs in its tissues. Measures were taken to mitigate such damage and as a result there were a quantitative reduction and a qualitative improvement of the industrial effluents. With the propose to investigate the regional real state, livers of the flatfish Achirus lineatus, collected at the Santos Bay, were studied because of its key role in metabolism and subsequent excretion of xenobiotics. Sample histopathological analysis showed the presence of Melano-Macrophage Centres and others structural alterations at the liver that can be an indicative of environmental stress. The present aim is monitoring the impact of the antropic activities at the region using biomarker that will allow, with others studies, assess the fish population resilience.

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REDUCING UNCERTAINTY IN THE DETECTION OF ANTHROPOGENIC DIC CHANGES

An ocean model (MOM4 with GFDL’s TOPAZ biogeochemistry model) is used to evaluate the changes in DIC and DOC estimated along Repeat Hydrography sections P16, P17, P20, and P2 in the Pacific and A16 in the Atlantic. The model is forced with reanalysis fluxes over the period 1958-2006. The first goal in using the model is to identify changes in DIC which are due to natural variability in the circulation of the ocean. For this natural vari-
LANTHANIDES PROFILES OF THREE BROWN SEAWEEDS ON THE COASTAL ZONE OF SANTA ROSALIA MINING DISTRICT, BAJA CALIFORNIA PENINSULA, MEXICO

The polluted coastal sediments of the Santa Rosalía mining region have specific rare earth element (REE) shale normalized patterns, characterized by a light REE enrichment and positive europium anomaly. The aim of our research was to evaluate the possibility of a transfer of lanthanides from the sediments of this area into a biota. The concentrations of eight REEs in brown seaweeds Sargassum sinicola, Padina duriavella and Dictyota dichotomy, collected in 2004-2005 along the shore with both pristine, and polluted environments, were measured by a neutron activation analysis. REE shale normalized patterns of the seaweeds, with some exceptions, do not follow the signatures of the surface sediments. The majority of the seaweeds samples display the shale normalized patterns similar to a sea water, characterized by dissolved heavy REE enrichment. Only a very limited number of the seaweed samples had other pattern, displaying Eu positive or negative anomalies, also seen in the soil and sediments of the mining region. It could be presumed that bioaccumulation of REEs into brown seaweeds is controlled mainly by the seasonally changed water transport along the coast.

MAKING GLOBALLY CONSISTENT WATER LEVEL MEASUREMENTS

In this presentation, we review the feasibility of making centimetric accuracy globally consistent swath measurements of water level for both oceans and fresh water bodies. The feasibility of such a measurement must strike a fine balance between technological feasibility (and cost), orbit and sampling design, and understanding of the end-to-end error budget (including physical and technical limitations), and sophisticated calibration techniques. In the first part, we will present the measurement concept behind wide-swath altimetric/interferometric techniques and review the suite of instruments required to make the measurement and the technology trades which are involved in designing an optimal configuration. In the next section, we provide a detailed description of all the error sources which make up the measurement and examine our current ability to deal with each of them. Finally, we conclude with the continuous calibration techniques which are required to obtain a globally consistent data set and present the accuracies expected for the proposed Water/EHydrosphere Mapper mission.

GROWTH AND REPRODUCTION OF INVASIVE KELP SPROOPHYTES (UNDARIA PINNATIFIDA), MONTEREY HARBOR

Biological invasions are attributed to about half of all endangered species declines worldwide. Undaria pinnatifida is an annual brown subtidal alga (Phaeophyceae; Laminariales), native to Japan, China and Korea, where it is cultivated and sold as wakame. The only invasive kelp in the world, Undaria was introduced to Monterey Harbor in 2001. The purpose of this study is to better understand the growth patterns of this invasive alga, Undaria pinnatifida, in the newly invaded range of the Monterey Bay, California. We characterized in-situ sporophyte growth of Undaria in Monterey Harbor and tested how simulated grazing damage (~80-90% of blade removed) affected sporophyte reproductive capacity (max. sporophyll size). In Monterey Harbor, average sporophyte growth rates were greater, and average maximum sporophyte total length were longer, when compared to the previously published data from Santa Barbara Harbor. Damaged sporophytes grew slower, proportional to that of smaller plants, however, maximum sporophyll size (reproductive capacity) was reduced. Further study is needed to determine whether sporophyte growth exhibits seasonal patterns like other Undaria populations worldwide, and the level of disturbance that is likely to result in reproductive failure.

THE COLOMBIA CURRENT: AN EASTERN TROPICAL PACIFIC COASTAL CURRENT, EARLY OCEANOGRAPHIC CHARACTERISTICS

Newly gathered hydrographic data from the Colombia Pacific Ocean is combined with remote sensing data to reassess the properties of the coastal current named Colombian Current by Wooster (1959). New hydrographic data were occupied along the Colombian Pacific coast during March of 2006, making 41 stations with measurements of CTD. On the other hand, sea surface temperatures (SST) were obtained from the MODIS-AQUA satellite and sea surface wind speed and wind direction stem from QuickScat, both averaged for March 2006.Finally geostrophic velocity was computed for the Colombian Current area at several layers.The SST during the month of March of 2006 was especially low in the oceanic zone, reaching temperatures between 19 °C and 24 °C The dynamic topography indicated the presence of a surface coastal current flowing towards the north and a crosscurrent to 400 m of depth never before described.Upwelling curl associated with the left (southeast) flank of Panama Jet generates a cyclonic eddy in the Panama Bight and SST cooling in its center. In the Panama Bight, the curl dipole produces a cyclonic circulation with northward flow along the Colombian coast.

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Weingartner, T.
Yankovsky, A.
Rogers-Cotrone, J. D.(3) investigates culturing a microbial species previously identified around Gulf of Mexico transport phenomena that would distribute bioproducts to hydrate accumulation sites, (2) studies possible gas hydrates in water-saturated porous media: (1) evaluates samples from all possible hydrate accumulations are prolific. This paper discusses laboratory results from forming

Dearman, J.

Clade A were the least sensitive to UV and elevated temperature (little or no effect) whereas exposed to a 12 hour light: 12 hour dark photoperiod over 14 to 17 days. Isolates belonging to

Bochdansky, A.
Rollwagen-Bollens, G.

GROWTH RATES AND FLUORESCENCE QUANTUM YIELDS (Fv/Fm) OF SYMBIODINUM ISOLATES (REPRESENTING clades A, B, C, D, and E) WERE DETERMINED FOR NON-AXENIC CULTURES EXPOSED TO TEMPERATURE AND UV (280 nm to 400 nm) LEVELS EXPECTED FROM GLOBAL CLIMATE CHANGE. EXPOSURES CONSISTED OF A 2 X 2 X 2 FACTORIAL DESIGN WHICH INCLUDED TEMPERATURE (27°C OR 31°C), UV (0 OR 105 W/m²) AND PHOTOPHYSICALLY ACTIVE RADIATION (527.05 cm²/m²). SYMBIODINIUM CULTURES WERE PREPARED IN STERILE POLYETHYLENE SAMPLING BAGS THAT WERE TRANSPARENT TO UV AND PERMEABLE TO CARBON DISSOLVE AND OXYGEN. CULTURES PLACED IN TEMPERATURE-CONTROLLED BATHS WERE EXPOSED TO A 12 HOUR DUSK PHOTOPERIOD OVER 14 TO 17 DAYS. ISOLATES BELONGING TO CLADE A WERE THE LEAST SENSITIVE TO UV AND ELEVATED TEMPERATURE (LITTLE TO NO EFFECT) WHEREAS CLADE E ISOLATES WERE THE MOST SENSITIVE TO UV AND ELEVATED TEMPERATURE (NO GROWTH 31°C). INTERMEDIATE SENSITIVITY WAS OBSERVED FOR CLADE B, C, AND D ISOLATES. OUR RESULTS ARE CONSIDERED IN RELATION TO THE REPORTED DISTRIBUTION AND SENSITIVITY TO CLIMATE CHANGE OF CORALS HOSTING THESE SYMBIODINIUM CLADES IN REEF ENVIRONMENTS.

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LABORATORY TESTS OF HYDRATE FORMATION IN POROUS MEDIA INFLUENCED BY BIOPRODUCTS

After observing the catalytic effects of synthetic surfactants on gas hydrate formation in a DOE-sponsored gas storage process, we extended the study to biosurfactants and bio-polymers promoting hydrates in ocean sediments, where microbial activities around gas hydrate accumulations are prolific. This paper discusses laboratory results from forming gas hydrates in water-saturated porous media: (1) evaluates samples from all possible biosurfactant classifications for influences on hydrate formation, (2) studies possible transport phenomena that would distribute bioproducts to hydrate accumulation sites, (3) investigates culturing a microbial species previously identified around Gulf of Mexico (GOM) hydrates, separates surfactant from the culture broth, and evaluates collected surfactant for hydrate promotion in porous media, (4) investigates adsorption, orientation, and interaction of bioproducts with specific mineral surfaces and their hydrate formation effects, (4) reports hydrate morphology effects that vary with biopolymers, and (5) evaluates biosurfactants and biosurfactants/minerals as nucleation for hydrate crystalization.

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THE EFFECTS OF SPATIALLY VARIABLE WIND FORCING ON FRESHWATER TRANSPORT IN A BOUYANCY-DRIVEN COASTAL CURRENT

This modeling study is motivated by observations in the Alaska Coastal Current (ACC). The model domain represents a fraction of the ACC, and periodic boundary condi-

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INTERACTIVE IRRADIANCE AND NUTRIENT EFFECTS ON THE PHOTOSYNTHESIS OF NODULARIA SPUMIGENA

The photosynthetic efficiency of Nodularia spumigena was investigated under different nutrient and light conditions. In axenic cultures, the strength of phosphorus flux was strongly dependent on irradiance levels as they changed with light, vertical nutrient distribution, and the behavior of the dinoflagellates. In addition, it formed a vector of phosphorus flux downwards due to sinking cells. The strength of phosphorus flux was strongly dependent on irradiance levels as they changed with light, vertical nutrient distribution, and the behavior of the dinoflagellates.

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COMMUNITY ENGAGEMENT: A CRITICAL ROLE IN OCEAN OBSERVATORIES

A series of new facilities is being planned at the NSF’s Ocean Observatories Initiative. These observatory systems and their linking cyberinfrastructure network have the potential to revolutionize ocean science research and education. The full impact of these observatories will most likely be achieved only if these new ocean observing assets are catalytically integrated with the broad range of currently existing research and education programs, facilities, and partnerships. In the education realm, some of the major challenges that we will discuss include: (1) formulating ocean science topics educators, textbook developers, and students are most interested in; (2) integrating data into teaching and learning developments in new technologies, social networks, and bilingual settings; (3) expanding local or regional successes into collaborative efforts with a nation-wide impact; (4) enhancing the size, intellectual scope, and diversity of the ocean education community; (5) emphasizing the creative opportunities enabled by the novel observatory projects (real-time data, the ability to control/configure sensors and mobile assets, high-bandwidth infrastructure for images); and (6) developing partnerships between networks of scientists, educators, and technology specialists.
Vertical habitat shifts in California current mesozooplankton: copepods vs. chaetognaths

We seek to determine whether vertical habitats of specific mesozooplankton groups are related in a consistent manner to the hydrographic or biotic structure of the water column, and are therefore likely to vary in a predictable manner with climate-related changes. To address this issue, we have examined vertical habitats of zooplankton in hydrographically distinct regions of the California Current as part of the CCE-LTER (California Current Ecosystem-Long Term Ecological Research) process cruises. Vertically stratified samples collected with a 202-Amesh MOCNESS have been digitized at 2400 dpi with a scanning device (Zooscan), then classified into distinct zooplankton taxa using an automated machine learning algorithm. Based on construction of a confusion matrix from which have consistently identified with sufficiently high fidelity include non-eucalanoid copepods, eucalanids, chaetognaths, and euphausiids, with correct identification rates ranging from 91% for non-eucalanoid copepods to 79% for eucalanids. Copepods, but not chaetognaths, showed higher vertical migration (DVM) behavior that differs by body size and geographic region. In offshore, more optically transparent waters, copepods show larger amplitude DVM, presumably associated with increased visual predation risk.

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Spatial patterns in hypoxia and zooplankton in the Gulf of Mexico

High resolution mapping of zooplankton, oxygen and physical properties of the water column in the northern Gulf of Mexico were conducted during four summers of differing freshwater input and wind-mixing. Our results show inverse relationships of hypoxia and water column-integrated zooplankton biomass. The spatial patterns of hypoxia and zooplankton exhibit significant annual and short-term variation due to differences in freshwater discharge, wind direction and intensity. Elevated areas of zooplankton biomass (hot spots) were associated with physical discontinuities and onychites. We compare estimates of hypoxic waters and plankton biomass in the northern Gulf of Mexico to other coastal systems to gain a better understanding of the effect of hypoxia on pelagic resources.

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Latitude heat flux variability in the tropical Pacific from observations and models

Tropical Pacific evaporation is a key metric for coupled model evaluations with respect to air-sea exchange. The evaporative fluxes at the sea-surface represent a tight connection between the ocean and the atmosphere that depends on wind, SST, air humidity, bulk parameterizations and boundary layer physics. At the same time the Tropical Pacific, which is an extended body of water, is the primary driver of the tropical atmospheric circulation and is well observed (by buoys, ships and satellites). The air-sea interaction at the tropical Pacific is described by several different physical mechanisms and scales of variability: for example the Warm Pool vs. the Niño3 region, the ENSO variability and the Madden-Julian Oscillation. Here, we compare the magnitude and variability of latent heat flux, wind and humidity in the Tropical Pacific from satellite derived datasets and in situ observations and investigate the fidelity of climate models with respect to evaporative fluxes in the Tropical Pacific.

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Current measurements in rivers from space by along-track interferometry

The along-track interferometric synthetic aperture radar (along-track InSAR) technique permits a high-resolution imaging of surface current fields from aircraft or satellites. Results from the Shuttle Radar Topography Mission (SRTM) and theoretical findings indicate that spaceborne along-track InSARs are suitable for current measurements in rivers if the water surface is at least 200-300 m wide and sufficiently rough for microwave backscattering at slanting incidence. The German satellite TerraSAR-X, which was launched in June 2007, will be the first to offer along-track InSAR capabilities during some longer period in an experimental mode of operation. In this presentation we give an overview of basic principles, SRTM results, and predicted current measuring capabilities of TerraSAR-X. SRTM-derived currents in the lower Elbe river (Germany) are shown to agree well with numerical hydrodynamic model results. Simulation results for TerraSAR-X indicate an even better data quality. Depending on width, surface roughness, and relative flow direction of a river, current estimates with an accuracy better than 0.1 m/s will be possible with an effective spatial resolution of a few hundred meters to kilometers.

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Interaction between diazotrophic bacteria and mangrove roots under different nutrient conditions

The ecological interaction between diazotrophs and mangrove roots was studied in a peat-based sediment located in Belize. A long-term fertilization experiment was established in 1998. Trees are fertilized at six-month intervals with phosphorus and nitrogen. Diazotrophy was measured by the acetylene reduction technique and compared with roots distribution in the sediments. The molecular diversity and community structure of diazotrophs in bulk sediment vs. rhizosphere (area directly around the roots) at different nutrient conditions was analyzed by PCR amplification of nifH sequences and TRFLP. We found that N2 fixation rates range from 0.2 to up to 34 nmol ethylene/dry wt/h with a significant difference among nutrient treatments and sediment depth. Undenitrified and N-fertilized sediments have lower rates that vary with root distribution. However, biological nitrogenase-like sequences have higher N2 fixation rates regardless of root distribution. Preliminary results of the nifH-TRFLP fingerprints showed that only ~20% of operational taxonomic units observed in the rhizosphere are found in bulk sediment indicating a distinct diazotrophic community associated with the mangrove roots.

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Airborne observations of wind-wave spectra in the Gulf of Tehuantepec

We present the analysis of airborne observations of surface waves collected during the Gulf of Tehuantepec Experiment (GOTEX) in 2004. This study is concerned with the evolution of the directional wave number spectrum in fetch-limited conditions. The directional spectrum is characterized through spectral properties (i.e., significant wave height and peak wave number), projections and moments. The main features of the observed spectrum, which highlight the approximate self-similar nature of the wave field, are used in formulating a parameterization of the directional wave number spectrum in the 2D wave plane which depends on the effective fetch and wind stress. The parameterization of the directional distribution in the Cartesian plane reproduces the main properties of the measured spectrum, and is simpler than the polar parameterization of Hwang et al. (2000) by a Fourier series. Our results are discussed in the context of previous observational and theoretical studies.

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Factors influencing the ammonium and nitrate concentrations in the Chesapeake Bay (Severn River)

Excess nutrient (e.g., nitrate, ammonium) inputs from anthropogenic sources is known to have begun effecting the Chesapeake Bay over 100 years ago. Eutrophication has resulted in large charges in the functioning of the Chesapeake Bay ecosystem. Declines in fisher have begun effecting the Chesapeake Bay over 100 years ago. Eutrophication has resulted in large charges in the functioning of the Chesapeake Bay ecosystem. Declines in fisher

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How does Changjiang River Plume spread in East China Sea and Yellow Sea?

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How does Changjiang River Plume spread in East China Sea and Yellow Sea?
The fresh water plume discharging from the Chiangjiang River estuary takes two dramatically different paths: the East China Sea between the summer and winter seasons. A 3D hydrodynamic model based on Regional Ocean Modeling System (ROMS) is developed to better understand the physical mechanisms responsible for the movement and spreading of the fresh water plume in the East China Sea and Yellow Sea (ECYS). ECYS is dominated by upwelling favorable wind in summer and stronger downwelling favorable wind in winter. Taiwan Warm Current flows northward throughout the year but is stronger in summer, carrying warmer and saltier water originated from Taiwan Strait and the Kuroshio branching. During the summer, the prevailing southerly wind together with Taiwan Warm Current pushes the plume in a north-east direction toward the Korean Peninsula. In contrast, the strong northerly wind in winter forces the plume to move south along the Chinese coast. We conduct a series of numerical experiments to illustrate how river runoff, monsoon winds, the large-scale currents and tides affect the dispersion of the fresh water plume and mixing with the shelf water in the ECYS.

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CORAL COMMUNITY CHANGE ALONG A SEDIMENT GRADIENT IN FOUHA BAY, GUAM, MICRONESIA

Alterations within Pacific Island watersheds have led to the degradation of coastal coral reefs and an accompanying loss of ecological, cultural and economic resources. This study from Fouha Bay, Guam, found a sediment output of approximately 2,515 tons/year, yielding 303 tons/km2/year from the adjacent watershed (La Sa Fuu), with rates ranging from 235 mg/cm2/day at the river mouth to 10 mg/cm2/day at the channel mouth. A model derived from this study, 31% of sediments collected in the sediment traps placed in the inner part of the bay and 15% in the outer part were attributable to resuspension of previously deposited material. The model calculating distance over which sediment deposition (50 mg/cm2/day) reversely affect corals was done at 86 m offshore. This finding was consistent with the Moving Window Analysis results, which indicated a transition of 100 m in to more a diverse coral community. The data generated from this study were used to guide the adjacent community of stakeholders on ways they could apply science to policy development and implementation for the protection of their reef resources.

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TSUNAMI RUNUP IN HAWAII: THE DESCRIPTION AND RECURRENCE OF EXTREME EVENTS

Hawaii's tsunami runup hazard is described using information from published sources, the National Geophysical Data Center's (NGDC) Global Tsunami Database, and Honolulu's tide gauge. A general description of tsunami source regions, exposure, and historical runup heights on Oahu is presented first. Far-field, near-field, and mega-tsunami sources are considered. The methods section presents the NGDC tsunami runup observations with a series of charts separating runup observations by island coastlines and discusses variability as a function of source region, earthquake magnitude, and exposure. Local topographic focusing and sheltering is evaluated using published tsunami refraction maps. Population increases within Oahu's coastal regions have amplified the need for a probabilistic assessment of expected maximum runup of future events. Runup measurements from far-field source regions were extracted from NGDC for Honolulu and Waialua. Extremal statistics yielded runup recurrence intervals and associated risk for the two locations. Adding 100-year sea level rise scenarios published by the Intergovernmental Panel on Climate Change (IPCC) to the runup significantly decreases the return period of given tsunami runup values at Honolulu and Waialua and greatly increases possible future risk.

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THREE DIMENSIONAL HYDRODYNAMIC AND EUTRIFICATION MODEL SET-UP FOR THE MOSQUITO LAGOON, FL

The Mosquito Lagoon (ML) is a sub-basin of the Indian River Lagoon (IRL) on the East Central Florida coast, ~54 km long and ~4 km wide with depths averaging 1.5 m. Tidal fluctuation varies less than 15 cm seasonally and circulation is wind dominated. The tide entering ML from its sole inlet (Ponce De León Inlet) is of limited reach and ML’s configuration makes it especially sensitive to sudden influxes of pollutants from increasing human activities within its watershed. Previous studies have indicated the overall health of this system is declining. Implementation of a coupled hydrodynamic-eutrophication model (EFDC/HM3D) of the entire ML will aid in establishing the current state of the ML and system is declining. Implementation of a coupled hydrodynamic-eutrophication model is of limited reach and ML’s configuration is declining. Implementation of a coupled hydrodynamic-eutrophication model (EFDC/HM3D) to the runup significantly decreases the return period of given tsunami runup values at Honolulu and Waialua and greatly increases possible future risk.

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PATTERNS OF ANTIBIOTIC RESISTANCE IN NORTHEASTERN COASTAL VERTEBRATES

The prevalence of antibiotic-resistant bacteria in the marine environment is a significant human health concern, but the degree to which marine mammals, seabirds and sharks harbor these organisms is not well documented. This project sought to identify the patterns of antibiotic resistance in vertebrates from coastal waters of the northeastern United States. 152 bacteria were isolated from tissues and fecal material of 157 vertebrates. Bacteria of clinical interest comprised 50% of organisms isolated. 380 isolates were tested for resistance to a suite of 16 antibiotics. Sixty percent were resistant to at least one antibiotic, while 46% were resistant to multiple antibiotics. A multiple antibiotic resistance (MAR) index value greater than 0.2 was observed in 60% of the resistant pathogens, suggesting exposure of the animals to significantly contaminated sites. Groups of antibiotics with commonly co-occurring resistance were identified. Structuring of resistance patterns based on sample type (live/stripped/ bycaught) but not animal group (mammal/bird/shark) was observed. Antibiotic resistant bacteria were widespread in marine vertebrates, geographically and taxonomically, and illustrated a potential linkage between marine and human health.

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THE ROLE OF FISH AND ULTRAVIOLET RADIATION IN STIMULATING ZOOPLANKTON MIGRATION

Previous research has demonstrated that fish and ultraviolet radiation (UV) both can elicit a behavioral response in freshwater zooplankton and stimulate deeper migration into the water column by day. However, experimental studies of UV-induced migration have been conducted in the absence of fish, and thus the relative importance of these two factors in diel vertical migration is not known. In June 2006 we conducted a factorial experiment (presence and absence of caged fish and UV) in 15 m deep mesocosms in transparent (1% diel vertical migration is not known. In June 2006 we conducted a factorial experiment (presence and absence of caged fish and UV) in 15 m deep mesocosms in transparent (1% UV-transparent mesocosms, with rates ranging from 235 mg/cm2/day at the river mouth to 10 mg/cm2/day at the channel mouth. Significant effect on the vertical distribution of Daphnia in the presence or absence of UV. The presence of fish and UV in controlling the depth distribution of Daphnia. Daphnia avoided the surface UV in transparent mesocosms, with the presence of fish had no significant effect on the vertical distribution of Daphnia in the presence or absence of UV. The relative importance of UV and fish as drivers of vertical migration is likely to be determined by the concentrations and chromophoric properties of dissolved organic matter and the consequent UV transparency of the water.

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VARIABILITY OF TERRESTRIAL INPUTS TO THE WAIPOA CONTINENTAL SHELF: EVIDENCE FROM STABLE CARBON ISOTOPES AND C/N OVER RECENT AND HOLOCENE TIME SCALES

Stable carbon isotopes and C/N from box cores and giant piston cores are presented from the Waipaoa continental shelf, North Island, New Zealand, to characterize transitions in storm event signatures, erosion and climate changes pre and post Polynesian and European influences. Abrupt δ13C and C/N oscillations within discrete layers in box cores signify rapid changes in terrestrial input during recent wet and dry storm deposition. Previous authors report sediments from two shelf depocenters (north and south) have similar physical characteristics, however there is no δ13C overlap between these sites, and the northern depocenter has a much more terrestrial δ13C signature than the southern, highlighting different modes of modern transport to these locations. Giant piston cores retrieved aboard the R/V Marion Dufresne in February 2006 date to 18 ky bp and show variations in allochthonous and autochthonous carbon sources and Quantity, over longer time scales. shelf break, northern depocenter and slope cores have depleted δ13C signatures with depth, revealing the transition between lowstand (late Pleistocene) and modern highstand conditions.
Loss terms include macro- and micro-zooplankton grazing. Results from laboratory experiments and constrained with weekly measurements of chlorophyll a that show interannual variability. The primary production model was parameterized with estimates of photosynthesis vs irradiance response, mixed layer depth availability for krill larvae in the water column prior to winter. Our primary production model is aimed at better estimating biomass in winter sea ice and estimating food for krill larval development. In the austral fall, ice formation results in suspended algae cells in the water column being entrained into the shear layer that resembled an inverted rough boundary layer; however, wake production shifted from a balance between advection, drag and pressure gradient at the upstream end of the kelp forest to a balance between drag and pressure gradient for fully developed flow. Within the kelp array, some TKE was generated by shear production in a sub-canopy layer that resembled an inverted rough boundary layer; however, wake production shifted from a balance between advection, drag and pressure gradient at the upstream end of the kelp forest to a balance between drag and pressure gradient for fully developed flow. Within the kelp array, some TKE was generated by shear production in a sub-canopy layer that resembled an inverted rough boundary layer; however, wake production shifted from a balance between advection, drag and pressure gradient at the upstream end of the kelp forest to a balance between drag and pressure gradient for fully developed flow. Within the kelp array, some TKE was generated by shear production in a sub-canopy layer that resembled an inverted rough boundary layer; however, wake production shifted from a balance between advection, drag and pressure gradient at the upstream end of the kelp forest to a balance between drag and pressure gradient for fully developed flow.
A MODELING EXPLORATION OF CONNECTION BETWEEN SEA SCALLOP POPULATION IN THE MIDDLE ATLANTIC BIGHT AND THE HURRICANE紐約

The interannual variability in the dispersion and settlement of the sea scallop larvae spawned on Georges Bank (GB) was explored using an individual-based scallop population dynamics model. The model consisted of four pelagic life stages (egg, trophophore, veliger and pediveliger) and three benthic life stages (juvenile, young adult and adult). The model results supported the findings from the scallop video survey made in recent years on GB and MAB.

The constraint of carbon export by iron supply to the subarctic Pacific is believed to have contributed to past global climate change. Quantifying iron inputs to these regions therefore is essential to our understanding of this ocean-atmospheric coupling. Each year, mesoscale (~100 km) eddies transport coastal waters to the open ocean. We measured dissolved iron in coastal waters, a 2007 Haida eddy off the Queen Charlotte Islands (Haida Gwaii), and oceanic waters. Our findings show that surface (-80 m) iron concentrations within the eddy were drawn down to oceanic levels, but concentrations in deeper waters remained tenfold higher than outside the eddy. Our calculations indicate that iron influx to the eastern subarctic Pacific surface region (~200 m) from this eddy is comparable to annual aerosol iron inputs. Considering that eddies form annually at 2 other locations, eddy transport may be a major iron source to this HNLC region. However, unlike aerosol inputs, eddy transport of iron likely would be less prevalent at low sea level stands during glacial times, offering a potential feedback mechanism for regulating global climate.

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GLIDER-BASED OBSERVATIONS OF THE KUROSHIO

Beginning in April 2007, a fleet of 2-4 gliders has conducted continuous surveys of the Kuroshio offshore of the Philippines and Taiwan. The primary technical objective is to demonstrate the utility of a glider fleet for sampling strong boundary currents. Scientific objectives are to characterize the structure and evolution of the Kuroshio and its meso-scale field. Glider transects of the surface to 1000 m in roughly six-hour intervals traveling 6 km through the water, traversing approximately 2000 km over the course of a 3-4 month deployment. Observed variables include pressure, temperature, salinity, depth-averaged velocity, dissolved oxygen, and optical properties. A salinity maximum is observed at 100-200 m, strongest in the region of the northward flowing Kuroshio. Low salinity intermediates have structure on roughly 50 km horizontal scales. Consecutive sections, occupied weeks apart, show the evolution of salinity anomalies in this intermediate layer. Northward velocity is more variable, with shorter horizontal scales, than is eastward velocity. The observations are ongoing, and by March 2008, 9 months of continuous coverage should be achieved.

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The input of fresh water to the Gulf of Maine sets up a coastally trapped, buoyancy-driven Gulf of Maine coastal current response due to seasonal freshwater discharge and variable sea level. The Gulf of Maine coastal current is characterized by a surface jet that extends from the mouth of the Penobscot Bay to the Cape Cod Canal. The current is strongest during years with high freshwater discharge, and it is weaker during years with low freshwater discharge due to the northward advection of the North Atlantic Current (NAC) through the Cape Cod Canal.

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IS MONA PASSAGE A BIOGEOGRAPHIC BARRIER? A HYDROCORTALS PERSPECTIVE
The Mona Passage, between the islands of Puerto Rico and La Hispaniola, has been proposed as a biogeographic barrier limiting the dispersal of marine organisms between the Eastern and Western Caribbean. The aim of this work is to explore the former hypothesis by studying the populations connectivity of an important, but underestimated component of the Caribbean reef; the hydromedusa Millopora alcicornis. Samples of Millopora alcicornis were collected from the island of Mona and the southwest coast of Puerto Rico. A DNA segment of the COI was amplified from each specimen. Sequence analysis of 120 colonies resulted in a total of 50 haplotypes, of 8 them shared between the locations. AMOVA analyses revealed that the within-population component of variability was significantly larger than the among-population component, implying the absence of populations structure. Fst neutrality test indicated an excess of rare mutations in specimen from Mona (P = 0.006) suggesting a population expansion. These preliminary results suggest that the Mona Passage is not an effective barrier for the dispersion of M. alcicornis.

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POPULATION DYNAMICS OF CALANUS FINMARCHICUS IN RELATION TO TROPHIC TRANSFER IN THE WESTERN GULF OF MEXICO: THE ROLE OF STORAGE LIPIDS
While its centers of abundance rest in the deep, central basins of the Gulf of Mexico, C. finmarchicus is also abundant and dominant in the megafaunal communities of the coastal shelf and ledges. We present data acquired from the Northeast Consortium PULSE and UNH Coastal Observing Center time series fixed stations showing life cycle and interannual patterns of abundance in the western Gulf, notably the dramatic decline of C. finmarchicus between 2003 and 2005 on Jeffery’s Ledge. We apply recent understanding of control of C. finmarchicus dormancy to develop a hypothesis for the role of climate-forced, bottom-up processes in determining zooplankton lipid levels in the Gulf of Mexico. Availability of storage lipids in late stage Calanus may be an important factor controlling distribution and nutritional condition of herring and tuna around Jeffery’s Ledge during summer.

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PHOTOBIOCHEMICAL PRODUCTION OF HYDROGEN PEROXIDE AND SUPEROXIDE BY PHAEOCYSTIS ANTARCTICA IN RESPONSE TO IRON LIMITATION
We report studies of the extracellular concentrations of hydrogen peroxide and superoxide in cultures of Phaeocystis antarctica, a marine Prymnesiophyte phytoplankter, treated with various phosphorus inhibition and exposed to different iron regimes. Concentrations of hydrogen peroxide and superoxide were determined using flow injection analysis techniques involving chelominescence of acridinium ester and methyl cyridina luciferin analogue (MCLA) reagents. The results suggest that the photobiocchemical production of reactive oxygen species (ROS) is influenced by iron bioavailability, and that hydrogen peroxide, and its immediate precursor superoxide, are produced as a result of inefficient electron transfer reactions in the photosynthetic apparatus. The results establish that ROS can be produced in seawater by phytoplankton as a result of inefficient photosynthetic electron transport processes, which can be induced by iron-limitation. The ROS produced in this manner may make some forms of iron more available to the phytoplankton.

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HIGH RESOLUTION BOTTOM BOUNDARY LAYER MEASUREMENTS, BED STRESS AND SUSPENDED SEDIMENT MEASUREMENTS
Suspended sediment and sediment transport are two important processes to understand for water quality and shoreline management. In lakes and reservoirs multiple physical processes contribute to sediment resuspension and transport, including boundary turbulence, breaking and non-breaking internal waves, wind generated waves and tributary inputs. Mixing near boundaries caused by bottom boundary layer turbulence and internal waves is examined using high resolution (1.5 cm depth cell size) pulse coherent Doppler profilers. Multiple acoustic velocimeters are used for comparison to the profiler data estimates of turbulence levels and bed stress. Profilers provide the unique look at the boundary layer structure as it undergoes accelerations related to changes in discharge, barotopic and baroclinic forcing. By fitting a modified boundary layer model, bed stress estimates can be directly calculated from the data. Coupled acoustic and optical backscatter measurements provide details regarding sediment load and turbidity and identify under which conditions sediment is resuspended or advected through the sampling volume.

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210Pb-DERIVED AGES FOR THE RECONSTRUCTION OF TERRESTRIAL CONTINENTAL HISTORY INTO THE MEXICAN PACIFIC COAST: POTENTIAL AND LIMITATIONS
Alteration of the natural landscape, due to urban development, road construction and agricultural practices resulted in increasing deliveries of land derived sediment and pollutants into coastal waters along the coastal states of Sinaloa and Oaxaca (Mexico). Isotopic proxies such as δ¹⁸O, δ²¹⁰Pb, trace metals and nutrients data, as well as ²¹⁰Pb-derived geo-chronologies from shallow marine sedimentary records have been used to reconstruct the history and rates of the resulting environmental changes and potential contamination of coastal ecosystems. From a few examples of ²¹⁰Pb profiles in estuaries and marine sediments from the area, we intend to discuss in particular the difficulty of obtaining reliable sedimentary records in such active and complex settings. Conditions for obtaining additional information from other short-lived natural isotopes (e.g. ³⁷Csl) are also briefly examined. Whereas coastal sediments may generally be seen as a sink for most contaminants, some of the records from the study area illustrate situations where post-depositional re-suspension likely due to extreme climate events may lead to a potential remobilization of contaminants.
PROJECTED CHANGES IN ANTARCTIC SEA ICE IN THE AR4 CLIMATE MODELS: IMPLICATIONS FOR ADELIE AND EMPEROR PENGUIN HABITATS

Using observations of Adélie and Emperor penguins and their needs for nesting and food as guidelines, we examine how the IPCC-AR4 coupled climate models predict that their habitat will be altered under global warming scenarios. Russell et al. (2006) compared 18 of the coupled climate models included in the latest IPCC report on the basis of how well they simulated the Southern Ocean circulation. That study used the strength of the Antarctic Circumpolar Current as a proxy for the overall health of the model simulation. In that analysis the most important factor to determining the quality of the ACC simulation was the strength and position of the Southern Hemisphere westerly winds. In this comprehensive analysis, we will address which of the AR4 climate model simulations of the Southern Ocean best represent the distribution and seasonality of sea ice, what changes are projected in the ocean circulation, sea ice extent seasonality and thickness around Antarctica under global warming conditions and what are the implications for ice-obligate species of penguins, like the Adélie and Emperor.

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LANDSCAPE INDICATORS OF WATERSHED IMPAIRMENT - NUTRIENTS

Complex interactions between anthropogenic activities in watershed landscapes and biological and chemical impairment require that appropriate indicators of watershed impairment be developed. We use refined nutrient budgets and their relationships to nitrogen and phosphorus discharges to develop a classification system for estimating the level of watershed impairment from landscape characteristics. We then apply this classification system to National Hydrography Dataset Plus (NHD+) watersheds in the Chesapeake Bay drainage. Preliminary classification attempts explain between 20 and 70 percent of the variability in nutrient discharges depending on nutrient and physiographic province. Our classification system uses a small set of easily attainable landscape characteristics and nutrient budgets. We will combine this nutrient impairment classification system with one for biological and hydrological impairment to obtain an overall classification of watershed impairment using landscape indicators.

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MEASURING SUSPENDED SEDIMENT CONCENTRATION USING HIGH RESOLUTION CURRENT METERS

Acoustic sensors measuring currents in high resolution have been around since the 90s. Recently researchers have started using them to provide information on suspended sediment load. Acoustical devices tend to be less prone to bio-fouling compared to electrical devices and the combination with high frequency velocity measurements allows for a direct estimate of turbulence fluxes of particulate material (e.g. Fugate and Friedrich, 2002). Here we present results of a careful lab evaluation of three such sensors; Two acoustic Doppler Velometers providing acoustic backscattering at two different frequencies (16MHz and 6MHz) and a Modcular Acoustic Velocity Sensor providing acoustic attenuation at 1.5MHz. We assess the concentration over which we get a linear response and compare measurements of beads of different sizes with the expected theoretical response. Field data is also presented to showcase the performance of this technology in comparison with tried and true optical sensors.

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SCALES AND PROCESSES OF PHYTOPLANKTON THIN LAYER PATCHINESS IN A COASTAL UPWELLING SYSTEM, FROM SYNOPTIC MULTIDISCIPLINARY MAPPING BY AUV

Using synoptic multidisciplinary mapping we describe phytoplankton thin layer patchiness in the highly dynamic coastal waters of Monterey Bay, California. Intensive observations were conducted in Monterey Bay during 2005 and 2006 as part of the ONR program Layered Organization in the Coastal Ocean (LOCO). High-resolution mapping by the MBARI AUV Dorado was conducted over nearly 1000 km of survey track within the bay, providing detailed observations of variability in thin phytoplankton assemblages and their environment. The relatively high speed of this AUV permits synoptic mapping, and its diverse sensor payload permits description of physical, nutrient, and optical properties. Horizontal scales of thin layer patches, ranging from sub-km to >10 km, are described using optical backscatter and chlorophyll fluorescence sections. These scales are related to meso and small-scale dynamics described by physical and nutrient sensors. Measurements of the particle size distribution reveal higher degrees of patchiness within thin layer structures characterized as contiguous in optical backscatter and chlorophyll fluorescence. This variability is related to biological and physical processes evident in the time-series of AUV-derived maps.

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FROM PHYSICS TO FISH: INFLUENCE OF OCEAN WINDS ON THE PELAGIC ECOSYSTEM IN EUPHEMISING REGIONS

Upwelling of nutrient-rich, subsurface water sustains high productivity in the ocean’s eastern boundary currents. Environmental variability is considered the major cause of decadal fluctuations characteristic of fish populations in these regions, but the mechanisms relating atmospheric physics to fish production remain unexplained. Two atmospheric conditions influence different types of coastal upwelling: alongshore wind stress, resulting in rapid upwelling (higher vertical velocity, w); and wind-stress curl resulting in slower upwelling (low w). We present a mechanism relating production of Pacific sardine (Sardinops sagax) in the California Current Ecosystem (CCE) with wind-stress curl over the past six decades. Records of density, nutrient depth, and chlorophyll concentration in the upper ocean suggest that this is supportive of this mechanism. The size structure of plankton assemblages is related to the rate of wind-forced upwelling, and sardine feed efficiently on smaller plankters generated by slow, curl-driven upwelling. Since the 1970s, wind-stress curl has been responsible for nearly 80% of annual, wind-forced upwelling in the southern CCE. Prior to the 1970s, coastal, alongshore wind stress played a more important role than curl in ecosystem variability.

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IMRINGER CURRENT ANTICYCLONES IN THE LABRADOR SEA OBSERVED IN THE HYDROGRAPHIC RECORD OF 1990-2004

A significant fraction of the lateral heat transport into the Labrador Sea’s interior, needed to balance the net heat loss to the atmosphere, is attributed to one kind of eddies, the Imringer Current anticyclones. In this study we discuss the evolution of these anticyclones as inferred from the analysis of hydrographic data from the Labrador Sea from 1990 to 2004. The 29 anticyclones identified naturally fall into two categories: unconvected and convected. The properties of the unconvected anticyclones are closer to those of the boundary current, including a fresh (and sometimes cold) surface layer. They are never observed in winter and are located near the boundaries. The convected anticyclones, on the other hand, are characterized by a mixed layer and are found throughout the year. A one-dimensional mixed layer model suggests that the convective eddies are formed during wintertime cooling acting over an unconvected eddy. This result has important implications regarding the release of the eddies’ heat and freshwater anomaly. Finally, we find a clear trend in the eddies’ properties towards warmer and saltier conditions after 1997.

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NUTRIENT-DRIVEN SELECTION AND GENETIC CONNECTIVITY OF COASTAL AND ESTUARINE DIATOM POPULATIONS

The timing, location and magnitude of diatom blooms in coastal and estuarine regions are difficult to predict based solely on environmental parameters. In the diatom Ditylum brightwellii, genetically distinct populations can have different physiological characteristics indicating that both environment and genetics can regulate bloom dynamics. Here, I examine how previously-identified estuarine populations of D. brightwellii are connected to coastal populations using microsatellites, high resolution genetic markers. In the spring of 2007, 335 single-cell isolates were collected along a 1300 km transect from the estuarine waters of Puget Sound, WA to the coastal waters of Southeastern AK. The transect was sampled twice over one month to examine spatial and temporal patterns of population structure. At least two genetically distinct populations were identified that bloomed under significantly different exposure to solar irradiance and silicate acid concentrations, suggesting that environmental selection may regulate bloom dynamics of distinct populations. By simultaneously examining the relative impacts of nutrient-driven natural selection and connectivity between estuarine and coastal populations, this research is beginning to unravel how interactions between environmental conditions and genetic variation drive diatom population dynamics.

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DISSOLVING OF AEROSOL IRON IN SEAWATER USING FLOW INJECTION CHELUMINESCENCE DETECTION

The bioavailability of iron limits primary production, influences phytoplankton community structures in the ocean and therefore indirectly impacts climate change. However, the solubility of aerosol Fe from dry atmospheric deposition into seawater is poorly understood and varies according to the approach used to quantify its dissolution. To better understand the dissolution of aerosol iron, an array of chemical (i.e. aerosol sources, model siderophores additions) and physical (i.e. light conditions, temperature, aerosol concentrations) variables were investigated under controlled conditions using an automated sampler and flow injection analysers. The kinetics of the dissolution of dissolved iron
from urban aerosol were determined in filtered (0.2 μm) North Atlantic surface seawater. From initial studies, iron dissolution from Plymouth Urban Particulate Material (PUPM) and NIST 1648 (dark/25°C/2mlg−1) in surface seawater showed a fast release of dissolved iron (up to 0.45 % solubility) with the maximum dissolved iron concentration occurring within the first two hours followed by a decrease, reaching pseudo-equilibrium after 7 days (down to 0.06 %). Further studies defining the impact of physical and chemical factors on the dissolution of Fe will be presented.

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GRAZING AND NUTRIENT RELEASE FROM ACARTIA TONSA COEPODES FEEDING ON TOXIC PRODUCING KARLODINIUM VENIFICUM: INTERACTIONS OF TOP-DOWN AND BOTTOM-UP CONTROL

The karlotoxin-producing dinoflagellate, Karlodinium venificum, is increasing in concentration and range in Chesapeake Bay. However, it is unknown if these toxins affect zooplankton grazer metabolism, such as nutrient regeneration – a potentially significant source of fuel for these harmful algal blooms. Using both non-bloom and bloom concentrations of K. venificum, we conducted a grazer nutrient release experiment with Acartia tonsa coeopodes, plus a 7-day bioassay in which A. tonsa excretia products were added to K. venificum culture. Copepods exhibited 40 times higher ingestion rates while feeding on bloom concentrations (205 μg Chl a/individual/day) compared to non-bloom concentrations, yet release rates were lower by 30% for DOC and 50% for NH₄⁺. Organic nitrogen release was too low to unambiguously evaluate in both treatments. During the bioassay, Chl a remained higher, and a larger drawdown of nutrients occurred in copepod excretia additions relative to controls. These results suggest that while copepods have the potential to effectively graze on and provide nutrients for K. venificum, nutrient release may be compromised by the toxin, leaving less bioavailable nutrients for phytoplankton and bacteria.

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ESTIMATING OCEANIC PRIMARY PRODUCTIVITY: AN EVALUATION OF OCEAN COLOR ALGORITHMS AND GENERAL CIRCULATION MODELS

Modeling oceanic primary productivity (PP) is crucial for biogeochemical studies, especially in order to better understand the carbon cycle on a global scale. We have expanded the PP Algorithm Round-Robin (PPARR) project into its fourth exercise by quantifying the skill of ~20 models (including both ocean color algorithms and biogeochemical general circulation models) in reproducing in situ PP data from various regions across the globe. Taylor diagrams, cumulative distribution functions and other statistical approaches were used to compare model performance in both open-ocean and coastal regions. Estimates of PP in the Sargasso Sea show that ocean color-based model skill was most sensitive to surface chlorophyll concentration followed by sea surface temperature and mixed layer depth. In the equatorial Pacific, skill in estimating PP was most sensitive to surface nitrogen inflow but was correlated with diatoms. However, model performance was not sufficiently high to support new biological oceanographic studies.

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WAVELETS

A wavelet-based method has been developed to automatically detect and characterize layered structure in oceanographic data from various autonomous sampling platforms including the Dorado AUV (Monterey Bay, 2003-present), Seagliders (Washington coast, 2002-present), and Slocum gliders (Gulf of Maine, June-July 2006). Depth profiles of fluorescence, optical backscattering, particle size distribution, and beam attenuation have been processed to derive objective estimates of peak width(s), intensity(ies), and depth(s). Additional metrics, related to more subtle characteristics of peak shape, have also been developed. Initial results from the wavelet-based processing are encouraging and are consistent with human-assisted characterizations of layered structure in the datasets we have evaluated. By discerning continuous depth profiles into separate features of interest (i.e., layers), we can compactly represent and query the important information contained in these large multi-parameter datasets and determine how the distribution of layers relates to physical, ecological, and biogeochemical processes in the ocean. This representation of the data facilitates its incorporation into existing geographic information systems, whose foundation is based upon the analysis of geographically discriminated features such as points, lines, and polygons.

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RELATIONSHIPS BETWEEN BENTHIC ORGANIC CARBON FLUX, OXYGEN PENETRATION, AND PLANKTON PROVINCES IN THE SOUTHERN OCEAN

Based on the comparison between benthic oxygen fluxes derived from oxygen microprofiles measured at sediment cores (ex situ) and by means of free fallinglander systems (in situ), a correction function was set up that was applied on existing ex situ flux data in order to revise the database for the Southern Ocean. Organic carbon fluxes range from 0.5 to ~3.5 mgC m⁻² d⁻¹. Oxygen microprofiles were measured at 134 sites in different sub-regions mainly of the Atlantic Sector of the Southern Ocean. Oxygen penetration depths and benthic organic carbon fluxes were derived from the profiles and investigated in respect to regional characteristics. In the Scotia Sea (~3000 m water depth) oxygen penetration depths of less than 15 cm were observed in deep-sea sediments. In contrast, the oxic zone extends to several decimetres in abyssal sediments of the Weddell Sea and south-eastern South Atlantic. The depth of oxygenation reflecting sedimentary long term organic matter influx was found to be correlated with diatom key species characterizing different regions of the surface ocean. From the partly very high fluxes derived from micro sensor data it can be concluded that episodic and seasonal sedimentation pulses are important for carbon supply to the sea floor even at great depths.

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AUTOMATED CHARACTERIZATION OF LAYERED STRUCTURE USING WAVELETS

A wavelet-based method has been developed to automatically detect and characterize layered structure in oceanographic data from various autonomous sampling platforms including the Dorado AUV (Monterey Bay, 2003-present), Seagliders (Washington coast, 2002-present), and Slocum gliders (Gulf of Maine, June-July 2006). Depth profiles of fluorescence, optical backscattering, particle size distribution, and beam attenuation have been processed to derive objective estimates of peak width(s), intensity(ies), and depth(s). Additional metrics, related to more subtle characteristics of peak shape, have also been developed. Initial results from the wavelet-based processing are encouraging and are consistent with human-assisted characterizations of layered structure in the datasets we have evaluated. By discerning continuous depth profiles into separate features of interest (i.e., layers), we can compactly represent and query the important information contained in these large multi-parameter datasets and determine how the distribution of layers relates to physical, ecological, and biogeochemical processes in the ocean. This representation of the data facilitates its incorporation into existing geographic information systems, whose foundation is based upon the analysis of geographically discriminated features such as points, lines, and polygons.

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WE A NEW MODEL OF ANTARCTIC SEA ICE ALGAL PRODUCTION: A TIMESERIES FROM 1997-2003

We constructed a coupled physical-biological model describing Antarctic sea ice dynamics and associated ice algal production. Using satellite-derived ice cover, snow depth, and ice advection, as well as climatological light and atmospheric forcing, the model grows and melts sea ice using a multi-layer approach to create a reasonably realistic sea ice environment. Internal ice conditions (e.g., temperature, nutrients, and salinity) and a multi-spectral optical model of light attenuation are used to characterize the algal growth environment in discrete model layers. The model domain covers a portion of the south-eastern South Atlantic. The depth of oxygenation reflecting sedimentary long term organic matter influx was found to be correlated with diatom key species characterizing different regions of the surface ocean. From the partly very high fluxes derived from micro sensor data it can be concluded that episodic and seasonal sedimentation pulses are important for carbon supply to the sea floor even at great depths.
Measurements of flow velocity at 2 Hz sampling rate at high spatial resolution together with suspended sediment concentration, temperature, salinity and dilute suspension flocc size in about 5 m depth on the muddy shelf fronting the Atacbfalaya Bank (Iaramillo et al. 2007 - Proceedings of ‘Coastal Sediments 2007’ V1, 661-670) allow to observe coupled wave-current-sediment dynamics and to estimate the characteristics of sediment and its effects on wave-current turbulence. A boundary layer model for fine sediment transport (Hu et al. 2007 - J. Geophys. Res. 112, C02011) is used to reconstruct near bed suspended sediment concentration and simulate its effects on the velocity field. This effort is made in preparation of a series of field experiments to be conducted in early spring, 2008 on the Atacbfalaya Bank to study the vertical structure of waves and turbulence in the presence of fluid mud layers. The experiments will employ coherent vertical and horizontal arrays of Acoustic Doppler Velocimeters sampling the velocity field at 20 Hz to separate the effects of waves and turbulence (Feddersen and Williams, 2007, J. Atmos. and Oceanic Technol., 24, 102-116).

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ROLES OF ECOSYSTEM COMPONENTS FOR BIOGEOCHEMICAL CYCLING IN THE HNLC SUBARCTIC PACIFIC: IMPORTANCE OF TOP-DOWN CONTROL

Ecosystem responses were quite different between SEEDS-I and SEEDS-II, a series of iron-enrichment experiments in the HNLC subarctic Pacific. During SEEDS-I, diatoms Chaetoceros debilis responded to the iron-enrichment, consumed nitrate and silicic acid and formed an extensive bloom (Chla = 20 mg m$^{-3}$). Heterotrophic dinoflagellate Gymnodinium sp. responded to the diatom increase and prevented further development of the bloom. The model experiment showed most diatoms were grazed by Gymnodinium sp. and the nitrate and silicic acid were remineralized surface mixed layer after experiment. During SEEDS-II, diatom fraction in phytoplankton assemblage decreased, and silicic acid consumption was not accelerated. The weak response of diatoms was due to the grazing of copepod Calanus plumchrus which consumed most of new production and transported carbon and nitrogen to the deep by their ontogenetic vertical migration. In spite of large difference in the bloom magnitude, the nitrate consumption was similar each other, and the nitrogen flux was larger during SEEDS-II than SEEDS-I. Biogeochemical responses to perturbations are largely influenced by ecosystem components, and top-down control is a key factor of the biogeochemical cycling in the HNLC subarctic Pacific.

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SPATIAL AND TEMPORAL VARIABILITY OF LOW LEVEL NITRATE, NITRITE, AND AMMONIA DISTRIBUTIONS FROM A COASTAL UPWELLING ZONE TO OILGOTRICHOTIC WATERS

Nitrigen inputs from recycling, nitrogen fixation, atmospheric deposition, vertical and lateral advection (filaments and eddies) provide the basis for oceanic primary productivity. These nitrogen compounds come from different sources and are found in different forms due to microbial activity via processes such as nitrogen fixation, remineralization, nitrification, and denitrification. A transect from Monterey Bay, California to an oligotrophic station approximately 800 km offshore in the California Current was done in July 2007. Nitrate profiles were measured with an In Situ Ultraviolet Spectrophotometer (ISS) instrument mounted on a CTD rosette. These measurements were made with a vertical resolution of 0.8 m and an estimated detection limit of 0.2 µM. In addition, discrete samples were measured shipboard using a 1 m (nitrite) or 2 m (nitrate and ammonia) path length flow cell. These low level nitrate, nitrite, and ammonia measurements had detection limits of about 4 nM, 2 nM, and 15 nM, respectively. The spatial variability of these nutrients along this transect will be presented along with 24 hour time series stations that examined temporal variability.

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sensing, characterization of endmember variability is important on at least two fronts. First, efforts to retrieve salinity via satellite if absorbance is considered as the slope of the salinity-fluorescence relationship changes. Second, with a combined understanding of the zero salinity fluorescence variability and fluorescence-to-DOC relationships, it may be possible to diagnose sources and sinks of terrestrial DOC within river plumes using circulation models and ocean color data.

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EDDY HEAT DIFFUSION AND SUBANTARCTIC MODE WATER FORMATION

Subantarctic mode waters (SAMW) form in the deep winter mixed layers occurring north of the Subantarctic Front (SAF). The recent increase of hydrogenic and surface drifter data in the Southern Ocean allows a better spatial representation of the distinct regions of SAMW formation. This study focuses on the thermodynamical processes acting on the winter mixed layer heat budget. Eddy heat diffusion play a substantial role in the local heat balance, whereas its action vanishes with large-scale averaging. South of the western boundary currents and north of the SAF, the eddy heating plays an important role in specific regions, counterbalancing the cooling of the mixed layer by Ekman advection and air-sea fluxes. Specifically, the eddy diffusion term reduces the tendency for mixed layer destabilisation north of the SAF in the Western Indian Ocean downstream of the Agulhas Retroflection and in the Western Pacific downstream of Campbell Plateau. This role for mixed layer eddy fluxes emphasizes a large-scale control of mixed layer properties by topography and mesoscale processes in the Southern Ocean.

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CONTINUOUS BARRIER ISLAND DETERIORATION FOLLOWING HURRICANE KATRINA

During Hurricane Katrina, the Chandeleur Islands in eastern Louisiana lost 85% of their surface area. The average shoreline retreat along the island chain was 286 m, likely the largest retreat ever reported for a storm. All of the visible sand on the islands was stripped off, reducing peak elevations from >6m to <3m, leaving only marsh fragments in the storm’s wake. In the 12 months following the hurricane, the islands continued to erode rapidly, in some places greater than an additional 200 m of landward retreat. At this time, the islands were composed mostly of mud that was bound by the roots of marsh grasses, and barriers were vulnerable to extreme erosion by relatively small waves. In fact, 58% of the length of the island chain experienced net erosion during the one year following Katrina. The remainder of the shoreline length underwent accretion of sand that built the shoreline seaward as is usually observed on sandy beaches following a storm. However, by the end of the 12 months following Katrina, the elevations of the islands had not increased appreciably. The consequence of this erosion was that the islands remained vulnerable to complete inundation during future storms, even those significantly less intense than Katrina. The talk will include results from a recently completed lidar survey that will allow these analyses to be extended to 24 months following Katrina, and will further define the extent that the Chandeleur Islands have been pushed towards complete failure.

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PARASITE INFECTION OF PLANKTONIC DINOFLAGELLATES IN A COASTAL TROPICAL AREA OF THE SOUTHERN ATLANTIC

Infection of planktonic dinoflagellates by the parasitic protist Amoebophrya sp. was studied during the decline of a late-summer dinoflagellate assemblage in the Cabo Frio upwelling area, Southeastern Brazil (23°0’20”S, 42°0’40”W). The microplankton community was initially dominated by dinoflagellates, mostly Ceratium falciforme, with cell densities up to 6 x 10^4 cells^1, shifting to a diatom-dominated community over a 4-week period. Parasite infection was detected by epifluorescence microscopy after whole-cell in situ hybridization of FITC-tagged, rRNA probes designed towards Amoebophrya 18SrDNA sequences. Ceratium falciforme was the most infected dinoflagellate species, with high est percentages of infected cells (up to 6.7%) detected during and after the population hybirdization of FITC-tagged, rRNA probes designed towards Amoebophrya 18SrDNA.

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DEEP-WATER CARBON AND DIATOM FLUXES FROM A NATURALLY IRON FERTILIZED PHYTOPLANKTON BLOOM IN THE POLAR FRONTAL ZONE OF THE SOUTHERN OCEAN

The CROZEx natural iron bloom and export experiment (CROZEX) examined the development and fate of a naturally occurring phytoplankton bloom in the vicinity of the Crozet Plateau in the Indian Sector of the Southern Ocean. Peak chlorophyll concentrations within the naturally iron-fertilised region north of the plateau were an order of magnitude higher than those in the high-nutrient low chlorophyll (HNLC) “control” region to the south. Deep (>2000m) sediment traps indicate that the annual fluxes of organic carbon were 0.82 ± 0.07 g C m^-2 yr^-1 in the north and south respectively. The four-fold increase in annual carbon flux is the first demonstration that the addition of iron to an otherwise HNLC system increases the export of carbon to the deep ocean. Fluxes were characterised by high biogenic silica content (35-80%), the diatom flux assemblage was dominated by Eucampia antarctica in the north and Fragilariopsis kerguelensis in the south. Molar ratios of Fe/C decreases have been calculated and are compared to previous artificial and natural fertilisation experiments. The results have important implications for glacial-interglacial CO2 cycling and iron fertilisation as a potential climate mitigation strategy.

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NITROGEN AND CARBON PRODUCTIVITY IN THE RETREATING ICE REGION OF THE EASTERN BERING SEA DURING 2007

The eastern Bering Sea supports large standing stocks at every trophic level from plankton to fish, birds and marine mammals. Some of this productivity can be linked directly to the ice edge that historically develops there by March. Extensive sampling was done from an ice breaker in this region in April and May 2007 as this ice edge retreated. Incubation rate measurements for new (nitrate) and ammonium as well as for carbon (primary) productivity were done in on-deck incubations. The results document the importance of the ice edge in fostering intense productivity in the marginal melt ponds. Rates of carbon productivity were maintained above 2 g C m^-2 d^-1 and new productivity was maintained above 10 mmol nitrate m^-2 d^-1 across an extensive region of the outer shelf for several weeks. The nitrogen/Fe ratio was also high suggesting a large export of carbon to shelf sediments. The ice edge enhancement of productivity was much greater in the western, outer shelf edge of the ice than it was in the eastern, inshore region and suggests that factors in addition to surface stabilization were important to the spatial patterns. The patterns in plankton production corresponded closely to those of acoustically-mapped macro-fauna and suggest a biological system subject to extensive change to ice conditions.

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SATELLITE-BASED ESTIMATES OF EDDY KINEMATICS

Fifteen years of sea-surface height fields constructed from the merged TOPEX, Poseidon, ERS-1, ERS-2, and Jason altimeter datasets are analyzed to investigate the kinematic properties of global ocean eddies. An objective eddy tracking algorithm is used to identify coherent features in the global data set. Geostrophic streamlines in a co-moving eddy frame are then constructed from the sea surface height observations associated with tracked eddies, and analyzed to obtain estimates of Lagrangian parcel motion induced by the eddy motions. Of particular interest is the extent to which propagating eddies repre- sented, translating cells of isolated fluid. The Lagrangian transport properties of the field of tracked eddies are computed, and the corresponding implications for nonlinearity of the eddy dynamics are considered.

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LIGNIN-PHENOLS IN DENSITY FRACTIONS OF LOUISIANA CONTINENTAL MARGIN SEDIMENTS: RIVER TO CANYON TRANSPORT

Major rivers, and associated deltaic environments, provide the dominant pathway for the input of terrestrial particular organic matter (POC) to marine sediments, and play a disproportionately important role in transporting POC to the ocean. However, the dynamics of carbon cycling and transport in deltaic environments is complex and largely understood. In order to better understand the partitioning and transport of POC, we used lignin-phenols as biomarkers in different density-fractions of sediments across the LCM (Louisiana Continental Margin). We sampled stations in the river proper, adjacent shelf, and Mississippi Canyon (MC). Lignin concentrations and (Al/Alv) ratios were
significantly higher and lower, respectively, in the low density fractions. Low-density fractions showed a more angiosperm dominated leafy or grassy signature, compared to a more angiosperm woody signature in high-density fractions. High-density fractions were more degraded during transport to the MC. Density fractions were helpful in determining the relative importance of selective degradation and aggregation/locculation processes during cross-shelf transport. Most of the lignin degradation within the bulk sediment signature is largely from selective loss in the low-density fractions.

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PHYSICAL MECHANISMS FOR SHELF RECRUITMENT OF CALANUS FINMARCHICUS OFF THE WEST COAST OF NORWAY

The shell population of the copepod Calanus finmarchicus along the coast of Norway is initialized each spring from over-wintering individuals from the Norwegian Sea. C. finmarchicus is an important food source for the larvae of the Norwegian Spring Spawning herring that result in improved coastal products capturing the finer scale coastal and estuarine processes. In order to produce higher resolution MODIS bio-optical properties, the 250m and 1000m land/atmosphere bands were coupled with the 1000m ocean bands to produce pseudo-250m ocean bands. We compare several atmospheric correction techniques applied to the MODIS imagery to determine the best method for removing the atmospheric effects in the imagery. The atmospherically corrected pseudo-250m reflectances are then used in bio-optical algorithms to produce higher resolution ocean color products. The higher resolution inherent optical products (IOPs) are compared to the atmospheric corrected reflectances to demonstrate that improved atmospheric correction and higher spatial resolution IOPs result in improved coastal products capturing the finer scale coastal and estuarine processes.

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FUTURE DIRECTIONS IN OCEANS AND HUMAN HEALTH RESEARCH

The Oceans and Human Health Act of 2004 established an Interagency OHH Program and required preparation of a ten-year plan to define "the goals and priorities for Federal research which most effectively advance scientific understanding of the relationship between the oceans and human health."

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SPORELLINE EROSION, SHORE PROTECTION, AND NEARSHORE SEDIMENT DYNAMICS IN CHERESAKE BAY

In many lakes and coastal plain estuaries, shoreline erosion is a significant contributor to the sediment budget and a leading cause of high nearshore turbidity. This is especially true where other sediment sources are relatively small and where shorelines are exposed to episodically high storm waves. Shore protection measures halt shoreline erosion locally, but it is not clear how they affect nearshore turbidity or sediment dynamics. We carried out nearshore monitoring in the pigalional proglacial Old Bay during the falls of 2002 and 2003 and the summers of 2006 and 2007 in two eastern shore tributaries of mid-Chesapeake Bay to examine these situations. Observations of waves, tidal height, currents, temperature, salinity, and turbidity were obtained with moored instruments and nearshore hydrographic surveys. These measurements were complemented by shoreline and bathymetric surveys and sediment sampling. The results show that nearshore turbidity and sediment dynamics are dominated by wave events in combination with water surface elevation. Turbidity levels quickly fall to a seasonally varying background level after the end of an event. Turbidity levels offshore unprotected shorelines and adjacent protected shorelines are similar due to rapid dispersion.

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TIDAL CREEK ECOSYSTEMS: SENTINEL HABITATS FOR ASSESSING THE CONSEQUENCES OF RAPID DEVELOPMENT ON SOUTHEASTERN COASTS

Meandering shallow tidal creeks are a dominant feature of Southeastern estuaries and provide nursery grounds for many fish and crustaceans. The shores of these creeks are also preferred sites for human development. Research throughout the Southeast has found linkages between surrounding watershed land use (e.g., impervious cover) and the ecological condition (i.e., physical-chemical and biological conditions) of headwater tidal creeks. This habitat has served as a platform for testing the new technologies and methods, including genomic and pathogenic measures, being developed in association with the Hollings Marine Laboratory Oceans and Human Health Center of Excellence. This research has shown that these headwater creeks have the potential to serve as sentinel habitats and a reliable testing platform for assessing the impact of watershed development on ecosystem and public health; however, most estuarine monitoring programs do not sample these habitats. Headwater tidal creeks are the appropriate scale to assess the impacts of land use change in the watershed as well as providing appropriate scale for making land use decisions.

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EFFECTS OF APPLIED VOLTAGES AND OXYGEN CONCENTRATIONS AT THE ANODE ON POWER OF A MICROBIAL FUEL CELL

Oxygen contamination of the anode chamber of an MFC could affect power generation in an MFC, and possibly the composition of the microbial community. Purging the anode chamber with air or pure oxygen for 16 hours, however, did not affect power genera-
tion. After the oxygen in the anode chamber was scavenged by aerobic bacteria, power sharply increased and returned to previous levels indicating no permanent damage in performance. When there were high concentrations of substrate in the anode chamber, the oxygen flux from the cathode chamber into the anode did not affect dissolved oxygen concentrations (DO). During operation of two MFCs in stack mode (in series), charge reversal occurred whereby one cell could charge the other cell. Applying a voltage of 2 V to a two-chambered MFC (the positive terminal of a power supply was connected to the anode) did not affect power generation. However, applying 3 V for 3 h resulted in a 15 h lag phase suggesting injury to the bacteria, but performance was restored when the applied voltage was removed with an external load of 1 kΩ.

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ON THE ORIGIN AND IMPORTANCE OF SWESTIES

Pingree (Phil. Trans. Roy. Soc. A, 354, 1-45) first observed a SWESTY (Anticyclonic Shallow Subtropical Subducting Wetted Propagating Eddies) in the eastern North Atlantic. These are mesoscale long live eddies (nearby 3 years) whose source region is south of the Canary Archipelago. They propagate westward along 26º N at least until 50º W. A unique feature of the SWESTIES combining altitude, density and numerical modelling (ROMS and processes oriented models). Preliminary results suggest that SWESTIES may originate as consequence of the Canary Current perturbation by the Canary Archipelago. Anticyclonic eddies are shed all year long by the central islands, Gran Canaria and Tenerife, and during fall by the flow acceleration between the eastern islands (Fuerteventura and Lanzarote) and the African Coast. ROMS model results indicates that these eddies introduce strong variability (KE) along 26º N, comparable to that generated by the Azores frontal region. Therefore Anticyclonic eddies shed by the Canary Islands may be very important for the zonal transport and mixing of physical and biological properties along the Subtropical Gyre.

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KILO NALU NEARSHORE REEF OBSERVATORY, OAHU, HAWAII

INTERDISCIPLINARY OBSERVATIONS OF PHYSICAL, GEOCHEMICAL AND BIOLOGICAL INTERACTIONS

The Kilo Nalu Observatory supplies data and power connections to a suite of instruments over an array of stations extending from 10 to 20 m water depth, enabling individual user-transparent access. The Kilo Nalu Observatory is designed to support biological, physical and oceanographic research in the coastal zone of Hawaii, specifically along the nearshore regions of Kualoa. The Observatory is a virtual laboratory that travel along the coast to the Gulf of Alaska often encounter eddies that frequent the Gulf of Alaska. They spend weeks foraging within these eddies, where they frequently dive to a depth of -500 m, several times a day. This yields a unique dataset of high frequency, long duration and deep temperature-depth profiles that can be used to examine the spatial and temporal evolution of the thermal structure of the eddies in the Gulf of Alaska. A comparison of the elephant seal dive patterns within and outside of eddies is used to understand how elephant seals utilize these “hot spots”.

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THE EFFECTS OF TEMPERATURE ON SCYPHOMEDUSAN CHRYSOAORA QUINQUECIRRA SWIMMING AND MORTALITY

In the Chesapeake Bay, an abundant summer population of scyphomedusan Chrysaora quinquecirra annually crashes in the fall. The fate of this gelatinous biomass is not well understood, but field observations suggest that sea nettles descend out of the visible layer as temperature approaches the lower limit of their tolerance. We designed mesocosm experiments to evaluate the effects of temperature on the swimming ability and mortality of C. quinquecirra. Here, we summarize the challenges faced in keeping sea nettles in captivity and present preliminary results. Pulsatia rates of sea nettles in the mesocosms were comparable to in situ pulse rates for C. quinquecirra. These initial observations suggested that the swimming ability of C. quinquecirra was not interrupted as a result of capture or this artificial environment. An unexpectedly early disappearance of sea nettles in 2007 prevented the completion of the experiment, but preliminary results support the hypothesis that sea nettles descend in the water column at temperatures below 15 degrees C.
SP THE LINKS BETWEEN THE SOUTHERN OCEAN AND LOW LATITUDE SURFACE AND BOTTOM WATERS

Subantarctic Mode Water (SAMW) is the primary pathway by which nutrients that are lost to the deep ocean by organic matter export are returned to the main thermocline. We use ocean model simulations and observations to illustrate how biological and physical processes in the SAMW formation regions of the Southern Ocean determine the low silicic acid and high nitrate concentrations of the main thermocline, and how these processes are also responsible for determining the silicic acid concentration of the deep ocean. We also discuss model simulations of how SAMW formation responds to global warming in the NOAA GFDL CM2.1 coupled climate model and what the implications of this may be for low latitude biogeochemical processes.

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SEASONAL AND INTER-SEASONAL VARIABILITY OF MARINE BIOLOGY IN THE KUROSHIO EXTENSION WITH AN EDDY RESOLVING COUPLED PHYSICAL-BIOLICAL MODEL

Seasonal and intra-seasonal variability of chlorophyll a in the Kuroshio Extension region is investigated using a simplified four-component ecosystem model embedded in an eddy-resolving ocean general circulation model. The model captures the realistic seasonal variability of chlorophyll-a distribution associated with the mesoscale eddy activities, sub-mesoscale front variability, Kuroshio meander, and upwelling. The generated cyclonic and anticyclonic eddies along the Kuroshio meander affect the ecosystem dynamics. In winter, the generated westward cyclonic eddy at the south of Kuroshio meander shallows the nutriline layer and maintains the high biological productivity. During one month, high chlorophyll a in the cyclonic eddy extends to about 200-300 m depth. The cyclonic eddy has a diameter of about 100-200 km and the westward speed is about 5 km/day. The biological production responds to the upshift and deepens of nutriline with the variability of mesoscale physical phenomena.

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DECADAL SEA LEVEL VARIABILITY IN THE SOUTH PACIFIC IN A GLOBAL EDDY-RESOLVING OCEAN MODEL HINDCAST

Sea level variability and related oceanic changes in the South Pacific from 1970 to 2003 are investigated using a hindcast simulation of an eddy-resolving Ocean general circulation model for the Earth Simulator (OFES) along with sea level data from tide-gauges since 1970. The model captures the realistic seasonal variability of chlorophyll-a distribution associated with the mesoscale eddy activities, sub-mesoscale front variability, Kuroshio meander, and upwelling. The generated cyclonic and anticyclonic eddies along the Kuroshio meander affect the ecosystem dynamics. In winter, the generated westward cyclonic eddy at the south of Kuroshio meander shallows the nutriline layer and maintains the high biological productivity. During one month, high chlorophyll a in the cyclonic eddy extends to about 200-300 m depth. The cyclonic eddy has a diameter of about 100-200 km and the westward speed is about 5 km/day. The biological production responds to the upshift and deepens of nutriline with the variability of mesoscale physical phenomena.

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DIRECT NUMERICAL SIMULATION OF SALT SHEETS AND TURBULENCE IN A DOUBLE-DIFFUSIVE SHEAR LAYER

We describe three-dimensional direct numerical simulations (DNS) of double-diffusively stratified flow interacting with infrared sheet. The extreme difference in diffusivity (and thus minimum length scale) between heat, salt and momentum in seawater is replicated for the unsheared case. The Schmidt number is much smaller than unity, indicating that turbulence. They then decay as the mean gradients that drive mixing diffuse. In the turbulent flow. Subsequently, two distinct mechanisms of secondary instability combine to lead the flow to a turbulent state. These instabilities are now under investigation using linear stability analysis. Turbulent diffusivities of heat and salt are largest just prior to the onset of turbulence. They then decay as the means gradients that drive mixing diffuse. In the turbulent state, the effective salinity diffusivity is smaller than that calculated by previous investigators for the unsheared case. The Schmidt number is much smaller than unity, indicating that salt sheets are less effective at transporting momentum than is often assumed.

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STRUCTURE AND MODIFICATION OF THE SOUTH PACIFIC EASTERN SUBTROPICAL MODE WATER

We examine the structure and modification of South Pacific Eastern Subtropical Mode Water (SPETMW) by analyzing all available temperature/salinity profiles (26,787 profiles) obtained by Argo floats from July 2004 to June 2007. SPETMW is located in 35-55°S, 160-70°W and characterized by temperature of 17-25°C, salinity less than 34.5psu, density of 24.5-25.8kg/m^3, and potential vorticity magnitude less than 5.0 x 10^-10 m^2/s kg^-1. Examination of the vertical structure of SPETMW reveals that it is truly vertically uniform water, that is, thermostad, halostad, and pycnostad simultaneously only immediately after the formation period; it is pycnostad but neither thermostad nor halostad otherwise. The temperature compensating surface temperature and salinity vertical gradients of SPETMW result in the formation being favorable for salt export or rapid salt intrusion processes. We use ocean model simulations and observations to illustrate how biological and physical processes in the SPETMW formation regions of the Southern Ocean determine the low silicic acid and high nitrate concentrations of the main thermocline, and how these processes are also responsible for determining the silicic acid concentration of the deep ocean. We also discuss model simulations of how SPETMW formation responds to global warming in the NOAA GFDL CM2.1 coupled climate model and what the implications of this may be for low latitude biogeochemical processes.

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ESTIMATING THE ERROR IN THE MERIDIONAL HEAT FLUX USING SATELLITE DATA

The oceanic meridional heat flux (MHF) can be estimated through the surface heat budget based on the net heat exchanged at the interface. The advantage of this method over the most direct approach from measurement of temperature profiles and velocity estimates is that our ability of using satellite data to estimate the oceanic meridional heat flux is extensive, and our objective is to estimate the error, identifying its components using data and evaluate the associated error. Latent and sensible heat fluxes are derived from microwave sensors (SM1/1 and TRMM). Radiation fluxes (ISCCP) and heat storage anomalies from sea surface height (TOPEX/Poseidon and Jason-1) complete the heat balance equation. We compare our results with direct measurements in the literature for the Atlantic Ocean. The total MHF as a function of latitude from the satellite data is apparently underestimated compared to direct oceanographic measurements. There is an increasing trend in the difference toward the north. We correct the MHF estimates by removing the linear meridional trend in the satellite data. Through a reverse calculation, the net surface heat flux over the Atlantic can be estimated from the derivative of the uncorrected MHF. The correction removes the surface heat flux that could not be attributed to the total heat flux that agrees with the direct measurements are on average about 10W.m^-2. This result is not intended to correct the surface heat fluxes but to prove that even a little deviation can lead to a significant bias in the total integrated heat flux.

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DATA ESTIMATING THE ERROR IN THE MERIDIONAL HEAT FLUX USING SATELLITE DATA

We discuss three-dimensional direct numerical simulations (DNS) of double-diffusively stratified flow interacting with infrared sheet. The extreme difference in diffusivity (and thus minimum length scale) between heat, salt and momentum in seawater is replicated for the unsheared case. The Schmidt number is much smaller than unity, indicating that turbulence. They then decay as the mean gradients that drive mixing diffuse. In the turbulent flow. Subsequently, two distinct mechanisms of secondary instability combine to lead the flow to a turbulent state. These instabilities are now under investigation using linear stability analysis. Turbulent diffusivities of heat and salt are largest just prior to the onset of turbulence. They then decay as the means gradients that drive mixing diffuse. In the turbulent state, the effective salinity diffusivity is smaller than that calculated by previous investigators for the unsheared case. The Schmidt number is much smaller than unity, indicating that salt sheets are less effective at transporting momentum than is often assumed.

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A NOVEL RADIATIVE TRANSFER APPROACH FOR IMPROVING SATELLITE BASED CHLOROPHYLL ESTIMATES IN THE PRESENCE OF CDOM

The concentration and absorption properties of biogeochemical constituents in the water column are critically important to remote sensing reflectance (Rrs) measurements of ocean color and estimates of chlorophyll concentration. While variability in absorption properties is due to both dissolved and particulate colored material, satellite algorithms cannot differentiate between these spectral signals. As a result, retrieved Rrs spectra are often dominated by the spectral absorbance of CDOM which overlaps chlorophyll and can account for 50% or more of total absorption at 443nm (Siegel et al., 2002). Consequently, CDOM can be a source of one of the largest errors in SeaWiFS global and regional chlorophyll datasets (Gregg and Casey, 2004). In this study, we investigate the use of CDOM absorbance in a forward model to retrieve more accurate chlorophyll estimates. CDOM estimates are obtained from bio-optical surveys and in situ time series (GoMOOS) in the Gulf of Maine which are incorporated into an exact RT program to quantify the influence of CDOM on nLw. The OC4 chlorophyll algorithm is then applied to corrected nLw yielding more accurate chlorophyll estimates.
SEA-GOING AND LABORATORY RESEARCH EXPERIENCES FOR UNDERGRADUATES COUPLED WITH OCEAN OBSERVATORY SEA-TRUTHING AND DATA INTEGRATION

Since 2003, the College of Charleston Transect Program has provided multidisciplinary research opportunities for undergraduate students, which includes a 5-day research cruise and full semester Oceanographic Research laboratory course. In November 2007 the program will pilot the integration of data associated with two continental shelf moorings (CAP2, CAP3) off the coast of Charleston, SC, in cooperation with the Carolina Coastal Ocean Observing and Prediction System (Caro-COOPS). Transect Program data will be used in student independent research analyses. The Transect Program serves to educate and train future ocean scientists in oceanographic research and technology, and is being proposed for implementation throughout the southeast region with numerous partner institutions. An additional program goal is to establish a long-term monitoring program of benthic and pelagic habitats on the continental shelf, coupling at-sea data collection with continuous real-time ocean observatory data. Research results and data inventory are available online for use by educators and scientists.
matter to sediments and a barrier to further infiltration of fines from the water column. Fine particle distributions are largely uncorrelated with bulk sedimentary chlorophyll. Chlorophyll concentrations show a steady exponential decline with depth, with an increase of chlorophyll concentrations indicative of degradation. Total fines show a similar decline in the surface, but grow into higher concentrations at depth. Shallow chlorophyll concentrations record recent downward mixing of benthic algae and bed filtration of planktonic algae. Minima in fines inventories are hypothesized to record the maximal depths of seasonal reworking by storms, with higher concentrations at depth resulting from both relict deposition and slow infiltration from shallower depths.

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UNDER-ICE INTERACTION AND MIXING OF SPRING FLOODWATERS WITH CONTINENTAL SHELF WATER IN THE ALASKAN BEAUTIFUL SEA

Spring floods transport more than half of the annual amounts of river water, suspended sediment and dissolved solids from northern Alaska to a frozen Beaufort Sea. In this study, offshore hydrography, water samples, and time series measurements were obtained through the ice during the period of spring breakup to determine the interaction and extent of mixing of under-ice river plumes from the Sagavanirktok and Kuparuk Rivers with offshore shelf waters. A 1-2 m thick under-ice river plume was traced >15 km offshore, and the fate of riverborne physical parameters in coastal seawater was found to be variably controlled by mixing and the volume and timing of the river discharge. Offshore transport and dispersion of spring floodwater under 2-3 m thick ice were linked to the seasonal river hydrographs with noticeable inter-annual variations that were due to river flow and the cooling and refreezing of flood waters during a given year. Observed variations in river flow and mixing with coastal seawater during this multi-year study provide insights to possible future responses to environmental change and increased river runoff in the Arctic.

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WIND INDUCED COASTAL CURRENTS IN THE NORTH MEDITERRANEAN MICROTIDAL SEA

The Northern Mediterranean coastal circulation is dominated by the cyclonic large Northern current and the Rhone river region of freshwater influence. The observed coherent structures on the continental shelf are mainly driven by the wind forcing as observed from satellite images and drifted buoys and HF radar surface currents measurements. The sensitivity of the coastal flow to the wind forcing both at mesoscale (continental and offshore winds) and sub mesoscale (land breezes) has been investigated using process oriented, realistic and climate scale (10 years) modeling. Observations on the wind shear are shown to control sub-mesoscale coastal circulation, inducing vortices, filaments, dense water formation and fronts. As a result, scales of oceanic response to the wind forcing are shown to lock on the local external and internal Rossby radius as well as bathymetric undulations in the case of microtidal coastal flows.

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DYNAMICS OF PHYTOPLANKTON, DETRITUS, AND COLORED DISSOLVED ORGANIC MATTER IN HYPOXIC AND NON-HYPOXIC GULF OF MEXICO WATERS.

Hypoxia commonly occurs seasonally west of the Mississippi Delta due to enhanced nutrient concentrations resulting in large algal blooms. Understanding mechanisms responsible for hypoxia is crucial in meeting a national mandate to decrease this hypoxic region. This project investigates the contributions of light absorption from phytoplankton, detritus, and colored organic matter (CDOM) constituents in the water column. An in situ, time-series measurement of absorption conducted was conducted in surface and bottom waters, at an offshore hypoxic station and a near shore non-hypoxic station. Water samples were analyzed for particulate ($a_\lambda$) and detrital ($a_\lambda$) absorption coefficients using the quantitative filter pad technique. CDOM absorption ($a_\lambda$) was analyzed with a dual beam spectrophotometer. Surface in situ absorption constituents will be synthesized with the larger spatial coverage of Moderate Resolution Imaging Spectroradiometer (MODIS) derived surface absorption constituents.

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THE EVOLUTION OF NONLINEAR INTERNAL WAVES IN THE MID-ATLANTIC RIGHT DURING SW06: NONHYDROSTATIC HINDCASTS

An intense field program, Shallow Water 2006 (SW06), was conducted in the Mid-Atlantic Bight off of the New Jersey coast from late July to early September 2006. The goal of the program is to understand the environmental processes that affect shallow water acoustic propagation. Nonlinear internal waves (NLIWs) are generated by barotropic tides interacting with topography and with the internal stratification in the ocean, by meanders and eddies from the Gulf Stream and by atmospheric forcing. The waves form a complex field of baroclinic internal waves which dominate much of the dynamics of the coastal ocean. A very high resolution, nonhydrostatic (NRL-MIT) model system is used to conduct hindcasts of the SW06 experiment. It is forced at the open boundaries by the hydrostatic NRL LISB NCOM model which has 1km resolution. The NRL-MIT model hindcasts are being conducted at several resolutions from 100m to 30m. NLIWs with amplitudes of 50m and greater are being generated by the model. The hindcasts are being analyzed and compared with data from SW06.

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ANNUAL VARIATIONS OF GEOSTROPHIC CURRENTS AND EDDY KINETIC ENERGY INFERRRED FROM TOPEX/POSEIDON-JASON-1 TANDEM MISSION DATA

Geostrophic surface velocity anomalies are used to analyze the annual variations of the large-scale geostrophic currents and of the Eddy Kinetic Energy (EKE) field of the mesoscale circulation. The under-ice-inter-annual variations that were due to river flow and the cooling and refreezing of flood waters during a given year. Observed variations in river flow and mixing with coastal seawater during this multi-year study provide insights to possible future responses to environmental change and increased river runoff in the Arctic.

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THE RETENTION OF COPEPOD RESTING EGGS IN PATCHES OF SEAGRASS IN COMPARISON TO BARE SEDIMENT IN A HIGH ENERGY AREA

To avoid unfavorable seasonal conditions, some species of zooplankton produce resting eggs that do not immediately hatch. These eggs sink to the ocean bottom and remain there until they experience favorable conditions. The eggs tend to behave similarly to other fine particles in the water column, and will accumulate in areas of high deposition and low resuspension. Seagrass beds are known to be environments that promote the accumulation of fine sestonic particles by inhibiting resuspension, so we hypothesized that they may serve as reservoirs for copepod resting eggs. Two years of field sampling on two sites in the northern Gulf of Mexico has revealed that viable resting eggs of the copepod Acartia tonsa are more abundant in grassy areas in comparison to adjacent sandy areas during times of the year when the seagrass canopy is high. However, this trend disappears in the winter when the seagrass blades have died off and the sediment in the beds is more easily resuspended. Further investigation could elaborate on why the observed patterns occur.

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DEEP SUBPOLAR GYRE FRESHENING: JUST A RESULT OF THE NAO?

Recent studies show a significant freshening of the Subpolar Gyre in the North Atlantic and in the Nordic Seas during the last decades of the 20th century. Several mechanisms have been proposed to explain single aspects of that freshening, including surface fresh-water fluxes as well as the latitudal import of fresh water out of the Arctic and the exchange of scale circulations in the subpolar gyre. An integrated concept of the mechanism is still missing. Based on a hierarchy of sensitivity experiments with realistic and simplified forcing conditions for the period 1958-2000, using the global NEMO ocean-sea-ice model, a complete freshwater budget for the sub-/artic/and subpolar basin has been assessed which resembles the observational estimates. We found a strong relation between the subpolar freshwater content variability and the North Atlantic Oscillation (NAO), in particular at depth. We also found observational evidence for this implication using salinity records taken close to the Ocean Weather Ship (OWS) Bravo.

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VARIABILITY IN THE QUALITY OF FLOODWATERS FOR WETLAND RESTORATION IN SOUTH SAN FRANCISCO BAY

The largest tidal-wetland restoration project on the west coast of the US is underway in South San Francisco Bay (SSFB). A major objective of this project is the conversion of salt-evaporation ponds to a mix of wetland habitats. Hydrologic reconnection to the bay will provide water, sediment, and tidal energy needed for this restoration. Water quality in SSFB is affected by many hydrologic factors, including inflows from local streams, mixing with water from North San Francisco Bay, and discharges from waste-water treatment plants. Therefore, the quality of the SSFB water available for wetland flooding can vary over multiple time scales. Fixed-site monitoring of basic water-quality variables over the last two decades provides historic data showing influences of tides, storms, seasonal weather patterns, inter-annual climate variability, and multiple-year droughts. Fixed-site records and data from other monitoring and research programs allow estimation of some water-quality variables certain times of the year. In winter, however, near-real-time observations now available on the Internet may be particularly useful because large, primarily weather-driven changes in water quality are common.

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THE MIDDLE SCHOOL STUDENTS OCEANOGRAPHIC SCIENCE AND TECHNOLOGY PROGRAM, A MULTIDISCIPLINARY, MULTI-METHOD APPROACH

The Kingsborough Community College Department of Physical Sciences has a 40 year history involving oceanography outreach. The KCC Office for College Advancement and NYS Education Department promote the academic mission of the College through outreach programs such as this. In this unique program, Brooklyn urban Middle School students participated in one of three two-week summer sessions. Students were introduced to a wide range of standards based geoscience concepts through the lens of oceanography. It is believed that this early exposure to oceanography in the form of personally relevant experiences will better prepare students for success in their continuing geoscience education. In this program, students engaged in classroom and shipboard activities. Shipboard activities included water quality testing and organism tows in New York Harbor while aboard the USP Pioneer. Classroom activities included using GIS, collecting oceanographic buoy data, building and using quadrants, and analyzing Ocean Drilling Program integrated and Seasonal Ocean Drilling Program materials and data. Quantitative evaluation of student’s reasoning and observational skills was accomplished using the Science Achievement for Middle School Students.

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EVIDENCE FOR BACTERIAL MERCURY METHYLATION AT THE OXIC/ANoxic INTERFACE OF THE HYPERSONAL ORCA BASIN

A profile of suspended particulate matter was collected in June of 2003 across the oxic/anoxic interface of the Orca Basin, northern Gulf of Mexico. At each depth, as much as 1000-1500 L of seawater or brine was passed through an autonomous in-situ filtration device. Subsamples of the frozen filters were digested for total particulate Hg analysis and extracted by distillation for particulate methyl Hg analysis. Concentrations of these two Hg fractions, both measured by time-resolved ICP-MS, are substantially elevated at the oxic/anoxic interface. Bacterial sulfide production is confined to the same depth interval as the particulate Hg concentrations throughout the brine, whereas none could be detected in the overlying seawater. Selected filters will be analyzed for 16S rRNA genes and the presence of putative mercury-methylating bacteria. This appears to be the first report of active mercury methylation in a hypersaline anoxic environment.

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SEASONAL VARIABILITY IN THE COMPOSITION OF DISSOLVED ORGANIC MATTER IN NORTHEAST U.S. RIVERS: IMPLICATIONS FOR TERRESTRIAL INPUTS TO THE COASTAL OCEAN

Rivers are the primary link between terrestrial carbon sources and the ocean. Export of dissolved organic matter (DOM) from ancient OM-rich continental rocks via rivers may impact isotopic distributions, estimates of terrestrial OM input, and carbon remineralization in ocean margins. DOM from northeast U.S. rivers was examined over two seasons using 1H-NMR spectroscopy to assess these potential terrestrial contributions. GIS was also used to characterize watersheds' lithology, land use, and variations in leaf area index (LAI). Variability in DOM composition between rivers was low in spring. Increases in aliphatic-H and decreases in carbohydrate-like and aromatic components were noted in summer for two of the smallest watersheds draining OM-rich lithologies and having the greatest ranges in river discharge and LAI. This suggests that smaller watersheds may respond more rapidly to increased terrestrial water inputs, downstream from OM-rich rocks. Fall and winter studies of DOM in these rivers may show smaller inputs from terrestrial vegetation, and should be carried out so that their corresponding impacts on the coastal ocean may be evaluated.

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RIVER PLUME EXPERIMENTS WITH THE HYBRID COORDINATE OCEAN MODEL: APPLICATION TO THE MISSISSIPPI RIVER DISCHARGE

Numerical simulations using the Hybrid Coordinate Ocean Model (HYCOM) are employed to study the development and evolution of river plumes, as a first step to understand the dynamics of the Mississippi River buoyant plume. Both process-oriented and realistic experiments are performed. Idealized domain experiments on a rectangular, mid-latitude f-plane, simulated the general structure of a buoyant plume, with an offshore anticyclonic bulge and a meandering coastal current. Different experiments were performed to evaluate the factors that influence the plume development and the sensitivity to mixing parameterizations. The offshore extent of the bulge, the strength of the coastal current and the vertical stratification were dependent on the bottom/coastal topography, the amount of river discharge and the available mixing. Simulations on the Northern Gulf of Mexico (NGoM-HYCOM) high resolution (~18 km grid) domain (nested within the Gulf of Mexico GoM-HYCOM model) focus on the particular characteristics of the Mississippi River plume and in particular interactions of the buoyant outflow with both shelf circulation and offshore circulation, which is dominated by the Loop Current.

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FRESHWATER FRACTIONS, PATHWAYS, AND MEAN RESIDENCE TIMES OF WATERS IN THE SURFACE LAYERS OF THE ARCTIC OCEAN DERIVED FROM TRACER DATA

The Oden 2005 trans-Artic section provides a new, high-quality tracer dataset with unprecedented resolution of the Canadian Basin of the Arctic Ocean. Using multiple tracers from this cruise, the water masses in and above the pycnocline are decomposed into their end members including Pacific and Atlantic inflow, as well as meltwater and sea-ice meltwater fractions. Measurement and eddy errors are propagated through an inversion technique to properly constrain the water mass estimates. We place the results into a dynamical context using satellite-derived sea-ice transit times, tritium/He-3, and CFC-derived tracer ages, and coupled sea-ice/ocean GCM output. Rapid transports in topographically guided boundary layers and zones of sluggish transport at the base of the pycnocline away from the boundaries are easily identified. The tracer-derived transit times are compared with time scales of surface sea-ice transport and basin-scale freshwater residence times from end-member mass balances and models to make a first estimate of residence time variances.

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FACEDERED AND DISPERSED FLOW AT SAND BOILS AND THROUGH POROUS SEDIMENTS: RELEASE OF NATURALLY OCCURRING ISOTOPES AND MEASUREMENTS OF TRANSIT TIMES

Fluid flow through porous sediments is an efficient mechanism transferring nutrients and trace gases, otherwise consumed by microbial activity or precipitated as minerals, into the bottom water. For tidal flat sediments of the Weser Estuary (Germany), we present a multi-tracer approach applied for investigations of submarine groundwater discharge and a 2D model considering fluid flow through permeable sediments. For simulation of discharge rates pore water studies, measurements of natural radio nuclides as well as flow-meter chambers were applied. The ecological impact of the release of nutrients and methane were considered and related to the spatial distribution of benthic organisms. In total an area of several square kilometres is affected by groundwater dis-
charge. Discharge occurs at distinct locations (‘sand boils’) and as dispersed flow through the sediments. Discharge rates of more than 100 L per day were measured at sand boils. Emanating fluids are enriched in nutrients as well as CH4. Furthermore, porous water profiles measured in “regular sediments” revealed the importance of diffusive discharge. A 2D numerical model, driven by hydraulic gradients, density, or permeability was developed. We applied the model to porous water profiles measured along transects crossing sand boils. The 2D model provides information about the complex interaction between the flow field, microbial degradation of methane and fluxes through the sediments-water interface.

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SEASONAL AND DECADAL VARIATIONS OF WEST GREENLAND CURRENT SALINITY AND THE IMPACT ON THE CENTRAL LABRADOR SEA.

Convection in the central Labrador Sea (LS) is closely related to the stability of the water column, thus thermal and haline stratification. Recent research has shown the influence of West Greenland Current (WGC) water anomalies on central LS top 200m salinities, on seasonal to decadal time scales. The LS is therewith highly affected by salinity changes in the WGC system. Seasonal and decadal analysis of these pathways was performed with an extensive constructed database. On the seasonal time scale eddy mixing at the Cape Desolation and southern branch of the WGC bifurcation south of Davis Strait are responsible for two different seasonal cycles in the central LS. Phases of high EKE in the LS show only one freshening whereas low EKE phases show two distinct freshenings within the seasonal cycle. For the decadal time scale it was found that variability of the upper central LS salinity has its main origin in reduced offshore salinities in the WGC at salinities above 34.7, thus with Inningmer Current (IC) origin. This is also found for the well described Great Salinity Anomalies (GSAs). Spectra and regression analysis of several areas within the LS suggests a 12-13 year salinity minimum phenomena emerging via the IC extension. Variations in WGC shelf water seem to have only very little influence on decadal central LS salinity variability. Thus the commonly believed arctic origin of GSAs in the central LS is discussed in reference to the found pathways.

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CLIMATE-DRIVEN VARIABILITY OF MARINE PRIMARY PRODUCTION AND AIR-SEA CO2 FLUX: COMPARISON OF CLIMATE CARBON CYCLE MODELS WITH OBSERVATION-BASED ESTIMATES

One important aspect in climate carbon cycle modeling is the validation of model output by observational data. The current study compares results from three fully coupled atmosphere-ocean carbon cycle models (IPSL, MPIM, NCAR) with data and observation-based estimates from (inverse) modeling. In particular, available satellite data that derive marine productivity from ocean color and results from (inverse) modeling are used to constrain marine primary productivity (PP) and air-sea CO2 exchange. The results show a good agreement between the regions that dominate the global signal in PP variability in both models and satellite estimates. Nevertheless, two of the models (MPIM, NCAR) are too strongly iron limited, which dampens the impact of climate variability (stratification, SST) on nutrient supply and PP. In IPSL the observed PP and PP via nutrient supply can be confirmed. Spatial correlations and seasonal variability of Delta pCO2 are moderately well reproduced by all three models and the resulting air-sea CO2 fluxes are close to results from ocean inversions. In summary, the results are promising that coupled climate carbon cycle models have reached the stage where they are not only able to represent climatological mean state, but also reproduce some of theodynamics of internal (climate) variability.

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ASSESSMENT OF THE SOUTHERN OCEAN SOLUTION IN THE ECCO2 DATA SYNTHESSES

Global ocean circulation models often do not adequately resolve high latitude processes, hence the characteristics and flow of deep and bottom waters often remain unrealistic. We present the assessment of the optimized solution of the ECCO2 data synthesis with respect to various Southern Ocean metrics as well as sensitivity experiments. The sensitivity studies were not only performed in order to determine the impact on the hydrography of the Southern Ocean, the Antarctic Circumpolar Current (ACC), and the global overturning but also to further improve the model solution. The sensitivity experiments comprise runs with increased salt fluxes and with imposed southern boundary conditions representing a regime from ice shelf-ocean-interactions. While the optimized solution serves as a baseline experiment, the first sensitivity experiment simulates the increase of salinity fluxes due to brine rejection during sea ice formation in future climate scenarios with changes in sea ice conditions. The second experiment investigates the impact of freshwater introduced in the southern hemisphere in individual basins on both regional and global scales. Excess evaporation enhances salt fluxes and modifies the hydrography consequently. The impact in the Arctic is strengthened the ACC and the meridional overturning. Additional freshwater stabilizes the water column and results in a reduction of the ACC transport as well as the meridional overturning.

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EDUCATION AND OUTREACH IN A NETWORK OCEAN WORLD

The ocean drives global climate, is the fuel tank for extreme weather, and accounts for half of the carbon on Earth. For human society the ocean provides food, natural resources, an economic engine, an untapped source of all renewable energy, and is an ultimate sink for products we produce. This combined with many observations that oceans are changing dramatically is improving ocean literacy a clarion call for our time. Oceanography is developing an observatory-based approach in which scientists continuously interact with instruments, facilities, and other scientists to explore the earth-ocean-atmosphere system remotely. A recently funded COSEE effort is focused on building the scientist-educator partnerships to create a Networked Ocean World (NOW). COSEE-NOW will serve as a facilitator for quality education and public outreach by focusing on three goals. The first are the development and dissemination of tools through targeted surveys and improved cultural competency practices. Secondly our goal is improve collaboration/coordination between scientists/educators by building online community and interactive GIS observatory communities that will deliver the information through a range of formal/informal education forums.

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REMOTE DETECTION OF MARINE MICROBES, SMALL INVERTEBRATES AND HARMFUL ALGAE USING MOLECULAR PROBE TECHNOLOGY AND THE ENVIRONMENTAL SAMPLE PRECESSOR (ESP)

The Ocean Observing Initiative is creating unique opportunities for deploying sensor systems in a distributed ocean observational context. We are exploring that potential through the development of the Environmental Sample Processor (ESP, http://www.mbari.org/microbial/esp). Near real-time observations are achieved through DNA probe and probe arrays. Filter-based sandwich hybridization methodology enables direct detection of ribosomal RNA sequences indicative of groups of Bacteria and Archaea, as well as a variety of invertebrates and harmful algal species. An antibody-based technique is used for detecting domoic acid, an algal toxin. To date the ESP has been deployed in ocean waters from near surface to 1000m depth. Shallower water deployments have emphasized application of all four types of assays in single deployments lasting up to 30 days. Deep water applications have focused on detection of Bacteria and Archaea in the water column as well as invertebrates associated with cold seeps and whale falls, with operations lasting several days. Current work emphasizes incorporating a 4-channel real-time PCR module, extending operations to 4000m depth and increasing deployment duration.

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DETECTING EMILIANIA HUXLEYI BLOOMS IN GLOBAL AVHRR IMAGERY

Bloom of the coccolithophorid Emiliana huxleyi profoundly affect marine ecosystems, impacting the biogeochemical and optical properties of the waters in which they occur through their production of coccoliths. Documenting the distribution pattern and its variability will permit us to assess the impact these blooms have on the carbon cycle and to model the response to climate variability and change. In order to document the interannual and longer-term variability of coccolithophorid blooms on a global scale, NOAA AVHRR imagery dating from 1982 to the present was used to yield a continuous, global time-series of remote sensing reflectances in which E. huxleyi blooms can be detected. Though less sensitive than satellite ocean color sensors, AVHRR observations bridge annual and longer-term variability of coccolithophorid blooms on a global scale, NOAA AVHRR imagery dating from 1982 to the present was used to yield a continuous, global time-series of remote sensing reflectances in which E. huxleyi blooms can be detected. Though less sensitive than satellite ocean color sensors, AVHRR observations dating from 1982 to the present were used to yield a continuous, global time-series of remote sensing reflectances in which E. huxleyi blooms can be detected. Though less sensitive than satellite ocean color sensors, AVHRR observations dating from 1982 to the present were used to yield a continuous, global time-series of remote sensing reflectances in which E. huxleyi blooms can be detected. Though less sensitive than satellite ocean color sensors, AVHRR observations dating from 1982 to the present were used to yield a continuous, global time-series of remote sensing reflectances in which E. huxleyi blooms can be detected. Though less sensitive than satellite ocean color sensors, AVHRR observations dating from 1982 to the present were used to yield a continuous, global time-series of remote sensing reflectances in which E. huxleyi blooms can be detected. Though less sensitive than satellite ocean color sensors, AVHRR observations dating from 1982 to the present were used to yield a continuous, global time-series of remote sensing reflectances in which E. huxleyi blooms can be detected. Though less sensitive than satellite ocean color sensors, AVHRR observations dating from 1982 to the present were used to yield a continuous, global time-series of remote sensing reflectances in which E. huxleyi blooms can be detected.
A second study was performed from a pier on the Hudson River, near Lamont Doherty experiment was carried out in a wave tank with mechanically-generated gravity waves. and the change in polarization of reflected light to infer the instantaneous 2-dimensional Wolff, L. B.
Banner, M. L.
Schultz, H.
EDUCATE, AND EMPOWER: SOME THOUGHTS FROM THE OTHER SIDE onshore flow is expected to be high in nutrients, which can then be brought up to the ing of the Alaska Coastal Current and entrainment generates the deep onshore flow. The interannual variability of the first mode is highly correlated with the strength of the Both modes show the flow of high saline, warm water onto the shelf in a bottom layer. of the covariance between salinity and temperature time series across the Seward Line. Oscillation. Two dominant modes of cross shelf circulation are identified through analysis coho salmon and eulachon, a local fish species. Both studies suggest that the onshore flow is driven by a combination of physical processes, including wind-driven upwelling and the effect of coastal freshwater discharge. Satellite observations and field measurements during SEDGES confirm the presence of high chlorophyll concentrations in the subarctic Pacific. The ecosystem model is used to further explore the mechanisms behind the onshore flow and its impact on the ecosystem. The model results are compared with observations in SIT to assess the model's ability to simulate the observed patterns. The model's predictions for the future are discussed in terms of potential changes due to climate change.

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INTEGRATION OF OCEAN OBSERVING SYSTEMS DATA IN UNDERGRADUATE CURRICULA SOEST at University of Hawaii is launching a regional ocean observing system to inte- grate cutting-edge research programs with delivery of operational online data focused on Hawaii waters. The information will supplement existing observ- ing programs that are currently incorporated into undergraduate courses. The Global Environmental Science (GES) B5 degree program utilizes information from local observ- ing systems at three levels in the curriculum. In an introductory seminar, GES majors learn about time-series measurements, in situ monitoring, and integrated sampling programs as conducted through the HOT program, the Kilo Nulo Observatory, and the CRIMP-CO2 buoy in Kaneohe Bay. Data from these observatories are incorporated in an upper division class, Interpretation of Earth-System Computer Databases, where students download and manipulate data from tide gauges, the HOT program, the TAU array, and from satellites. Finally, all GES majors complete senior research projects, many based on research with our existing ocean observing programs. The incorporation of ocean observ- ing data in the GES curriculum successfully exposes students to cutting edge science and technology as they master valuable skills in obtaining, analyzing, and interpreting these observations.

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INTERANNUAL VARIABILITY OF THE ONSHORE FLOW OF HIGH SALINE, COLD WATER ONTO THE SHELF IN THE NORTHERN GULF OF ALASKA The Northeast Pacific GLOBEC (GLOBal ocean Ecosystems dynamics) program (October 1997 to December 2004) collected hydrographic data along the Seward Line that stretches from the inner shelf (59.8N, 149.5W) and extends over 200 km beyond the continental slope (58.1N, 147.8W). The complex of the interannual hydrographic vari- ability in this area stems from the interacting influences of local forcing such as winds, coastal freshwater discharge, eddies, and fronts with remote forcing like El Niño-Southern Oscillation. Two dominant modes of cross shelf circulation are identified through analysis of the covariance between salinity and temperature time series across the Seward Line. Both modes show the flow of high salinity, warm water onto the shelf in a bottom layer. The interannual variability of the first mode is highly correlated with the strength of the alongshore wind stress. While, the second mode suggests that offshore surface spread- ing of the Alaska Coastal Current and entrainment generates the deep onshore flow. This onshore flow is expected to be high in nutrients, which can then be brought up to the euphotic zone by upwelling produced by Ekman pumping.

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A METHOD FOR RECOVERING THE TWO-DIMENSIONAL SLOPE FIELD OF OCEAN SURFACE WAVES USING AN IMAGING POLARIMETER We present a passive optical remote sensing technique for recovering shape information about a water surface, in the form of a two-dimensional slope map. The method, known as Polarmetric Slope Sensing (PSS), uses the relationship between surface orientation and the change in polarization of reflected light to infer the instantaneous 2-dimensional slope across the field-of-view of an imaging polarimeter. For unpolarized skylight the polarization orientation and degree of linear polarization of the reflected skylight provide sufficient information to determine the local surface slope vectors. A controlled laboratory experiment was carried out in a wave tank with mechanically-generated gravity waves. A second study was performed from a pier on the Hudson River, near Lamont Doherty Earth Observatory. We demonstrated that the two-dimensional slope field of short grav- ity waves could be recovered accurately without interfering with the fluid dynamics of the air or water, and these observed water surface shapes appear remarkably realistic. The combined field and laboratory results demonstrate that the polarimetric camera gives a robust characterization of the fine-scale surface roughness features that are intrinsic to wind-driven air-sea interaction processes.

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IRON LIMITATION OBSUCES SIMILARITIES BETWEEN SEASONAL PLANKTON CYCLES IN THE SUBARCTIC ATLANTIC AND PACIFIC Satellite estimates of phytoplankton carbon provide an alternative to chlorophyll for as- sessing phytoplankton biomass. Here, we show that phytoplankton carbon concentrations in the subarctic Pacific reach a late summer maximum that rivals peak concentrations during the North Atlantic spring bloom. This finding is at odds with previous studies, which concluded that persistently low chlorophyll concentrations in the subarctic Pacific are indicative of low biomass, and that the accumulation of phytoplankton is limited by low iron concentrations and strong grazing pressure. In contrast, we propose that the low chlorophyll concentrations do not reflect the seasonal cycle of phytoplankton biomass, because iron limitation suppresses cellular Chl:C ratios. Satellite observations and field measurements during SEDGES confirm the suppression of Chl:C ratios under ambient iron concentrations in the subarctic Pacific: inside the iron-fertilized patch, Chl:C ratios were three times higher than in the surrounding waters. This physiological response to iron is consistent with culture studies and model simulations and has to be taken into account when chlorophyll observations are used to infer ecosystem behavior.

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ZOOPLANKTON PRODUCED FLUORESCENT DISSOLVED ORGANIC MATTER (FDOM) IN THE GREAT SOUTH CHANNEL In the Gulf of Maine, the endangered North Atlantic Right whale feeds primarily on the copepod Calanus finmarchicus. Previous work has shown zooplankton contribute to the FDOM pool through excretion products. Zooplankton FDOM, referred to as Peak Z, is unique from previously defined FDOM peaks. In other studies, the vertical distribution of Peak Z has been found to be correlated with zooplankton abundance. In May/June 2007 we took water column FDOM samples in the Great South Channel off of Cape Cod to examine the spatial and temporal presence and distribution of Peak Z. In addition, we are determining if the distribution of peak Z has any correlation with feeding North Atlantic Right whales. Samples were obtained from several transects lines as well as two separate 24 hour stations. At each station, water samples for FDOM were collected from depths of 2 meters and either the pycnocline or chlorophyll maximum. We will be presenting data on the vertical and spatial distribution of Peak Z and discussing its relationship to sightings of right whales, zooplankton abundance, and water column structure.

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EFFECT OF FLOCCULATION PROCESSES ON THE TRANSVERSE DISTRIBUTION OF COHESIVE SEDIMENT IN TIDAL ESTUARIES An idealized model is discussed to gain fundamental knowledge about the physical mechanisms underlying the distribution of sediment in estuarine cross-sections. In this presentation the effect of a nonconstant settling velocity of cohesive sediment (due to floccu- culation processes) on sediment trapping is studied. The flow is governed by the shallow water equations and forcing is due to tides, river discharge, horizontal density gradients and wind. The sediment transport is computed from a concentration equation, in which erosion of sediment by the bed shear stress is limited by the availability of sediment. An across-channel varying availability coefficient is resolved from imposing a morphody- namic equilibrium condition such that there is no net evolution of the bed. The model is applied to a 500 m wide cross-section of the Ems estuary in Germany. In that transect, observations of flow, sediment concentration and salinity were collected over a full tidal cycle. The preliminary comparison of model results and observations over part of a tidal cycle shows an improved agreement between model results and observations when floccu- culation effects are incorporated.

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IN SITU ANALYSIS OF PHOTOSYNTHETIC GENE EXPRESSION OF THE SMALLEST KNOWN EUKARYOTE, OSTREOCOCCUS SPP. The ubiquitous marine picocyanobacterium, Ostreococcus, is an early-diverging class within the green plant lineage. We evaluated gene expression of Ostreococcus spp. light harvesting
complex (LHC) by applying reverse transcriptase PCR (RT-PCR) from environmen-
tal samples collected every three hours during a 24-h cycle, off the coast of California. Corresponding light levels and other parameters were also measured at the time of collec-
tion. Preliminary steps in RT-PCR optimization were taken to enable semi-quantitative re-
sults through relative quantitative PCR. We designed species-specific primers for a variety of targeted LHC genes and for a TATA transcription factor binding site to use as a house-
keeping gene control. Our results show that differential expression of the LHC2 gene oc-
curs over the 24-h cycle. LHC2 transcripts were found to be present between 1200hr and 2200hr, while dropping below detectable levels at all other times. This suggests that Ostreococcus spp. only expresses light harvesting genes when photosynthetically active. In addition, the lack of detectable levels of mRNA shortly following sunset suggests that the instability of mRNA within Ostreococcus cells may be similar to that within prokaryotes.

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A REAL TIME SYSTEM FOR PREDICTION OF COASTAL CIRCULATION AT GREAT LAKES BEACHES

A nested grid hydrodynamic circulation model with outer grid horizontal resolution of 2 km and nested grid horizontal resolution of 100 m has been developed for several coastal locations around southern Lake Michigan. The nested model domain is on the order of 20 km in the alongshore direction and 10 km in the offshore direction. The nested grid is driven by coarse grid boundary conditions generated from an operational whole lake model. Both models are run in real time using wind fields derived from surface weather stations and around the lake. The domains of the high resolution nested model generally include one or more tributary inflows. The flow rate from the tributary is set based on real time USGS stream flow reports. The model is fully three dimensional, but for visu-
alization purposes a two-dimensional advection model is used to simulate the dispersion of the tributary plume. Time series of tributary water concentration at beaches near the tributaries are presented as potential indicators local water quality. The model is updated four times a day and graphical results are available on the World Wide Web.

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MODELING TROPHIC TRANSFER OF TOXINS TO PREDICT HEALTH RISKS FOR MARINE MAMMAL POPULATIONS

Bottlenose dolphins are apex predators, exposed to persistent chemical contaminants that biomagnify through the food chain and to harmful algal bloom (HAB) toxins that are transported through the food chain. A comparative study along the southeast U.S. coast and Gulf of Mexico has identified “hot spots” for dolphin exposure to anthropogenic chemicals and for HAB-associated toxin exposure in regions of the Gulf of Mexico where mortality events, involving hundreds of dolphins, have occurred repeatedly over the last 8 years. While localized pollutant sources have been identified for some areas, a clear expla-
nation for increased or higher exposures has been elusive for others. Dolphins are oppor-
tunist feeders and their diet composition varies across regions, season, and in response to alterations in the environment. We demonstrate a mathematical model to explore the influence of prey composition on likely exposure of dolphins to both chemical and HAB toxins. We apply the model using toxin concentrations measured in potential prey species and examine how shifts in trophic feeding level alter the risk of toxin exposure.

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IN SEARCH OF AN ELUSIVE SCALE FOR THE RELATIVE HYDROPHOBICITY OF EXOPOLYMERIC FORMING SUBSTANCES

While it has been shown that aquatic exopolymeric substances (EPS) may undergo selec-
tive assembly (Chin et al, Nature 1998), little is known about the relative importance of EPS association in determining a relative scale of hydrophobicity for gel-forming EPS. But as more data were acquired, relationships between HCA and chemical composition of EPS showed promise for determining a relative scale of hydrophobicity for gel-forming EPS, but neither this source of mining, nor this potentially significant climate feedback, is included in current state-of-the-art coupled climate models. We examine results of hypothetical 21st century simulations where CO2 increases at 1% per year. Our results suggest that transient mixing from tropical storms might play a significant role in the location and magnitude of ocean heat uptake in a warming climate, particularly as the intensity of tropical storms increases.

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HURRICANE-INDUCED MIXING AND ITS EFFECT ON OCEAN HEAT UPTAKE AND CIRCULATION IN 21ST CENTURY CLIMATE CHANGE EXPERIMENTS

A parameterization of hurricane-induced mixing is incorporated into a coupled climate model of intermediate complexity. In our model, transient diapycnal mixing representing the aggregate effect of tropical storms is added to a background field of diapycnal mixing; the strength of this transient mixing is a function of the potential intensity of tropical storms, with the parameterization varying with the climate system. Neither this source of mixing, nor this potentially significant climate feedback, is included in current state-of-the-art coupled climate models. We examine results of hypothetical 21st century simulations where CO2 increases at 1% per year. Our results suggest that transient mixing from tropical storms might play a significant role in the location and magnitude of ocean heat uptake in a warming climate, particularly as the intensity of tropical storms increases. Monte Carlo simulations find an average of 0.48°C of ocean heat uptake in our model is arguably a better match to observed ocean warming in the past 50 years, in comparison with a version of our climate model without this parameteriza-
tion. Changes in the model's large-scale ocean circulation in the 21st century are also com-
pared with and without the effect of hurricane-induced mixing.

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WAVELET APPROACH TO THE ANALYSIS OF SEDIMENT CONCENTRATION AND HYDRODYNAMIC DATA IN THE SURF ZONE

Typical understanding of sediment transport revolves around identifying waves and the accompanying near-bed turbulence. The traditional theory covering large scale oceanic processes is highly nonlinear and turbulent. The traditional theory covering large scale oceanic processes is based on advective control calculations in addition to the rela-
tionships to sediment concentration. However, it is less common to adopt methodologies that concentrate on scrutinizing local characteristics of these processes observed in time series. Here we utilize a new approach to study local features observed in hydrodynamic and sediment concentration data based on the wavelet transform. The data analyzed is from the cross-shore sediment transport study obtained during the CROSSTEX conduct-
ed at O.H. Hinsdale Wave Laboratory, Oregon State University. Preliminary results using the wavelet transform to velocity time series in alongshore and cross-shore directions during beach accretion show a correlation of high sediment concentration events and turb-
ulent intermittent velocity patches which are associated with steep waves. Approximately 60% of the steep waves have turbulent patches associated with them while less than 50% of these events are also correlated for high concentration events. The statistical results suggest that a wavelet framework is useful to understand the complex interactions between sedi-
ment suspension and steep wave/breaking wave turbulence. Such analysis is also critical in guiding subsequent numerical modeling efforts.

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LARGE-SCALE OCEANIC TURBIDITY EXPLORED WITH SATELLITE OBSERVATIONS AND NUMERICAL MODELS

The large scale flow in the ocean is quasi-two-dimensional because of density stratification and Earth's rotation (so it's in geostrophic balance). It also has enormous Reynolds number and is highly nonlinear and turbulent. The traditional theory covering large scale oceanic currents (and also atmospheric winds) is geostrophic turbulence theory, and is traditional-
ly studied in idealized numerical model simulations or rotating tank laboratories. Satellite observations of the surface currents began in late 1992, and recently provide long enough records to study equilibrated geostrophic turbulence throughout the World Ocean. For the last few years we have been studying these oceanic observations from the turbulence perspective and comparing the results with idealized numerical model experiments. New phenomena we've discovered include the inverse cascade of baroclinic kinetic energy and highly anisotropic current structures that persist much longer than the timescale of the turbulent flow. Analysis of satellite observations from the turbulence perspective is prov-
ing useful in providing information on the energy cycles of the ocean.

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SENSITIVITY ANALYSIS OF A 1-D OCEAN CARBON CYCLE MODEL IDENTIFYING THE ORIGINS OF UNCERTAINTY

Two major unknowns in the attempt to balance the global carbon cycle are the flux be-
tween the atmosphere and the ocean, and the flux between the atmosphere and the ter-
restrial biosphere. Ocean carbon cycle models have been developed to directly address the first of these and in doing so quantification of the second. These models are highly complex, rep-
resenting many different physical and biological processes and the interactions between them.
Many of the parameters which govern these processes are poorly understood and highly uncertain, resulting in large uncertainties in model predictions. This work uses a sensitivity analysis to identify specific sources of uncertainty in the HadC3M GCM (Hadley Centre Ocean Carbon Cycle) model used by the UK Met Office in their HadCM3 GCM. This enables research to be focussed into model parameters that contribute significantly to output uncertainty, while parameters with negligible effect can safely be fixed. It also informs the interactions between parameters and whether their importance is global or regional. Results for different locations in the North Atlantic will be shown and discussed.
IS THERE LIFE BEYOND HYDROSTATICS? SOME IDEAS ON NLIWS PARAMETERIZATION

Conventional wisdom holds that realistic modeling of Nonlinear Internal Waves requires nonhydrostatic models. Unfortunately, the solution of the ensuing three-dimensional elliptic problem is very expensive numerically, which greatly limits the spatial and temporal extent of the problems that can be studied. In this talk, we explore a relatively simple way to go beyond hydrostatics without incurring the steep price of a fully non hydrostatic model. Rationale and application to both structured and unstructured grids will be discussed.

IMPORTANCE OF LATERAL CIRCULATION TO ESTUARINE STRATIFICATION AND MIXING

Traditionally the interaction between the along-channel density gradient and the vertical shear in the along-channel flow is assumed to control estuarine density stratification. The interaction between lateral density gradients and transverse circulations can have significant impacts on both the creation and destruction of density stratification. As a result, these lateral processes play a key role in determining when and where mixing occurs in an estuary. This is illustrated by using field observations and a three-dimensional numerical model of the Hudson River. Both the model and observations show that strong lateral stratification of the density field creates significant stratification over the shoal regions during the flood tide. Unlike the pattern attributed to longitudinal tidal straining, maximum stratification occurs over the shoal at the end of flood tide due to lateral straining. Much of this stratification is then mixed away during the ensuing ebb. As a result, the most intense mixing in the Hudson River is observed during the ebb tide over regions flanking the deepest portions of the channel. The creation of stratification by lateral flows at tidal time scales allows for intense mixing to occur and continue throughout the spring tide, even though the sub-tidal stratification is at a minimum. The intensification of lateral flows during spring tidal conditions contributes significantly to the spring-neap variability in mixing.

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NITROGEN NUTRITION AND TOXICITY OF PSEUDO-NITZSCHIA SPP. ALEXANDRIUM CATENELLA AND DINOPHYCIS SPP. BLOOMS IN THE BENGUEL

Harmful Algal Blooms are a regular occurrence on the west coast of South Africa, in the Benguela upwelling system. This talk explores the relationships between nutrient regime, species selection and toxicity at a monitoring station in this region. In March 2006 Pseudo-nitzschia spp. reached concentrations of 13 x 10^6 cells L^-1, representing 82% total phytoplankton carbon, with chl-a as high as 57 g L^-1. Dissolved acid concentrations were 0.3-3.3 g L^-1, with cellular quotas increasing 5-fold as cell numbers dropped after the bloom. Nitrate was depleted from <10 to <0.1µM in a few days. Cell numbers remained high for another 4 days, sustained by regenerated nitrogen, with f-ratios dropping to <0.5. In contrast, a bloom of Alexandrium catenella (450,000 cells L^-1, 26 µg chl-L^-1) occurred in March 2007 at high nitrate concentrations (17µM), displaying high f-ratios (0.6-0.9), and were outcompeted by diatoms as nitrate decreased. In April, Dinophysis acuminata reached 31,000 cells L^-1, representing 61% of phytoplankton carbon. Nitrate concentrations were very low (<0.5µM) and production rate was based on regenerated nitrogen, as shown by the extremely low f-ratios (<0.1). Nutrient kinetic experiments showed that Pseudo-nitzschia had the highest maximum uptake rates, whereas Dinophysis had the highest affinity for nitrate, ammonium and urea.

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STRUCTURE OF NEAR-INERTIAL BAND GENERATED BY HURRICANE GEORGES BETWEEN TWO ISLANDS

Unique observations were acquired before, during, and after hurricane Georges passed through the Mona Passage (MP), between Puerto Rico and Hispaniola. Two acoustic Doppler current profilers and one S4 were deployed in the MP Georges crossed the MP with maximum winds of 49 m/s and 970 hPa having the moorings at the right side of its trajectory (September 22-23, 1998). The oceanic response to George's winds was strong in the mixed layer with magnitude of 118 cm/s at the center of MP and 160 cm/s near Hispaniola. The near-inertial band was bounded by 0.93f and 1.2f, (f represents the local inertial frequency). The near-inertial velocity shows a maximum value of 30 cm/s at the mixed layer. The phase of near-inertial wave propagates upward below the mixed layer and downward radiation of energy reached 300 m depth at the sill of MP after 31 IP (28-38 h). The transfer of energy to other frequency bands and the interaction of the inertial wave with topography generating internal wave are considered as possible mechanisms responsible for the decrease in mixed layer energy.

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METABOLIC RESPONSES TO OCEAN ACIDIFICATION

Ocean acidification will lead directly to intracellular acid-base imbalance in marine animals. Most species are expected to tolerate this disturbance via buffering and ion transport, depending on the evolved capacity to handle natural changes in acid-base balance that result from cellular metabolism and environmental variability. Those species with low metabolic rates or from stable environments are expected to be more sensitive to acidification. However, we find here that some species with exceptionally high metabolic rates are nonetheless sensitive to modest changes in the partial pressure of carbon dioxide consistent with that expected by the end of the century. In particular, squid blood demonstrates extreme pH sensitivity that facilitates complete release of oxygen from the blood at the metabolizing tissues, but also inhibits oxygen extraction from the ambient water under conditions of environmental acidification. We find that ~1000 ppm PCO2 results in a significant reduction in activity and consequent metabolite suppression in ommastrephid squid.

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EXAMINING THE VALIDITY OF THE OUTER BANKS HF RADAR SYSTEM

A long-range direction-finding HF radar system has been operated on the Outer Banks of North Carolina since fall 2003. The radar footprint typically extends from the nearshore region north of Cape Hatteras to east of the shoreward edge of the Gulf Stream and presents an opportunity to examine shelf/Stream interactions in considerable detail. However, the installation suffers from a variety of noise problems that can severely limit the radar coverage. Also, the large change in current speeds within a given range from the antennas presents unique challenges to the standard processing algorithms used with the system and if not correctly can produce significant regions of incorrect solutions at times. Experimentation with the processing parameters suggest improved solutions are possible. The validity of re-processed solutions are explored for a six-month period of low noise by examining the tidal solutions over the shelf and slope and subtidal flow patterns.

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ASLO/AGU/TO/ERS 2008 Ocean Sciences Meeting
Fluctuations in the Gulf Stream position and surface transport are extracted and compared to available independent estimates.

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PAST, CURRENT & FUTURE TRAJECTORIES OF WATERSHED NUTRIENT EXPORT: A GLOBAL NEWS APPLICATION TO THE MILLENNIUM ECOSYSTEM ASSESSMENT SCENARIOS

Dramatic global increases in anthropogenic nutrient production on land and negative impacts on marine ecosystems due to runoff from rivers are extensively documented. Recently, the Millennium Ecosystem Assessment (MA) concluded that excessive nutrient loading of ecosystems is one of the major drivers of global ecosystem change. Increased nutrient mobilization is expected to continue for decades in response to economic and population growth.

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NUTRIENT IMPACTS ON THE CHESAPEAKE AND ITS SUB-ESTUARIES: RESILIENCE (?) AND RECOVERY (SLOW TO UNDETECTABLE)

Nutrient loads to the Chesapeake and its primary tributaries have increased over the past 200 years, resulting in eutrophic conditions throughout the mainstem of the Bay and some of the lower reaches of its principal tributaries. Analyses of long-term records for discharge, nutrient loads, land use, and plankton responses suggest substantial seasonal and spatial expansion of the spring diatom bloom and associated bottom water hypoxia and anoxia. Nutrient reduction strategies in the basin have resulted in modest reductions in nutrient loads for some systems, but limited detectable planktonic responses. Phytoplankton biomass and productivity remain high, with phytoplankton blooms observed in all seasons, driven by local/regional meteorology and accompanying responsive phytoplankton blooms and bottom water hypoxia. The Global Nutrient Export from Watersheds (NEWS) model, designed to meet these data needs, was recently applied to past (1970) and current (2000) conditions, and compared to four MA future scenarios thru 2050. These scenarios integrate economic, social, and ecosystem processes, and represent plausible futures with contrasting degrees of global cooperation and of sustainability of ecosystem services.

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DATA ASSIMILATION INTO REGIONAL OCEAN MODELING SYSTEM OF THE NORTHWEST PACIFIC MARGINAL SEAS BY USING ENSEMBLE KALMAN FILTER: IDENTICAL TWIN EXPERIMENT

Data assimilation scheme strives to determine the optimal state of a system from a set of incomplete and inaccurate observation. Ensemble Kalman Filter (EnKF) of data assimilation is implemented into the Regional Ocean Modeling System (ROMS) configured for the Northwest Pacific Marginal Seas. The regional model has 0.25 horizontal grid resolution and 20 sigma levels in the vertical, and includes the East China Sea, the Yellow Sea, the East/Japan Sea and Northwestern part of the Pacific Ocean. The main focus on this study is to assess the performance and the capabilities of the EnKF before assimilating real observations by the identical-twin experiments, which is a useful tool for both operational applications and observing systems design, prior to actual measurements. In these experiments, we obtain the true state from single model integration with the ECMWF atmospheric forcing and boundary conditions with the ECCO. Pseudo-observations of SST are obtained by adding (identically independently distributed) white noise with mean zero and variance equal to 0.5% of the temporal standard deviation at a grid of 30 observational locations every 10 days. The comparisons between the truth and the estimations from both non-assimilating and assimilating results are beneficial in setting up an effective configuration for the assimilation of real data in near-real time situation.
Riedel, T. & Berelson, W. - Summit will be discussed. Gas results from firn air studies at the WAIS Divide site, West Antarctica, and Greenland on top of polar ice sheets. We find a modern zone of deep air convection 25-30 m thick.

Since benthic fluxes are influenced by sediment grain size, temperature and other induced changes, there is a spatial and temporal variability in sediment-water exchanges in most coastal environments. The aim of the present study was to quantify the annual amount of NH4+ and HPO42− exported from intertidal-muddy and subtidal-sandy areas in order to evaluate their contribution to the lagoon nutrient budget. Porewater NH4+ profiles evidenced a peak in the top-most mudsy sediment (380 µM) suggesting higher mineralization rate when oxygen is more available, while maximum HPO42− concentration (113 µM) occurred in the suboxic layer probably due to phosphorous desorption under reduced conditions. In organically poor sandy sediments, porewater concentrations were always lower than in muddy sediments. Studies developed in this lagoon have shown that N and P entering the system are quickly removed by primary producers, what might explain the low NH4+ (< 4 µM) and HPO42− levels (< 2 µM) in overlying water. These values, 2 to 3 orders of magnitude lower than those found in porewater lead to concentration gradients that drives sediment-water exchanges. Diffusive fluxes predicted by a mathematical model based on geochemical processes, were higher during summer, in both muddy and sandy sediments, while during lower temperature periods fluxes were 3 to 4 times lower. Based on simulated nutrient effluxes, the estimated annual amount of NH4+ and HPO4− exported from intertidal areas was 3 times higher than that released from subtidal areas (22 ton y−1 - NH4+; 2 ton y−1 - HPO4−), emphasizing the importance of tidal flats for the high productivity of the lagoon.

Kawamura, K. & Severinghaus, J. P. - Mamala Bay are affected by physical structure and events. Clearly, thin plankton layer characteristics in dissipate or advected thin layers in most cases. Abrupt current reversals either dis- resolved physical structure. Recurring high frequency internal waves were found to vertically congregate in vertically thin layers. This work will present for the first time the observations of thin layers on the south shore of Oahu, Hawaii. We investigated the formation, displacement, and dissipation of these thin layers as a function of physical structure in the water column, and periodic events forced by shoaling internal tides. Acoustic Doppler Current Profilers (ADCPs) were used to measure currents and backscatter. One ADCP was calibrated to output absolute volume scattering strength from zooplankton. The influence of physical structure and events.

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THE INFLUENCE OF PHYSICAL STRUCTURE AND SHOALING INTERNAL TIDES ON THIN PLANKTON LAYERS IN MAMALA BAY, HAWAII.

Plankton distributions in coastal environments have recently been observed to be temporar- ily concentrated in vertical layers. This work was undertaken for the first time to observe the distribution of thin layers on the south shore of Oahu, Hawaii. We investigated the formation, displacement, and dissipation of these thin layers as a function of physical structure in the water column, and periodic events forced by shoaling internal tides. Acoustic Doppler Current Profilers (ADCPs) were used to measure currents and backscatter. One ADCP was calibrated to output absolute volume scattering strength from zooplankton. Thermostat chains measured internal water propagation, and a autonomous profiler resolved physical structure. Recurring high frequency internal waves were found to vertically displace thin layers, but not to dissipate them. Abrupt current reversals either dis- solved or advected thin layers in most cases. Clearly, thin plankton layer characteristics in Mamala Bay are affected by physical structure and events.

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HEAVY NOBLE GASES AS TRACERS OF PAST AIR CONVECTION IN ICE CORE RECORDS

Argon, krypton, and xenon abundances and their isotope ratios are diagnostic of turbulent mixing (eddies diffusion), in a number of different environmental settings. Here we outline recent progress made in measurement techniques and show applications to deciphering the paleoclimate record from trapped air in ice cores. These records include past mean ocean temperature (from atmospheric krypton abundance via solubility), local ice sheet surface temperature, indirect records of mechanical disruption of the firm stratigraphy by crevassing and thermal contraction cracks, and passage of atmospheric CO2 and tem- perature variations, all of which are affected by air convection in the firm layer (snowpack) on top of polar ice sheets. We find a modern zone of deep air convection 25–30 m thick in the firm at the Megadunes site, central Antarctica, which demonstrates these heavy noble gas fractionation patterns and allows calibration of the ice core record. Recent noble gas results from firm air studies at the WAIS Divide site, West Antarctica, and Greenland Summit will be discussed.

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THE BENTHIC FLUX OF IRON FROM RIVER-DOMINATED CONTINENTAL SHELVES OF THE NORTH PACIFIC.

We present benthic iron flux data from two river-dominated regions along the Oregon- California continental shelf. Multiple sites along the Eel and Umpqua River margins were occupied in Spring and late Summer of 2007. In Spring benthic oxygen fluxes ranged between 2–6 mmol m−2 day−1. Benthic iron fluxes range from ~90 µmol m−2 day−1 to 2500 µmol m−2 day−1, with fluxes generally being higher near the Eel River. These values are more than a factor of four greater than non-river dominated California margin benthic iron fluxes (Eldred et al., GRL 2004). We tentatively speculate that the difference in benthic iron flux is driven by the greater availability of reactive iron within the Eel river sediments. Further, we observe a trend towards exponentially larger iron fluxes as oxygen is depleted within the benthic flux chambers. This result suggests that iron fluxes in excess of 1000 µmol m−2 day−1 occur when oxygen concentrations are low. Preliminary data for samples collected in September 2007 indicate that oxygen fluxes were 40–80% greater in late sum- mer than springtime values. Iron fluxes at both locations are, however, mostly lower com- pared to springtime fluxes, possibly indicating that the reactive sedimentary iron pool has become depleted over the summer.

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HISTORIC, HUMAN DIMENSIONS OF CORAL REEF Ecosystems: CONTRIBUTIONS TO MARINE Ecosystem-BASED MANAGEMENT

Marine ecosystem-based management (EBM) is regarded as a promising solution to degradation across many marine ecosystems, largely because it recognizes oceans as com- plex, adaptive, social-ecological systems (SES) and encourages managing for resilience. Conventionally, focus has been on ecological or social systems, rather than integrating the two and using synergies and approaches to managing connectivity in SESs are rather lacking. This research intends to provide managers practical tools for integrating human and ecologi- cal dimensions, by working with diverse experts in the local community. It investigates historical ecology and human dimensions on Kona Coast, Hawaii’s coral reef ecosystems by coupling approaches from both biophysical and social sciences. Investigations of SES dynamics and co-evolution were conducted through interviews and participatory observa- tion with local ocean experts: Native Hawaiians, fishers, divers, aquarium collectors, scientists, conservationists, and others. Ocean experts/observations and perceptions of change unravel an 80-year ecosystem-level history, from watersheds to pelagics. Findings reveal experts’ beliefs about key sources of disturbance and renewal; diverse cultural values of oceans; distinct ecological knowledge systems; and potential sources of cooperation and conflict. Finally, research indicates several SESs operate in concert that are undergoing similar social regime shifts in response to local and remote ecological disturbances.

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IRON REDOX DYNAMICS IN THE SURFACE WATERS OF THE GULF OF AQABA, RED SEA

In situ measurements of Fe(II) concentrations and oxidation kinetics were conducted regularly during an eighteen months period in the highly irradiated warm surface waters of the Gulf of Aqaba, Red Sea. Rapid photo-reduction and oxidation rates (up to 200 µM per minute) were documented, with subsequent high turnover rates (10–30 per day) and modest Fe(II) concentration (20–400 µM). Fe(II) oxidation is governed by molecular oxygen throughout the year, while photo-generated short lived oxidants such as hydrogen peroxide became significant following an intensive algal spring bloom. Photoreduction rates varied substantially with highest values in the autumn, despite the fact that seasonal variations in the irradiation flux and the total and filtered iron concentrations were quite small. We suggest that aerosol dust deposition and iron-reacting reagents iron is in the stratified upper waters are responsible for the enhanced autumn photo-reduction rates.

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INTER-COMPARISON OF REMOTE SENSING SEA SURFACE TEMPERATURE PRODUCTS DERIVED FROM MULTI-SENSORS IN THE CHINA SEA

The consistency of the AVHRR/MODIS/TMI SST products are evaluated for waters in China Sea and nearby West Pacific regions ([111–130E, 12–32N], in particular to seven sub-regions (Taiwan Strait (TWS), East China Sea (ECS), South China Sea (SCS), Kuroshio water; and three other West Pacific areas that have the same longitude as the ECS, Kuroshio and SCS sub-regions). For the West Pacific waters, the difference among the three SST products is within ±0.2°C and the rms is within 0.4°C with little difference in the two infrared SST values. Differences are relatively larger in the China Sea. For example, for the SCS, the infrared values are always higher (~0.2°C) than that from microwave; for the ECS, AVHRR SST differs by ~0.24°C and -0.07°C (rms values are 0.74°C and 0.96°C) when compared with SST from MODIS/TMI, respectively. In one word, there is no obvious difference among the three SST products in the China Sea and its adjacent regions. However, the SSTs show large differences for frontal areas and/or areas seriously affected by clouds, with larger differences appear in Winter/Spring.

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SPATIAL VARIATION IN CORAL DISEASE ON THE MESOAMERICAN BARRIER REEF: BIOLOGICAL AND ENVIRONMENTAL CORRELATES

We examined the prevalence of Yellow Band (YBD) and Dark Spots (DS) coral diseases on the Mesoamerican Barrier Reef system in Belize. Infection rates were recorded at four locations that represent a spectrum of habitat qualities with one oceanic atoll, two barrier reef sites, and one lagoon site. We observed strong spatial variation on a scale of 10s of kilometers with both diseases markedly higher at one barrier reef site than the other three sites. Multiple regression using common indicators of reef health as well as variables from principle component analysis of fish and benthic assemblages improved the models slightly but most of the variance was still spatial in nature. We postulate that the high incidence of disease at this site is caused by periodically low water quality due to seasonal high exposure to continental run-off, and its location within a regional gyre. Our observations are consistent with a broad pattern of differential coral morbidity at sites subject to chronic stress. Reduction of local anthropogenic stressors could greatly improve coral reef health even in the face of global climate change.

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LINKING WATER COLUMN DISSOLVED ORGANIC MATTER AND CORAL MICROBIAL COMMUNITIES

Coral reefs in the FL Keys have experienced a significant decrease in coral cover over the past few decades with most reefs currently exhibiting <10% overall coral cover. Environmental factors routinely examined for their impact on coral vitality include nutrients, turbidity, water temperature, and light availability. We are evaluating water column DOM variability near reefs throughout the middle and lower Keys and investigating the direct relationship between microbial communities within corals/surface micropycnocline-charle layer and ambient water column DOM conditions. In the middle and lower Keys, DOC concentrations can range from <100-300 uM C at nearshore patch reefs and from <100-200 uM C along the reef tract. Variability in the magnitude of the DOM pool is strongly correlated with daily and seasonal pulses of FL Bay discharge, but local DOM sources become important during periods of decreased flow from FL Bay. Additional data indicates that the bioavailability of DOM emanating from FL Bay is enhanced by photochemical breakdown of its higher MW pool. We are investigating whether bacterial communities associated with corals are stimulated by DOM that is bioavailable to water column microbes. (Although this work was reviewed by EPA and approved for publication, it may not necessarily reflect official Agency policy).

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ATMOSPHERIC TRACE METAL AND LABILE IRON DEPOSITION FLUXES TO THE EQUATORIAL PACIFIC OCEAN DURING EUCFEC2006

In the equatorial Pacific Ocean iron limitation persists despite the existence of the equatorial upwelling (EUC) which carries high loads of nutrients. Deposition of atmospheric particles may constitute an important pathway for which iron is delivered to the remote ocean, where only sparse atmospheric data exists. We collected aerosols between Hawaii and Papua New Guinea during the EUCFec cruise (RV Kilo Moana, Aug-Oct 2006) as part of the larger campaign to characterize the various iron sources to this region. A high-volume cascade impactor operating at 760 L min-1 was used to resolve aerosols in four size fractions. In addition, we measured total atmospheric iron deposition in flux estimates. Samples were digested and analyzed by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) and long pathlength absorbance spectroscopy for trace metals and iron speciation, respectively. Data is interpreted with principal component analysis and HYSPLIT air mass back trajectories.

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INTERACTION OF FLUID CHEMISTRY AND MICROBIAL BIOFILMS ON LARVAL ECOSYSTEMS OF CORAL REEFS

Within the context of larval ecology of some coral species.

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VARIABILITY OF ARCTIC SUMMERTIME OCEAN-TO-ICE HEAT FLUX ALONG THE 2002-2007 NPS FLUX BUOY DRIFTS

The Naval Postgraduate School Autonomous Ocean Flux Buoy Program has deployed buoys at the North Pole Environmental Observatory each spring from 2002 through 2007. These buoys measure upper ocean temperature, salinity, and velocities at turbulence-resolving scales over the course of year or so as they are carried southward towards and Fram Strait with the Transpolar Drift. Ocean-to-ice heat fluxes are estimated using a bulk method in which the flux is proportional to the product of the interface friction velocity and the departure of temperature from the freezing point. The temperature departure is directly measured and the friction speed is estimated from measured ice velocity using Rosby similarity theory. Over the six years of observation, summer-averaged, ocean-to-ice heat fluxes varied between 9.3 and 4.3 W m⁻², which when integrated over the autumn season correspond to sensible heat fluxes of 0.50 and 0.23 W m⁻². Summer-averaged fluxes were large in 2002 and 2003, small from 2004 to 2006, and large again in 2007. There are no obvious relationships between satellite-determined sea ice concentration and the summer ocean-to-ice heat flux, from which we conclude that the observed variability is most likely due to changes in ice thickness.

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MICROBIAL ECOLOGY OF CORALS: INVESTIGATING BACTERIAL COMMUNITIES IN EARLY LIFE STAGES OF CARIBBEAN CORALS

Like many marine invertebrates, scleractinian corals have been shown to harbor diverse assemblages of microbes, but neither the specificity of these associations nor the mechanisms that maintain them across development are well understood. Bacterial communities in planula larvae of the Caribbean corals Porites astreoides and Favia fragum were characterized in this study. Molecular techniques were used to identify microbes associated with larvae, and sequence-specific oligonucleotide primers were designed to survey multiple samples for the presence of particular bacterial species. Fluorescence in situ hybridization (FISH) and microscopy were used to locate particular species within the larvae and determine relative abundance of certain groups of bacteria. In contrast, gamete bundles from the mass-spawning corals Montastrea spp. and Acropora spp. did not contain bacteria or archaea. This study reveals new insight into mechanisms by which reef-building corals maintain specific microbial assemblages during embryo genesis and early development. In addition, these results present the possibility for a bacterial role in larval ecology of some coral species.

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FROM PHYSICS TO FISH AT THE SHELF EDGE

The shelf edge of the Celtic Sea is a site of pronounced mixing driven by the internal tide. The associated patch of high surface chlorophyll corresponds to remarkably focused activity of fishing vessels. We use direct observations of primary production, vertical turbulent diffusivity, and nitrate to show that phytoplankton growth at the shelf edge responds to a spring-neap cycle of vertical nitrate flux driven by this mixing. At the same time flow cytometer, size-fractionated chlorophyll, and microscope cell counts show the shelf edge to be a region with a markedly different primary producer community compared to the adjacent open Atlantic Ocean and the Celtic Sea. Cyanobacteria dominate the thermocline communities on either side of the shelf edge. At the shelf edge the narrow region influenced by the internal mixing is dominated by large eukaryotic phytoplankton cells. Thus the internal tidal mixing both fuels the shelf edge primary production with nitrate, and sets the physical conditions that favour a phytoplankton community more suited to supporting larger zooplankton and fish.

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source populations, determine the means of introduction and predict persistence and ecological impacts. Such an approach is being used to evaluate the dynamics and impact of the human-mediated introduction of the orange cup coral, Tubastrea coccinea, introduced into the Caribbean and subsequently into Florida, including the Florida Keys National Marine Sanctuary. As observed with many introduced species, T. coccinea can proliferate rapidly, due to production of asexual larvae, and appears to exclude native organisms on particular substrates likely causing a loss of biodiversity. Genetic analyses are being utilized to identify the potential source populations and evaluate levels of genetic diversity and clonal structure. Ultimately, the genetic analysis of the introduction and range expansion of this coral will be used to model biological connectivity throughout the Caribbean and Gulf of Mexico.

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IMAGING THE THERMOHALINE STRUCTURE OF THE SOUTH ATLANTIC OCEAN

Seismic reflection profiling has been used to capture snapshots of ocean fine structure in the largely uncharted South Atlantic Ocean using a gridded survey of legacy seismic data from the Falkland Trough. The area is of oceanographic interest as Antarctic Intermediate Water (AAIW) underlain by Upper Circumglobal Deep Water (UCDW) from the Antarctic Circumpolar Current follow the Sub Antarctic Front route around the trough to the Argentinean Basin after exiting Drake Passage. Finestructure imaged in the data occurs dominantly in the boundary layer between the AAIW and UCDW while transitional thermocline regions reflect a more uniform thermohaline character. Disrupted refractions along the slope boundaries reveal displacements due to internal waves produced by wave reflection and generation processes as water loops around the trough, flowing to the West at its Southern edge and to the East along the Northern trough boundary. The survey was shot partly in January and partly in April and differences in the acoustic recording provided interesting insight into the temporal variability of the water masses.

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THREE-DIMENSIONAL MODELING OF INTERNAL SOLITON PROPAGATION IN THE ASIAX AREA

Internal solitons are prominent recurrent features in Synthetic Aperture Radar (SAR) images of the South China Sea (SCS). During the field experiment ASIAX 2001, the SAR imagery showed a strong soliton packet passing over the SCS shelf/slope area, coincident in time and location with moored CTD measurements of the passage of a soliton packet. We have conducted a three-dimensional numerical simulation of internal soliton propagation across the same region to see the extent to which these observations can be modeled and to gain some insights into soliton propagation over realistic two-dimensional bathymetry. The initial condition is a depression soliton of ~150 m in amplitude and ~2 km in width in 1 km deep water and ~150 km from the shelf. The result shows the shoaling soliton gradually loses its speed, and at the same time the along-shelf bathymetric variation causes it to refract with a curvature similar to that shown in the SAR image. At the shallow depth, a transition to a multiple-wave packet takes place similar to that observed in situ. This work is sponsored by ONR.

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DEEP MIXED LAYERS AND MODE WATER FORMATION FROM ARGO FLOAT PROFILS IN THE SOUTHERN OCEAN

Argo float temperature and salinity profiles are used to determine the mixed-layer depth (MLD) in the Southern Ocean. The deepest mixed layers are found from June to October in the Pacific and Indian Oceans just north of the Antarctic Circumpolar Current (ACC) where Antarctic Intermediate Water and Subantarctic Mode Water (SAMW) are formed. Examination of individual MLDs indicates that deep mixed layers are concentrated in a narrow surface density band corresponding to the density range of SAMW. The deep mixed layers are within the region of strong wintertime cooling just to the north of the ACC, consistent with the idea that deep convection from wintertime cooling leads to the formation of mode water. Although the wintertime cooling from air-sea heat fluxes in the Pacific and Indian Oceans are comparable, the Indian Ocean experiences strong cooling from the Ekman advection, whereas the vertical entrainment in the Pacific is stronger than that in the Indian Ocean. Those differences suggest that the mode water formation in each region may be preconditioned by different processes.

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SHIPBOARD LARGE THROUGHPUT CELL CYTOMETRY WITH CINEMATIC DIGITAL HIOGRAPHIC MICROSCOPE
A shipboard, large throughput flow cytometer based on cinematic Digital Holographic Microscopy (DHM) is being deployed. Ability of DHM to suitably image of microorganisms over a large depth (10mm), at a spatial resolution of 11 microns in all directions enables us to perform cytometry without focusing. Setup consists a flow cell of 10x50x5mm (latter being the depth) and an in-line 10X DHM, equipped with a high-speed camera. Collected samples are gravity-driven through the cell at 1fps (speed of 120mm/s, i.e. require 166s/cell). This system in conjunction with an in-situ digital holographic submersible was deployed this summer near Leo-15 to characterize content and concentration of marine particles being transported in turbulent boundary layer, and to investigate how transport is influenced by surface wave. 23 samples (700GB) were collected.

Preliminary analysis shows presence of a large number of clam larvae, whose concentrations correlate strongly with wave phase. On-going data analysis combined with core current flow and concentration measurements by the holographic submersible is expected to elucidate interactions between migrating marine organisms and surface waves.

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AN INTEGRATED 2D/3D STORM SURGE MODELING SYSTEM FOR SIMULATING HURRICANE-GENERATED WAVES, CURRENTS, AND STORM SURGE

An Integrated 2D/3D Storm Surge Modeling System, CH3D-SSMS, has been developed and applied to simulate hurricane-generated waves, currents, and storm surge during the 2001-2002 Atlantic hurricane seasons including Isabel, Katrina, and Wilma. CH3D-SSMS consists of a coastal surge model CH3D which can be run in 2D or 3D, a coastal wave model SWAN, a large scale surge model (ADCIRC/UNCHID) and a large scale wave model WW3. We compare 2D and 3D simulations with available observed wave, current, and storm surge data to answer such questions as: Do 3D models yield more accurate results? Are there physical processes that can only be accurately resolved by 3D models? Are 3D models necessary for the simulation of waves, currents or storm surge? For Isabel (2003) and Ivan (2004), the 3D model yields best results (water level, currents, and wave) when wave-current interaction (wave-induced drag, radiation stress, and bottom stress) is included. In addition, the 3D model yields significant vertical and horizontal flow and allows more accurate representation of wave effects on currents and storm surge.

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THE TEMPORAL DYNAMICS OF VIRUSES AND BACTERIOPLANKTON IN BERMUDAS INSHORE WATERS AND CORAL REEF ECOSYSTEMS IMPACTED BY SEWAGE OUTFALL.

Microbial communities exist in high abundance and diversity in coral reef environments and play important roles in nutrient cycling within the ecosystem. The effect of sewage plumes on the abundance of viruses and bacteria populations in Bermudan coral reefs is unknown. Here we examine, the seasonal variations in the abundance of virus-like particles (VLP) and bacteria in Bermuda’s inshore waters compared to sites near the main sewage outfall. To determine the affect of sewage contamination on the coral reef ecosystem, the surface microlayer of Perities astreoides was examined from proximities to sewage outfall sites. Initial results using the nucleic acid stain, SYBR green I and DAPI, show that concentrations of VLP and bacteria in the water column varied spatially and temporally. Concentrations were lowest (4.6E09 VLP/L, 4.7E08 bacteria/L) in winter months in the outer lagoon. Concentrations were highest (3.2E10 VLP/L, 3.3E09 bacteria/L) in late summer in a restricted marina. The sewage outfall sites result in elevated concentrations of VLP and bacteria in the water column (5.3E09 VLP/L, 1.1E09 bacteria/L) and the coral surface microlayer (8.0E10 VLP/L, 1.8E10 bacteria/L).

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SAN FRANCISCO BAY OUTFLOW PATTERNS

On every tidal cycle a large volume of water flows out of San Francisco Bay and a similar, although different, volume is returned. This raises the question: what happens to the water that returns at different times? In this presentation we will present preliminary results from a set of studies examining the coastal impact of Bay outflow. Recently, HF-radar data has been used to map surface currents, water-following drifters have been deployed in Golden Gate, and moored temperature-salinity sensors have been deployed to monitor coastal locations. Low-salinity waters persist in the northern Gulf of the Farallones, but the bay outflow plume and moored temperature-salinity sensors have been deployed to monitor coastal locations. During northerly winds, the bay outflow is transported south but contact with the coast is minimal beyond Land’s End. The simple patterns indicated by these preliminary results indicate that the time-varying

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ROVER: A MOBILE PLATFORM FOR LONG-TERM DEEP OCEAN ECOCLOGICAL RESEARCH

The Rover is a tracked vehicle capable of making long term time-series measurements at abyssal depths up to 6600 m. The Rover is equipped with instruments developed to study sediment community activity and biogeochemistry at multiple sites. Two respirometer chambers on the front of the vehicle measure sediment community oxygen consumption. New instrumentation will include a fluorometry system to detect phytoplankton fluorescence from fresh phytoplankton on the sediment surface and acoustic imaging that will provide profiles of the underlying sediment structure. Three cameras on the Rover provide images of the sediment being measured and a wide-angle view of the immediate surroundings during transects. The Rover can be deployed autonomously for up to six months or tethered to an ocean observatory. The Rover has completed over a dozen autonomous test dives in the Monterey Bay and at Station M (depth 4000m) augmenting ongoing ecological studies. The Rover will be connected to the Monterey Accelerated Research System (MARS) cabled observatory in 2008 for long-term studies at bathyal depths in Monterey Bay, California.

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EKMAN DRIVEN VELOCITY PROFILES AND MIXING IN A FAST FLOWING DEEP WATER CASCADE IN THE NORTH ATLANTIC

The overflow of deep water across the Wyville Thomson Ridge at the southern end of the Faroe-Shetland Channel carries cold Norwegian Sea Deep Water down a narrow gully and into the Rockall Trough. It is intermittent with maximum transports of order 2 Sv (making it at times a significant ocean current). The 3D nature of the flow is emphasised. Its body is geostrophic, and during high flow the velocity profile is greatly sheared in the bottom 50 to 60 m - maximum speeds (> 1.5 m/s) are observed up to 100 m above the seabed. Ekman dynamics cause a strong leftward flow (looking downstream) at the bottom which is compensated by a return flow in the upper layers, the strength of which is revealed in animations of the velocity profile. Small (Thorpe) scale overturns indicate strong mixing particularly in the lower part of the overflow. Internal tidal currents become significantly amplified during large overflow events but appear to have a marginal impact on bottom transport. These processes combine to produce a distinctive water mass that emerges into the Rockall Trough.

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GENOME-WIDE EXPRESSION DYNAMICS REVEAL DEI L PATTERNS OF METABOLIC SWITCHING IN THE UNICELLULAR DIATOMIC MARINE CYANOBACTERIUM CROCOSPHAERA WATSONII WH 8501

Unicellular diatrophic cyanobacteria can contribute a significant fraction of new nitrogen in the world’s oceans. Some species/phylotypes of this group of organisms exhibit a diel switch of expression of some metabolic genes, yet the pattern of metabolic switching among the entire functional repertoire is poorly understood for any marine cyanobacteria. Using a whole-genome microarray, we monitored gene expression in the marine unicellular diatrophic cyanobacterium Crocosphaera watsonii WH 8501. Our results demonstrate pronounced diel oscillations of the key metabolic pathways. Expression of photosynthesis and carbon fixation (i.e., Calvin cycle) genes increased during the day, whereas transcripts for nitrogen fixation increased at night, accompanied by an elevated transcription of enzymes that participate in respiration (e.g., cytochrome c oxidase), the urea cycle and glycogen hydrolysis. The period of cell division, occurring in the early morning based on flow cytometry results, was preceded by evening expression of the replication gene dnaA and dawn expression of genes for cell wall/cell membrane synthesis and cytokinesis (e.g., lpxA, ftsI, ftsZ). In a broader context, our transcriptome data strongly suggest a global regulatory switch operating marked changes in cellular metabolism that reflect the diel cycle.

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OBSERVATION OF A MASSIVE BLUE ALGAE BLOOM EVENT IN THE CHIN S TAI LAKE DURING THE SPRING OF 2007 USING THE MODIS DATA

During the spring of 2007, a massive blue algae bloom broke out in the Tai Lake, one of the largest inland lakes in China. This massive bloom event eventually became an environmental crisis that choked off the drinking water supply for the nearly two million residents in WuXi City in the China southeast region. In this presentation, we provide MODIS results that demonstrate the remote sensing capability for monitoring & observa-
GLOSSARY

- **ASLO/AGU/TOCS/ERF**: American Society for Limnology and Oceanography, American Geophysical Union, The Oceanography Society, and the Environmental Research Facility.

- **DOC**: Dissolved Organic Carbon.

- **HS**: Humic Substances.

- **MODIS**: Moderate Resolution Imaging Spectroradiometer.

- **SWIR**: Short Wavelength Infrared.

- **TSA**: Tsugaru Strait.

Turtles (Dermochelys coriacea) satellite-tagged during 2004-2007 at Playa Grande, Costa Rica. The region used by the turtles over the tracking period spanned the eastern tropical and South Pacific Ocean. At high latitudes (12°N and 40°S), and between longitude 130°W and the coast of Central and South America. Home-range utilization distribution maps at the 95% level indicated that turtles occupy an inter-nesting area of ~1.2 million km², and a post-nesting home range of ~13.2 million km². Turtle movements within intersecting habitats suggest that relatively small expansions of existing marine reserves could significantly enhance protection. Turtle movements moved rapidly (>4km/day) southwest through an open-ocean corridor spanning from Costa Rica past the Galápagos Islands. South of 105°, the turtles moved into areas of low MKE and chlorophyll. Turtle swimming speeds decreased (~<25km/day) and they dispersed widely; taking meandering paths at low speeds into a region characterized by very weak current variations, very low phytoplankton standing stocks, and the absence of dynamic oceanographic features.

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**DOES TEMPERATURE STRUCTURE PHYTOPLANKTON COMMUNITY COMPOSITION IN THE ROSS SEA, ANTARCTICA?**

The Ross Sea polynya experiences one of the largest phytoplankton blooms in the Southern Ocean. Energy flow potential within the Ross Sea food web is primarily set by diatoms and prymnesiophytes, the latter dominated by Phaeocystis antarctica. We investigated physical, chemical, and biological factors that drive phytoplankton taxonomic composition and nutrient uptake in late austral spring. Principal components analysis (PCA) and ordination plots showed that from 2001 to 2005, increased dissolved nutrients (INIE), size fractionated chlorophyll, sample depth, BS, POC, PON, temperature, and pigments. The temperature-based PC explained 13% of the variation in the data set, and other linear regressions were performed to assess the relationship between temperature and other phytoplanktonic variables. A significant relationship between increases in sea surface temperature and phytoplankton nitrate removal (R²=0.76, p<0.0001) was observed. Additionally, P. antarctica abundance appears to be favored under colder conditions while diatoms are abundant when surface temperatures are higher. Significant interannual differences in surface temperature were observed and are likely driven by changes in solar heating, stratification, or by water mass intrusions, suggesting that physical processes may impact phytoplankton assemblage nutrient removal. This is an abstract of a proposed presentation and does not necessarily reflect EPA Policy.

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**PREDICTING THE CLIMATE CHANGE RESPONSE OF DISSOLVED AND COLLOIDAL TRACE ELEMENTS IN THE YUKON RIVER BASIN**

In an ongoing study, dissolved and colloidal trace elements are being determined in rivers and streams within the Yukon River Basin in Alaska and Canada. Within this basin, climate change is likely to affect landscapes, organic matter generation and transport, and weathering reactions, all of which can affect the trace element composition of surface waters. Therefore, linkages between the trace elements and controlling factors such as landscape and DOC are important for understanding the climate change response of the trace elements. For many trace elements, the chemical control can be explained generally by a simple model balancing organic complexation with adsorption or precipitation (for Fe). pH also plays a role by proton competition for binding sites. With regard to landscape, forest cover correlated with dissolved Fe and DOC. Chemical and landscape relationships, however, are non-linear which therefore suggests a non-linear response of trace elements to climate change.

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**HOT SPOTS FOR EASTERN PACIFIC LEATHERBACK SEABRACE TURTLES (DERMOCHELYX CORIACEA)**

We describe coastal and pelagic hot spots for 46 critically endangered female leatherback turtles (Dermochelyx coriacea) satellite-tagged during 2004-2007 at Playa Grande, Costa Rica. The key of the initiation of the huge ice reduction in the summer of 2007 lies in the precondition of sea ice before melt season. The clockwise Beaufort Gyre was the strongest since 1979, which was twice larger than that in 2005 (previous recorded minimum ice year), even though the anticyclonic atmospheric forcing did not show significant differences between 2004/2005 and 2006/2007 winters, suggesting less stress from the coast. The strengthening of sea ice motion was caused by less sea ice cover along the southern Queen Elizabeth Islands before melt onset, which was established by mechanical crash of thin multi-year sea ice existing there. By this activation of large-scale sea ice motion, thin first-year ice formed in the southern Canada Basin was carried north beyond 80°N in the western part of the gyre, and relatively heavy ice in the northern Canada Basin was delivered to the south. The resultant distribution of sea ice before summer created a favorable condition for huge ice reduction. The activation of sea ice motion would be a catastrophic change in ice-ocean coupled Arctic climate.

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**LOW-LEVEL WIND IETS AND THEIR MODIFICATION BY SST FRONT IN THE WEST OF THE TSUGARU STRAIT**

We investigate responses of a coastal wind jet flowing through the Tsugaru Strait to SST front from a case study on 7-9 June 2003. In summertime, easterly wind blowing over the northern Japan often forms strong wind jets in the western exit of the Tsugaru Strait with width of 20 km. On the other hand, the Tsushima Warm Current flows into the Tsugaru Strait and the current boundary forms SST front. Under this situation, easterly wind jet blows over the SST front along the wind jet axis. We look into the evolution and distribution of the wind jets in the west of the Tsugaru Strait by using high-resolution wind field from RAPSARAT and SeaWinds. Based on the results, using meteorological numerical model MM5, the simulated surface wind fields are analyzed, and it is discovered that wind speed rapidly decreases from >100-200 km from the terrestrial gaps around the strait and that they shows diurnal variation. Along the wind jets, pairs of positive and negative wind shear (curl) bands extend. By comparing an experiment with constant SST field, these shear bands are intensified.

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**EXPERIMENTAL STUDIES ON BACTERIAL PRODUCTION OF MARINE HUMIC SUBSTANCES**

Humic substances (HS) have been known to be one of the main components of refractory dissolved organic matter (DOM) in the ocean. Although recent studies indicate that HS are produced through bacterial metabolic activities, bacterial participation in the production of HS has not been proved experimentally. In the present study, we carried out the incubation experiments using mixtures of bacterial assemblage and glucose, to elucidate the relationship between bacterial growth and the concentration and molecular weight composition of HS. A rapid decrease in dissolved organic carbon concentration was noticed during days 1-5 and this coincided with the increase in bacterial number. The humic-like fluorescence intensity (Ex/Em=335/410nm) increased in the initial 20 days and more than 60% remained on maximum on day 20. After that, the fluorescence intensity decreased and stabilized after 70 days. These results clearly show that bacteria transform labile DOM to recalcitrant HS. The size exclusion chromatography showed that the retention times of some peaks of natural sea water sample were identical with those of the incubated sample, strongly suggesting that bacteria play an important role as a producer of the recalcitrant DOM and HS.

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SEASONAL VARIATION OF THE LOW SALINITY INTERMEDIATE WATER IN THE SOUTH OF SUBPOLAR FRONT OF THE EAST/JAPAN SEA

Seasonal variation of the low salinity intermediate water (East Sea Intermediate Water, ESIW) in the south of subpolar front of the East/Japan Sea was studied by using historical oceanographic data observed by the Maizuru Marine Observatory (MMO) of Japan and the Korea Ocean Research and Development (KORDI). To obtain the water characteristics of the ESIW for isopycnal surfaces, depth, temperature, salinity and depth profile data were interpolated every 0.01 interval of potential density. And then the interpolated values were averaged at the same potential density. On the representative potential density of the ESIW (sigma theta=27.2), depth, potential temperature and salinity were analyzed. The salinity on the isopycnal surface of 27.2 sigma theta varied with seasonally in the south of the subpolar front (south of 38°N); high in winter and low in summer. However, near south of polar front the salinity was the lowest in spring and then increased with time. In the Ulleung Basin, the salinity was lower than the Yatomo Basin and low in both of winter and summer. This implies that flow path and intrusion time of the ESIW into the two basins are different each other.

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CLIMATE CHANGE IMPACTS ON ANTARCTIC MARINE ECOSYSTEM AND KRILL FISHERY

Life of Antarctic krill, which supports predators as well as fishery, is strongly associated with sea ice, inherently subjected to climate changes. Concurrent examination of sea ice and chlorophyll from the satellite imagery identifies a number of critical areas for the maintenance of krill population that undergo predictable sea ice development and subsequent algal blooms. Field survey and analyses of recent sea ice indicate that part of the Western Weddell Sea is more important as krill source than previously thought but the sea ice in the area is likely to suffer a fairly rapid decline when climate change proceeds at current rates. Continued loss of sea ice beyond natural variability will result in much less over-winter grounds available for krill population. This should drastically alter the fate and distribution of krill population, and hence the well-being of predators as well as the behavior of krill fishery. Control of fishing efforts, which is already limited in affecting the dynamics of krill, will do little to impact either the predators or the krill fishery in any way, and will be over-written by climate changes.

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SEASONAL CHANGES OF VERTICAL DISTRIBUTION OF MESOZOOPLANKTON IN THE KOREA STRAIT

The profile of a fixed site at station M (54.77 N, 129.13 E) in the Korea Strait was studied from March 2006 to February 2007 to understand the relationship between the annual pattern of thermal stratification and the seasonal variation of mesozooplankton composition. Environmental factors such as temperature, salinity and chlorophyll a, which strongly influence the proliferation and diversity of mesozooplankton were also investigated. The population of copepod was the largest among mesozooplankton groups. There were 27 genera and 66 species of copepods. Mesozooplankton was classified into 19 groups to the minimum and 32 groups to the maximum during the study due to the seasonal variation and depth of water column. The number of mesozooplankton groups fluctuated after March 2006 and increased from September. The greater number of mesozooplankton groups was found at the lower part of water column than at the upper part. Copepod dominated mesozooplankton community during the study. The proportion of copepod among mesozooplankton groups was from 24.5% to 96.8% during the study and was smaller in April and May compared to the rest of study period. Dominant copepod species were Paracalanus parvus, P. crassirostris and Oithona similis. This study will discuss the smaller in April and May compared to the rest of study period. Dominant copepod species dominated mesozooplankton community during the study. The proportion of copepod was the largest among mesozooplankton groups. There were 27 genera and 66 species of copepods. Mesozooplankton was classified into 19 groups to the minimum and 32 groups to the maximum during the study due to the seasonal variation and depth of water column. The number of mesozooplankton groups fluctuated after March 2006 and increased from September. The greater number of mesozooplankton groups was found at the lower part of water column than at the upper part. Copepod dominated mesozooplankton community during the study. The proportion of copepod among mesozooplankton groups was from 24.5% to 96.8% during the study and was smaller in April and May compared to the rest of study period. Dominant copepod species were Paracalanus parvus, P. crassirostris and Oithona similis. This study will discuss the smaller in April and May compared to the rest of study period. Dominant copepod species were Paracalanus parvus, P. crassirostris and Oithona similis. This study will discuss the smaller in April and May compared to the rest of study period. Dominant copepod species were Paracalanus parvus, P. crassirostris and Oithona similis. This study will discuss the smaller in April and May compared to the rest of study period. Dominant copepod species were Paracalanus parvus, P. crassirostris and Oithona similis. This study will discuss the smaller in April and May compared to the rest of study period. Dominant copepod species were Paracalanus parvus, P. crassirostris and Oithona similis. This study will discuss the smaller in April and May compared to the rest of study period. Dominant copepod species were Paracalanus parvus, P. crassirostris and Oithona similis. This study will discuss the smaller in April and May compared to the rest of study period.

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CONTRIBUTION OF N FIXATION TO NEW PRODUCTION IN THE WESTERN NORTH PACIFIC ALONG 155°E

N fixation and nitrate assimilation were evaluated using 15N tracer in February and March 2007 along 155°E meridian from the equator to 44°N in the western North Pacific. N fixation was observed only south of 28°N where nitrate+nitrite (N+N) were depleted below 30 m, ranging from 12 to 152 μmolN/m²/d. The highest N fixation rate was observed at 24°N, which was accompanied by a depletion of phosphate (<10 mM), suggesting exhaustion by diatoms. The integrated nitrate assimilation rates varied between 184 and 349 μmolN/m²/d in the area from the equator to 24°N, and no significant latitudinal trend was observed. Nitrate assimilation was more active toward the equator. After N and oxygen fixation, nitrate fixation became insignificant. The contribution of N fixation to new production (N fixation plus nitrate assimilation) ranged from 2% to 37% with a mean of 15% in the N+N depleted region, and the highest contribution occurred in the central part of the subtropical gyre (24°N). The present results clearly show that N fixation is an important source of new nitrogen in the western North Pacific.

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PARAMETERISING SUBGRID-SCALE EDDIES IN AN ANISOTROPIC, ADAPTIVE MESH OCEAN MODEL

The Imperial College Ocean Model (ICOM) is a finite element ocean model that uses an anisotropic, fully unstructured, tetrahedral mesh that can be adapted to the properties of the flow as it evolves. Despite the ability of such a mesh to resolve small scale eddies, it is still impractical, and indeed impossible, to resolve all scales of motion. At some point the effects of subgrid-scale eddies must be parameterised. The challenge posed by ICOM is that the definition of ‘subgrid-scale’ changes both across the domain and as the mesh adapts to the evolving flow. Here we present how the Gent-McWilliams parameterisation scheme can be implemented within such a model. The inclusion of this scheme is of vital importance as, along with an isopycnal diffusion scheme, it provides an adiabatic eddy closure that greatly reduces spurious mixing between water masses - a common cause of problems in ocean models. We will focus on the results of applying this model to an idealised wind driven gyre.

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HYDROTHERMAL SYSTEMS AS NATURAL ANALOGUE OF CCS

Hydrothermal systems are suitable for natural analogue of a high CO2 environment in the ocean. Hydrothermal vent fluids are highly enriched in CO2 and the CO2 rich fluids are released into the ocean as a hydrothermal plume. Observation of the hydrothermal-CO2 would provide opportunity for understanding physical-chemical behavior and diffusion process of liquid CO2 in the ocean, and environmental assessment of oceanic high CO2 environment. Observation of hydrothermal-CO2 droplets was carried out at the hydrothermal system on the Okinawa Trough. The rising CO2 droplets were tracked by an ROV, and based on pH and pCO2 in seawater near the CO2 droplets were measured during their ascent. The observation results suggest that the discharged hydrothermal-liquid CO2 does not cause pH depression to extend to a wide area. The results of pH mapping showed only localized pH depression at the CO2 venting site. At the NW Eefuku submarine volcano, hydrothermal-liquid CO2 dispersion was observed by using a towing multi-layer monitoring system. Low pH plume of 100m high and 200m wide was detected above the summit of the NW Eefuku submarine volcano.

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IMPACT OF ANTHROPOGENIC COMBUSTION EMISSIONS ON THE INPUT OF SOLUBLE IRON TO THE SURFACE OCEAN: ESTIMATES FOR THE NORTH ATLANTIC BASIN

The results of several recent studies challenge the reigning paradigm that continental soil dust provides the only significant atmospheric source of dissolved iron to the surface ocean. This evidence includes correlations between the water solubility of aerosol iron and atmospheric loadings of elemental carbon and aluminum-normalized vanadium, both of which are associated with fossil-fuel combustion emissions. These observations suggest that the relative solubility of aerosol iron, hence the aerosol flux of dissolved iron to the ocean, may be impacted by anthropogenic combustion products. Based on our recent work in the Bermuda region, we have developed a method to estimate the relative solubility of aerosol iron from bulk aerosol concentrations of Fe, V and Al. We apply this method to a large body of published data for North Atlantic sites where aerosol composition ranges from fine dust to fine anthropogenic (I). Our results suggest that anthropogenic emissions contribute ~75% of the aeolian flux of dissolved iron to the ocean near Bermuda, and ~95% near Ireland, implying that human activities have profoundly affected the global iron cycle.
the continental shelf. CDW is around 3°C warmer than the surface freezing point and when it has access to the base of an ice shelf, high melt rates result. In early 2007, we undertook an intensive observational program to investigate the oceanographic regime of the Bellingshausen Sea. A number of CTD sections were occupied, including across troughs that are thought to act as conduits for CDW on-shelf transport, and across the fronts of the floating ice shelves. Results will be presented and discussed in the context of CDW transport from the shelf break to the ice shelves, and the impact of this circulation on the ice shelves.

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LONG TERM ASSESSMENTS OF STREAM ECOSYSTEM HEALTH WITHIN A WATERSHED IMPACTED BY HIGH POPULATION GROWTH RATES

We compared the findings of two biotic and physicochemical surveys conducted thirty years apart at impaired sites within the South and East Codorus Creek Branches of the Susquehanna River Watershed. Species richness and the number of intolerant species dramatically decreased during the three decades at both sites. Although there were minor decreases in diversity within the East section, diversity values were greatly reduced in the South over that same period. We also observed increases of the percent Salmonids from 0 to 3 and 0.3 to as high as 5 within the East and South branches respectively. Additionally, we assessed control sites during the latter survey and determined that fish communities were significantly different between control and impaired sites evidenced by the lower number of parasitized fish, greater biomass, and greater numbers of salmonids and other pollution intolerant fish at the control sites. The higher total phosphorus concentrations and suspended sediments in the impaired sites mostly likely explain the low number of pollution intolerant species and the need for restoration in these impaired areas.

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REDUCING RECRUITMENT UNCERTAINTY IN ALASKAN SABLEFISH STOCK ASSESSMENT THROUGH THE APPLICATION OF ENVIRONMENTAL SATELLITE INFORMATION

Sablefish are a fast-growing, highly valuable groundfish species that are widely distributed in the North Pacific. Adults are typically found in depths greater than 200 m along the continental slope, shelf gullies, and deep fjords. Very little is known about the early life history of these fish. They are assessed as a single population and do not recruit to the fishery or survey until four to five years of age. Therefore, information to estimate recent recruitment is sparse and highly variable. The objectives of this project are to evaluate the various sources of early life history data and explore integration of satellite-derived environmental time series within the sablefish stock assessment model to reduce the uncertainty of recent recruitment estimates. Model recruitment estimates show high autocorrelation and potential decadals shifts, which are supported by the survey data. Reducing recruitment uncertainty may increase efficiency in harvest decisions through more reliable future harvest projections.

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THE IMPACT OF SATELLITE ALTIMETERS ON UPPER OCEAN PARAMETER SIMULATIONS

We investigate the relative impact of the number of satellite altimeters on the U. S. Navy's operational ocean data assimilation system. Satellite altimeter data are assimilated into the NRL Layered Ocean Model (NLOM) to produce dynamically interpolated sea surface height (SSH) fields. These are used with optimally interpolated sea surface temperature (SST) fields by the Modular Data Assimilation System (MODAS) to produce three-dimension

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NEAR-SURFACE EDDY DIFFUSIVITIES IN THE SOUTHERN OCEAN

Near-surface eddy diffusivities are presented for the Southern Ocean. Recent studies (Marshall et al. 2006) have used the "effective diffusivity" approach to calculate stream-wise average eddy diffusivities for the Southern Ocean from tracer fields advected by velocities derived from altimetry. The results to be presented here will instead focus on more local eddy diffusivities. On a basin-scale, the focus is on eddy diffusivities in the Pacific sector. On a more regional scale, the focus is on diffusivities associated for example with eddies which apparently reside in the same location for months. Two possible extensions to the effective diffusivity calculations are described which provide local eddy diffusivities, one based on tracer calculations confined to small patches, and the other incorporating information from Lagrangian particle trajectory calculations. The results are considered firstly in the context of observations of the motion of drifters with the aims of validating the approach and characterizing the characteristics of the observations. Secondly, the results are considered in the context of physical processes, such as the influence of bottom topography, which may lead to enhanced values of eddy diffusivity. Thirdly, the results of a multi-year calculation in the Pacific region are presented to highlight interannual variability in the eddy diffusivities and to investigate the mechanisms generating this.

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MODELING OF UPWELLING/RELAXATION EVENTS DURING AUTONOMOUS OCEAN SAMPLING NETWORK (AOSN) EXPERIMENTS

Predictions of upwelling/relaxation events during Autonomous Ocean Sampling Network (AOSN) Experiments (Summers of 2000, 2000 and 2006) are evaluated. The modeling system consists of an implementation of the Navy Coastal Ocean Model (NCOM) of the Monterey Bay area. The model is forced with atmospheric fluxes from the Coupled Ocean-Atmosphere Mesoscale Prediction System (COAMPS), and with open-boundary conditions from a basin-scale NCOM-based California Current System. The data assimilation component is a version of The Navy Coupled-Ocean Data Assimilation (NCODA) system. The following issues are investigated: impact of glider data assimilation and assimilation of other observational assets (data denial experiments) on surface and subsurface properties of the model predictions; impact of COAMPS atmospheric fluxes on model predictions of upwelling/relaxation events; use of sigma versus hybrid (sigma-z) vertical grid; and coupling with a larger-scale model on the open boundaries.

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LOUISIANA WETLAND MONITORING USING SATELLITE ALTIMETRY AND SAR INTERFEROMETRY

At present, accurate monitoring of coastal estuaries and wetland water level changes and its changes relative to the shoreline presents a challenge to the contemporary spaceborne active remote-sensing tools, including the pulsed-limited nadir radar altimeters and the repeat-pass synthetic aperture radar interferometry (InSAR). While the Ku-band radar altimeters and the innovative use of the dual-bounce SAR interferometers, etc., have been demonstrated to be feasible to observe water level changes in vegetated wetlands, the establishment of absolute and high-resolution (e.g., up to 40 m) water level change time series remain difficult. Here we present a study using retracked Ku-band radar altimetry (TOPEX, ENVISAT) water level change time series (up to decadal), and high-resolution waves. This conversion is clearly defined using the integrated wave vorticity as a diagnostic, and the observed transient point agrees well with predictions based on weakly non-linear theory using the background stratification and shear. Microstructure and velocity measurements were carried out for the first few waves of each train, providing estimates of kinetic energy, available potential energy and dissipative loss in the waves. The energy of individual waves often changed rapidly; factors controlling this alteration included dispersion, wave interactions and intense mixing events.

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Predictions of upwelling/relaxation events during Autonomous Ocean Sampling Network (AOSN) Experiments (Summers of 2000, 2000 and 2006) are evaluated. The modeling system consists of an implementation of the Navy Coastal Ocean Model (NCOM) of the Monterey Bay area. The model is forced with atmospheric fluxes from the Coupled Ocean-Atmosphere Mesoscale Prediction System (COAMPS), and with open-boundary conditions from a basin-scale NCOM-based California Current System. The data assimilation component is a version of The Navy Coupled-Ocean Data Assimilation (NCODA) system. The following issues are investigated: impact of glider data assimilation and assimilation of other observational assets (data denial experiments) on surface and subsurface properties of the model predictions; impact of COAMPS atmospheric fluxes on model predictions of upwelling/relaxation events; use of sigma versus hybrid (sigma-z) vertical grid; and coupling with a larger-scale model on the open boundaries. A number of error metrics are used for skill assessment and error analysis of the modeling system predictions. Results from the data denial experiments are interpreted utilizing adjoint sensitivities maps.
relative water level changes using ERS C-band InSAR over the Louisiana watershed/wetland region. We assess the impact of environmental corrections (water vapor and in situ) on the altimetric water level over the wetlands. With the use of available water stage data, we provide a separation of land subsidence and water level change, allowing the feasibility to accurately link the solid Earth to the water level.

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AN ASSESSMENT OF GEOCHEMICAL MOBILITY OF METALS IN SURFACE SEDIMENTS OF THE SANTA ROSALIA MINING REGION, WESTERN GULF OF CALIFORNIA

The sediments near Santa Rosalía are polluted by metals, produced by ancient copper smelting. However high metal enrichments were not observed in the brown seaweeds collected in the ‘pollution hot spot’, suggesting low bioavailability of the metals. To check this hypothesis, a sequential chemical leaching was applied to the sediment samples with different levels of pollution, and relative abundances of Cd, Cu, Fe, Mn, Ni, Pb and Zn were measured in each fraction. Most of metals of the sediments of the ‘pollution hot spot’ were found mainly in a residual (refractory) fraction. For example, the copper abundances in the highly polluted surface sediments with concentrations of this metal ranging from 2895 mg kg⁻¹ to 4818 mg kg⁻¹ followed the next sequence: residual fraction (79.5 ± 4.6 %) > adsorbed form (14.0 ± 4.6 %) > Fe and Mn oxyhydroxides (5.7 ± 1.5 %) > associated with organic matter and sulphides (4.3 ± 3.6 %). The mobile (exchangeable form and carbonates) fraction abundance was the highest for Cu, Zn, Mn and Cd in non-polluted or slightly polluted sediments.

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IRON/LIGHT CO-LIMITATION OF THE DEEP CHLOROPHYLL MAXIMUM IN THE WESTERN PACIFIC OCEAN

The deep-chlorophyll maximum (DCM) is a ubiquitous feature of oligotrophic open ocean waters, with different mechanisms proposed to explain its formation and maintenance. The depth of this feature is in part determined by the tradeoff between light from above and nutrients supplied from below. Here we describe six amendment grow-out experiments at four stations in the equatorial Pacific Ocean (between 140W and 150E) and 2 stations in Western Pacific Warm Pool designed to test iron and light co-limitation. Photosynthetic efficiency (Fv/Fm) and biomass responses to different amendments, including planktonic community structure (planktonic diatoms, photosynthetic picociakaryotes, Synechococcus, Prochlorococcus, and major Prochlorococcus ecotypes) were assessed. Except for some ecotypes of Prochlorococcus (eMT9313 and eNAT27A), all populations were light-limited in the DCM; only planktonic diatoms showed a significant increase with the addition of iron, and no populations were limited by iron alone. These responses were relatively consistent across the equatorial Pacific Ocean and in the Warm Pool, and suggest that light is the primary limiting factor of the DCM in spite of the variability in iron flux across this vast ocean region.

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MODELING THE SUPPLY OF NUTRIENTS TO THE COASTAL OCEAN: THE ROLE OF A SHELF BREAK FRONT

The coastal ocean off the East Coast of the United States is not an upwelling regime, but has an open ocean source for nutrients via a mechanism referred to as “shelf break upwelling”. Shelf break upwelling occurs along isopycnals of a shelf break front and so the dynamics of the front influence the source waters for the upwelling, which in turn determine the flux of nutrients supplied to the shelf. It is unclear, however, where the water comes from, and what influence the winds have on the source waters. A three-dimensional, nonhydrostatic, high-resolution model with idealized bathymetry is used to simulate the shelf and shelf break front circulations of an archetypical passive margin off the eastern coast of the United States. The model is adapted for the coastal setting from a model developed for open ocean fronts (Madhevan et al, 1996a; Madhevan et al, 1996b). Data collected from the Mid-Atlantic Bight is used to ground-truth the model. A series of tracers are introduced that will be used to demonstrate dependence of the source waters on the winds. We find that where the front resides, the outer shelf/upper slope region dominates the supply of nutrients to the shelf. Madhevan, A., J. Oliger, and R. Street, Physical Oceanogr. 26, (9), 1168-1880, 1996a; Madhevan, A. J., Oliger, J. and R. Street, Physical Oceanogr. 26, (9),1881-1900, 1996b.

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A TIME SERIES ASSESSMENT OF SEDIMENT PLUMES AND PHYTOPLANKTON BLOOMS IN THE SANTA BARBARA CHANNEL, CALIFORNIA

The ocean waters of the Santa Barbara Channel (SBC) are affected by plumes of suspended sediment and intensive blooms of phytoplankton driven mostly by storm runoff and the upwelling of new nutrients. Here, a decade of in situ and satellite observations from the Plumes and Blooms program are used to assess the scales and sources of variability of SBC physical, chemical and biological properties. Fair correspondence is found between ship and satellite indices of sea surface temperature, chlorophyll and suspended sediment concentrations. Large interannual variations in water properties are observed in connection with El Niño events. Empirical orthogonal function analyses show four dominant modes which explain ~90% of the variance among a suite of hydrographic and biological variables. These modes represent four associated water types, each with a high lithogenic particle concentrations and low salinity (12.6%) and a mode with high lithogenic particle concentrations and high salinity (11.3%). The attribution of statistical modes with physical processes provides a way of assessing the importance of plumes and blooms to SBC water properties.

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APPLICATION OF MISST L4P ANALYSES PRODUCT FOR OPERATIONAL MARINE FORECASTING AT NOAA OCEAN PREDICTION CENTER

The NOAA Ocean Prediction Center issues operational marine weather warnings and forecasts of winds and waves for high seas area in North Pacific and North Atlantic oceans and off shore regions adjacent to the US. High resolution sea surface temperature analysis is an important tool for forecasters to determine factors such as location and strength of the Gulf Stream. Frequent heavy cloud cover associated with large winter ocean storms over the extratropical ocean results in lost of SST observations by IR and microwave sensors. Techniques using a combination of IR and microwave SST observations have demonstrated a superior capability to produce much improved SST coverage. OPC introduced a L4p analysis product (Reynolds, et al., 2007) into marine forecast operations in Fall, 2007. We will present an initial assessment on using the new SST analysis in making operational marine weather warnings and forecasts.

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OBSERVATIONS OF NORTH ATLANTIC INFLOW BY DUAL USE OF A TRANS-ATLANTIC FIBRE-OPTIC CABLE

The northern branch of the Atlantic-water inflow to the Nordic Seas was monitored using a technique based on the novel employment of a fiber-optic cable. Induced voltages, caused by the motion of saline water across the earth’s magnetic field, were measured over a branch-line of the transatlantic (CANTAT3) cable, extending 110 km northwards from Tjärnö on the northern coast of the Faroe Islands. To ensure the quality of the complete electric circuit of the monitoring system and of possible thermal influences...
on the voltage signal. This inquiry showed that the obtained voltage time series could be used for oceanographic purposes. The results from a spectral analysis of the data demonstrated that the signal is dominated by tides, which is reasonable since the observational technique is known to yield estimates related to the barotropic flow across the section. Comparisons were made with ADCP data from nearby moorings and correlation analyses gave at hand that the voltage measurements provide estimates of the flow immediately north of the Faroe Islands.

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SOURCE, DEGRADATION, AND FATE OF SEDIMENTARY ORGANIC MATTER IN A COASTAL MARINE ENVIRONMENT: EVIDENCE FROM THE HAURAKI GULF, NEW ZEALAND

Molecular level analysis of amino acids, n-alkanes and the distribution of their δ13C composition quantify the relative marine and terrestrial inputs to sedimentary organic matter (OM) in the Hauraki Gulf, northeastern New Zealand. Levels of recalcitrant biomarkers (alkanes) indicate marine inputs to the organic matter are constant across the Hauraki Gulf with terrestrial OM levels equaling or exceeding marine inputs by up to 5-fold, proximal to point sources. Microbial biomarkers (D-amino acids) indicate preferential microbial utilization of terrestrial material in the inner gulf (proximal to delivery). Preferential microbial utilization of marine organic matter occurs in the outer gulf, however, terrestrial contributions to microbial synthesis there are comparable to marine. Total OM accumulation rates (3.2 to 10.7 mg cm⁻² yr⁻¹) vary with sedimentation rates and alkane accumulation rates (less than 15 µg cm⁻² yr⁻¹). This approach is used in a rural school in Georgia. We will share our experiences (and the thrill) of having students fall in love with the diversity and complexity of the oceans though through inquiry-based learning. Using hands-on activities from the COSEE-System Ocean model. Time series of depth-dependent and depth-integrated near-inertial kinetic energy are calculated from available mooring data after filtering to isolate near-inertial frequency motions. Observational results document a pronounced seasonal cycle featuring a wintertime maximum in results from depth-integrated near-inertial kinetic energy derived chiefly from variability in the upper 500 m of the water column. A simple depth-integrated near-inertial kinetic energy model consisting of a wind forcing term and a dissipation term is proposed. The kinetic energy model captures the overall order of magnitude of the observed near-inertial kinetic energy, as well as the winter enhancement, though agreement on the time scale of individual wind stress events is poor.

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CHARACTERIZATION AND REMEDIATION OF ENERGETIC COMPOUNDS IN SEDIMENT AND WATER ON VIEQUES ISLAND, PUERTO RICO

In Vieques, Puerto Rico, former naval sites were used for weapons training and housed several disposal sites. The Atlantic Fleet Weapons Training Area consists of areas and nearby waters that have become contaminated primarily by United States Department of Defense (DoD) activities. Known areas of concern include waters influenced by target practice off the eastern shores of Vieques, areas where ships were anchored north of Vieques, and waters near the western side of Vieques, including Mosquito Pier. It is not fully understood whether the Navy’s operations on Vieques expose residents to unhealthy levels of environmental contamination. Detection and remediation of energetic compounds, such as TNT, RDX, and HMX in these areas are necessary to protect the health and well-being of the present and future Vieques residents and visitors. Our research focuses on the characterization of energetic compounds, such as TNT, RDX, and HMX on the island of Vieques. In addition, the remediation of energetic compounds with an innovative embolized zero-valent iron (EZVI) system is explored.

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DYNAMIC MODELING OF NONLINEAR INTERNAL WAVES IN THE SOUTH CHINA SEA

Tidal flow through the Luzon Straits generates internal tides which are routinely observed in the South China Sea (SCS) as diurnally modulated large-amplitude nonlinear internal waves (NLIW). Predictive and hindcast first-principles calculations of these waves are presented. Unique aspects of the simulations are simplified hydrostatic and isopycnal physics (with concurrent computational efficiency) but realistic geometries and boundary conditions. In spite of these simplifications, the model shows skill in predicting the presence and location of NLIW when compared to in-situ and remote-sensing observations. The model allows for a detailed energy analysis of baroclinic generation, modal conversion, and evolution. It is found that NLW formation results from a mid-basin nonlinear internal wave amplification of a K1 tide, leading to steepening of the internal tide as it approaches the continental shelf. It is also found that semidiurnal modulation of K1 internal tidal generation occurs, predominantly in the Southern Luzon Strait, and thus the simulations broaden our current understanding of the source regions for SCS NLWs.

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SEASONAL SEDIMENT ERODIBILITY AND TIDAL EFFECTS IN AN IDEALIZED NUMERICAL MODEL OF THE YORK RIVER ESTUARY

A quasi-one-dimensional model was used to study sediment transport in the York River estuary, Virginia. This ROMS (Regional Ocean Modeling System) model used semidiurnal tidal forcing and radiation boundary conditions to generate uniform bed shear stresses. Specificity to the site was obtained through the input of erodibility profiles of critical shear stress for the sediment bed. Erodibility profiles were generated through microcosm erosion tests on sediment cores taken in September 2006 and May 2007. Representing fall and spring, these months show seasonal differences in erodibility profiles. After running for 30 days (60 tidal cycles), the model was analyzed through spatial variation, time series plots, and erodibility profiles. Suspended sediment concentrations were maximized during peak ebb and flood tides, and minimized during slack tide, the period of maximum deposition. Spring suspended sediment concentrations were three times greater than those estimated for fall. Spring sediment also eroded at lower critical shear stresses for the entire duration of the model run.

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TOTAL AND EXTRACTED PHOSPHORUS IN SEDIMENT CORES COLLECTED BEFORE AND AFTER ONSET OF AN APHANIZEMONEN FLOS AQUAE BLOOM IN UPPER KLAMATH LAKE, OR, USA

Bottom sediments in Upper Klamath Lake (UKL) are a potential source of phosphorus (P) for Aphanielmomnium flos-aquae (AFA) blooms in the water column. To test this hypothesis we collected duplicate sediment cores at 4 sites in April, 2005, before onset of an AFA bloom.
ASLO/AGU/TOS/ERF

Session 1: Ocean Observing Systems and Data Management

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TOWARDS RAPID ENVIRONMENTAL ASSESSMENT AND COASTAL FORECASTING IN THE NORTHERN ADRIATIC

A high resolution coastal ocean forecast system in the Northern Adriatic is developed to respond to operational assessment requests on a rapid way. This work aims to establish a Rapid Environmental Assessment system based on three coastal monitoring networks and the large scale operational forecasting system of the Adriatic Basin investigating different modeling issues. FOM model is implemented in the Northern Adriatic and nested in the Adriatic Regional model. Model validation is performed with Satellite Sea Surface Temperature observations and coastal CTDs. A multi-scale optimal interpolation technique is applied to blend coastal data and large scale fields in the model initialization owing to a forecast skills improvement. The spin up time, necessary to develop the new scales circulation features, is investigated in order to reach the minimum time required with the maximum accuracy in the model forecasts. A spin-up period of two weeks is required for kinetic energy to settle to the new values allowed by the higher resolution nested model. This is possible through energetic evaluation and comparison with coastal observations too.

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BUILDING COOS EXTENSION AND EDUCATION PROGRAM CAPACITY: LESSONS LEARNED FROM THE SOUTHEAST ATLANTIC COASTAL OCEAN OBSERVING SYSTEM (SEACOOS) PROJECT

In addition to the observation, collection and analysis of data, SEACOOS (Southeast Atlantic Coastal Ocean Observing System) funded supporting the development of a complementary Extension and Education (E&E) component. The E&E Work Group (WG) was tasked with providing information and education to ocean and coastal users, and to

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**Atlantic Coastal Ocean Observing System (ACOOS)**

**LESSONS LEARNED FROM THE SOUTHEAST ATLANTIC COASTAL OCEAN OBSERVING SYSTEM (SEACOOS)**

**Design user needs assessments for educators and researchers in the development of useful products and extraction of purpose of this presentation is to discuss how these education and outreach functions have been structured and developed, and to discuss how the E&E WG collaborated to support and extend the research of SEACOOS. Additionally, because SEACOOS, the pilot RCOOS for the Southeast U.S., is in its fifth and final year, activities undertaken to transition E&E to the regional association, SECOORA (Souththeast Coastal Ocean Observing Regional Association) will be presented. Regional, national and international program activities will be included.**

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**THE PUZZLE OF MIXING IN THE SEASONAL THERMOCLINE OF THE SHELF SEAS**

**Turbulent kinetic energy inputs, arising from stresses at the two boundaries, drive stirring which competes with surface buoyancy exchange to control the seasonal stratification in shelf seas. After the spring bloom, which exhausts the nutrients in the surface layer, subsequent new biological production is determined by the transfer of nutrients from the bottom layers into and through the pycnocline and into the surface mixed layer where levels are frequently undetectable. A maximum in phytoplankton concentration, indicated by a peak in Chlorophyll concentration, is frequently observed in the pycnocline suggesting that nutrient uptake is such that diffusive fluxes of nutrients are taken up as soon as it reaches a level where adequate light and stability are available. Production in this region is postulated to be the dominant contribution during the summer and a major part of the total annual carbon fixation. The key questions are: (i) what mechanisms drive the mixing responsible for the crucial fluxes in the pycnocline? and (ii) can we determine the magnitude of the fluxes involved? Here we report the result of a four-week experiment with water column concentration interpolated technique is applied to blend coastal data and large scale fields in the model initialization owing to a forecast skills improvement. The spin up time, necessary to develop the new scales circulation features, is investigated in order to reach the minimum time required with the maximum accuracy in the model forecasts. A spin-up period of two weeks is required for kinetic energy to settle to the new values allowed by the higher resolution nested model. This is possible through energetic evaluation and comparison with coastal observations too.**

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**SURFACE NUTRIENTS IN RELATION TO PHYTOPLANKTON COMPOSITION IN THE SEA ICE ZONE WEST OF THE ANTARCTIC PENINSULA**

**Abundant macronutrients characterize shelf waters west of the Antarctic Peninsula. We present results from a 13-year time series (1995–2007) from the Palmer LTER project in order to characterize patterns in nutrient distribution in surface waters. The establishment of a steeper, mixed layer in late spring isolates surface waters from winter waters (0-150 m). The growth of phytoplankton is able to reduce nutrient concentrations from winter values and the rate of reduction differs depending on dominant phytoplankton assemblages. Diatoms are more abundant in coastal waters where the Silicate:Nitrate ratio can exceed 4.5 and least abundant in slope waters where Silicate:Nitrate averages 1.5. Large accumulation of cryptophytes increase Silicate:Nitrate due to differential uptake of nitrate. The resultant nutrient distribution is a mosaic combining onshore–offshore nutrient gradients superimposed on nutrient uptake in response to phytoplankton biomass. Additionally, local differences in nutrient ratios respond to phytoplankton composition. We discuss the influence of water masses, topography, nutrient concentration at depth (250-500 m) and differential biological uptake on nutrient concentrations and nutrient ratios.**

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**COMPARISON OF THE PERFORMANCE OF A COMPLEX OCEAN ECOSYSTEM MODEL WHEN COUPLED TO TWO DIFFERENT GENERAL CIRCULATION MODELS**

**We present results from simulations using the PLANKTOM5.0 ecosystem model, which includes five plankton functional types or PFTs (corresponding to diatoms, mixed phytoplankton, coccolithophorids, micro- and mesozooplankton), and biogeochemical cycling of four elements (carbon, phosphate, silicate and iron). Experiments were performed where the same ecosystem model, with identical parameterizations, was embedded in two contrasting physical models, namely OCCAM and OPA. The two physical models have comparable horizontal resolution and external forcing, but different numerical grids, vertical resolution and mixing parameterizations. We compare predictions of bulk ecosystem properties (primary production, export, biomass), as well as partitioning among the different PFTs, between the two simulations. The stability of the model solutions to changes in parameter values is also assessed. Results indicate considerable sensitivity to choice of both physical model and ecosystem parameterizations.**
Molecular microbial water quality assessment and bacterial source tracking for the Florida area coastal environment (FACE program)

The Florida Area Coastal Environment Program (FACE) at NOAA/AOML was developed to assess whether municipal infrastructure impacts the health of Florida coastal ecosystems by providing an integrated analysis of the physical, chemical, and biological oceanography of coastal areas near wastewater outfalls, septic systems, inlets, and canals. With the FACE program, we have utilized both traditional culture-based and molecular-based detection methods to assess microbial water quality for a variety of fecal indicator bacteria, alternative indicators, bacterial source-tracking markers, and selected bacterial, viral, and protozoan pathogens. Analysis of surface soil water from six wastewater outfalls along the SE Florida coast demonstrated presence of both pathogenic viruses and protozoan cysts, but essentially no presence of bacterial fecal indicators or bacterial pathogens. In contrast, certain SE Florida coastal inlets and several canal and near-shore coastal areas of the Florida Keys demonstrated elevated levels of fecal indicator bacteria, presence of source tracking markers for both human-source and domestic animal fecal contamination, and the presence of viral and protozoan pathogens. These continuing studies aim to assess the efficacy of on-going sanitation improvement programs in the region.

The effects of brevetoxin on natural microbial populations

Brevetoxin is a potent neurotoxin that has been linked to fish kills, marine mammal kills, sea bird deaths and adverse human health affects. Brevetoxin producing Karenia brevis has also been shown to have toxicological effects on several phytoplankton species. The effects of brevetoxin on the natural microbial communities, however, remains understudied. To assess the effects of brevetoxin on natural microbial communities, synthesized brevetoxin was added to bacterial communities from three different bay locations along the east coast and Florida. Each location represents a system with varying historical brevetoxin exposure. Brevetoxin additions, ranging from 0-200 μg/L, elicited distinct responses in the microbial populations. Significant differences were observed in the total bacterial cell number and the proportion living versus dead bacteria after 24hr incubations. These results suggest that microbial populations that have previously been exposed to brevetoxin may be less susceptible to it effects than those populations that have limited or no exposure.

A comparison of Arctic and Antarctic faunas: A case study of the Laptev and Weddell seas

We compare macrobenthic species diversity of the Arctic Laptev Sea (LS) and the Antarctic Weddell Sea (WS). There are 1414 macrobenthic species in the LS and 1448 in the WS. The LS has fewer species than the WS in Periuridae (75/159), Arctozoa (27/48), Pycnogonida (22/85), Myidea (17/32), Gastropoda (137/274), Cephalopoda (7/12), Brachiopoda (2/7), Holothuroidea (11/34), Echinoida (2/19), Asteroidea (17/50), Ophiuroidea (13/56), Pterobranchia (0/5), Ascidiacea (26/51). These taxa are epifaunal and most are stenon-feeders, carnivores or carion-feeders. The LS has more species than the WS in Hydrozoa (85/41), Nemertea (41/10), Polychaeta (228/60), Amphipoda (308/120), Pogonophora (6/1), Bivalvia (78/64). Four of these taxa are infaunal and two are epifaunal. In conclusion, Antarctic benthic communities are dominated by epifauna, mainly sessile suspension-feeders, whereas Arctic bottom communities are dominated by infauna, mainly deposit-feeders. Essential differences in bottom-sediments (muddy sand with gravel/boulders in WS versus clay/silt in LS) and functional histories may explain these differences. The recent Antarctic glacial fauna originated from the ancient Antarctic fauna putting Antarctic epifauna at an advantage over infauna early on. Recent Arctic shelf fauna in contrast evolved on shallow bottom.

Controlling the air-sea fluxes in a global oceanic model by assimilation of SST and SSS data

Bulk formulation parameterizing turbulent air-sea fluxes remain a major source of error in present model, which strongly affect the ability to provide a realistic short term forecast. The recent Antarctic glacial fauna originated from the ancient Antarctic fauna putting Antarctic epifauna at an advantage over infauna early on. Recent Arctic shelf fauna in contrast evolved on shallow bottom. (End of text)
Chemical characteristics of marine aggregates are largely unknown. We investigated neutral aldehydes (NA)(absorbing and scattering components of marine aggregates and other organic matter size fractions in the field. NA yield increased with increasing particle size for all fractions except marine snow. The NA yield indicated that marine snow could have been diagnostically derived from particulate and HMW-fractions, i.e. marine snow aggregates. NA included both monomeric and colloidal material. There was no clear correlation between marine-snow aggregate size and NA yield, i.e. there appears to be no general age difference between small and large marine-snow aggregates. NA composition was similar among different marine-snow size-fractions collected during the same day, indicating that aggregation/disaggregation reactions resulted in homogenizing NA composition in marine-snow aggregates of all sizes. This leads us to believe that the major component, sourced from lignin, is surviving transport from the river to the ocean. We use GC-IR-MS to establish the isotopic signatures of specific DOM components, especially the lignin. It is possible that lignin-derived compounds have previously evaded detection by lignin-phenol methods due to the structural re-workings that occur during microbial or photochemical processes. Overall, our preliminary results indicate that we have identified an abundance of lignin-derived compounds in marine water.

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EVIDENCE OF A LIGNIN SOURCE FOR PREVIOUSLY UNCHARACTERIZED COMPONENTS OF DISSOLVED ORGANIC MATTER (DOM) IN MARINE WATERS

We utilize Fourier transform ion cyclotron resonance mass spectrometry (FT-ICR-MS) and high performance liquid chromatography isotope ratio mass spectrometry (GC-IR-MS) to characterize the lignin contribution to dissolved organic matter (DOM) isolated from terrestrial and marine waters in the Chesapeake Bay and offshore coastal sites. Molecular formula assignments and structural assignments for the individual constituents of DOM, based on FTICR-MS results, indicate that there is a great similarity in the DOM from terrestrial and marine sites. One possibility is that the major component, sourced from lignin, is surviving transport from the river to the ocean. We use GC-IR-MS to establish the isotopic signatures of specific DOM components, especially the lignin. It is possible that lignin-derived compounds have previously evaded detection by lignin-phenol methods due to the structural re-workings that occur during microbial or photochemical processes. Overall, our preliminary results indicate that we have identified an abundance of lignin-derived compounds in marine water.
a success, we are striving to ensure adoption into classroom curriculum by conducting follow-up workshops that will take place in October and providing the necessary equipment and support to each participating schools. We will present dissemination methods, related to the Kentucky Department of Education's Core Content, lessons learned from our initial summer workshop, services that will benefit teachers and curriculum adoption, student outcomes, survey results of the fall 2007 follow-up workshop. We strongly feel that our methods will lead to the integration of stream ecology concepts in the classroom as well as raise overall environmental awareness.

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OCEANIC HEAT TRANSPORT AND ARCTIC SEA ICE COVER

Effects of variation in the poleward advection of oceanic heat on the Arctic ice cover is explored. The oceanic heat transport is specified at a boundary of a simple column model that has a vertical 1m resolution and resolves the sea-ice distribution with more than 40 ice classes. The column model (1Dice) is horizontally integrated, uses monthly mean atmospheric forcing, and reproduce the Arctic sea-ice thickness distribution and most of the thinning onwards from the 1970s (Söderqvist and Björk 2004). The effects of increased oceanic heat transport is sensitive to the depth at which advection is specified and the model mixing, in addition to the obvious heat transport estimate. Many different scenarios are fully explored until they reach a steady state, usually within 20-50 years. Results presented include the Arctic Ocean and the area that receives the largest oceanic heat transport of any seasonally ice cover in the Arctic - the Barents Sea.

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USING SYNTHETIC PROFILES TO IMPROVE SOUND SPEED PREDICTION IN OPERATIONAL GLOBAL OCEAN MODELS

Accurate representation of sound speed is a major objective for operational naval ocean models. The Modular Ocean Data Assimilation System (MODAS) uses climatologically-determined regression coefficients to project satellite measurements of sea surface height and sea surface temperature into synthetic profiles of temperature (T) and salinity (S). Sound speed derived from these standard profiles has a climatological average vertical structure. Mixed-layer depth (MLD) forecasts from the NRL Layered Ocean Model are used to modify MODAS synthetics to better represent sound speed inflection points. The standard and MLD-modified synthetics are assimilated into the global Navy Coastal Ocean Model to produce dynamically-balanced T and S forecasts. While the adequacy of any particular sound speed estimate can be highly dependent upon depth and frequency of the sound source, accuracy of ocean characteristics such as MLD, sonic layer depth and below-layer gradient are good indicators of a product's overall suitability for many acoustic applications. Evaluating the various products related to unassimilated in situ observations, we produce global maps of system performance to identify preferred products for calculating acoustic transmission.

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THE 1/12 DEGREE REAL TIME HYCOM NOWCAST/FORECAST SYSTEM

The 1/12 degree global HYCOM nowcast/forecast system has been running in near real time since 22 December 2006 and in real time since 16 February 2007. With ~7km longitude resolution (3-4km near the poles), the system will depict the location of meso-scale features such as oceanic eddies and fronts and provide the three dimensional ocean temperature, salinity and current structure. The Navy Coupled Ocean Data Assimilation (NCODA) system is used to assimilate available observations. NCODA is a multivariate optimal interpolation scheme (MOVD) that assimilates surface observations from satellite altimeter tracks and available CMSSST data. NCODA also assimilates in situ observations, including profile data from BT's and ARGO floats. The different components of the system will be described and the latest results including comparisons with independent observations will be shown. The prediction system will provide boundary conditions for higher resolution coastal models. An accurate representation of the oceanographic fields at the open boundaries of a coastal model is important for a successful coastal ocean prediction system. Results from the global system can be viewed on the HYCOM web page http://www.hycom.org/. The model output can also be accessed through this web page.

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Since the fall of 2003, a line of stations extending from Cape Cod about half way to Bermuda has been occupied twice a year as part of an investigation of interannual variation of the Deep Western Boundary Current (DWBC). Prior to the near shelf part of the line was sampled a number of times during the Primor and other projects in the 1990s and early 2000s. The line begins as a total of 38 locations occupied between 1994 and 2007. The water property cores for Labrador Sea Water (LSW) and Denmark Strait Overflow Water (DSOW) in the DWBC were identified as maxima in chlorofluorocarbon concentration and average properties for these extrema were calculated for each crossing of the DWBC. Two vintages of well-ventilated low salinity LSW passed through the section in 1994-1996 and in 2005, corresponding to periods of deep convection in the Labrador Sea in 1989-1993 and 2000 respectively. DSOW salinity increased between 1994-1996 as LSW freshened, but then freshened after 2000. Changes in other properties will also be presented.

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COASTAL-TRAPPED WAVE PROPAGATION IN THE PRESENCE OF SUBMARINE TOPOGRAPHY

CTW propagation along the continental slope and its subsequent interaction with the submarine canyon was investigated experimentally. Our observations demonstrated that CTW propagates along the continental slope with the strongest currents being concentrated near the shelf break. The topographic irregularity was strong enough to promote wave scattering. Flow characteristics in the canyon were found to be sensitive to the relative value of the Burger number. When the latter was very large (strong stratification), no variations in the wave spatial structure were observed in the canyon region. The scattering effect becomes significant at moderate values of the Burger number (of the order of unity). It was shown that stratification can eliminate backward propagating modes and limit the number of transmitted modes, forcing the flow to generate highly-energetic evanescent modes in order to adjust to the variations of the topography. Eventually strong mesoscale flows are generated in the form of a cycloidal eddy trapped inside the canyon region influencing the transport of nutrients and pollutants in the coastal region.

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SEDIMENT WATER INTERACTIONS IN THE SWAN RIVER ESTUARY (AUSTRALIA), 2000-2006

Geoscience Australia has conducted four surveys to the Swan River Estuary, Western Australia, between 2000 and 2006 to determine the importance of sediments as a source of nutrients. Extreme seasonality of river flow causes the estuary to alternate between fully marine (summer) and almost fresh (winter). Catchment derived nutrients and internal recycling, combined with stratified conditions, drive temporary algal blooms within the waterway. Between 2000 and 2006 there has been a significant increase in the amount of organic matter being degraded, and therefore, nutrient release from the sediments of the upper Swan River. Fluxes of TCO₃⁻, NH₄⁺, PO₄³⁻ and SiO₄⁴⁻ have been among the highest we have recorded in any Australian estuary. The increase in organic matter is also limiting the phosphorus binding capacity and adversely affecting the denitrification efficiency of the sediments. It is possible that reduced flows as a result of global climate change are responsible for the increased organic matter degradation.

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MICROORGANISMS LIVING DEEP WITHIN MARINE SEDIMENTS

Recent investigations have led to the discovery that much of the life on Earth resides below its surface. This has resulted in a substantial revision of our understanding of the physical extent of Earth’s biosphere. Cores retrieved by the Integrated Ocean Drilling Program have yielded evidence that microorganisms exist in sediments hundreds of meters below the seafloor. Data from multiple sites have been used to estimate that up to 10% of the extent of Earth’s biosphere. Cores retrieved by the Integrated Ocean Drilling Program have yielded evidence that microorganisms exist in sediments hundreds of meters below the seafloor. Data from multiple sites have been used to estimate that up to 10% of the extent of Earth’s biosphere.
Since the early 1990s ESA has flown Along Track Scanning Radiometer (ATSR) instruments on its ERS-1 and -2 satellites and is currently flying the Advanced ATSR instrument (AATSR) on its very successful Envisat mission; each successive sensor has been an incremental improvement over the last. The sensors have been specifically designed to provide the information urgently needed for the debate on climate change and global warming, as well as to produce properly calibrated image data sets for use in a wide range of EO studies. Each ATSR exploits the multi-channel method pioneered in AVHRR but also uses new technology to improve instrument stability and calibration, detector signal to noise, and to provide observations of the same surface scene at two different angles. The novel feature of each ATSR, from which the sensor is derives its name, is its use of along-track scanning to reduce the effects of the atmosphere on surface measurements. This method obtains two observations of the scene through differing amounts of atmosphere; the

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AMIS EDUCATION PROGRAMS FOR THE OCEAN SCIENCES: A PARTNERSHIP OF A PROFESSIONAL SOCIETY, GOVERNMENT AGENCIES, UNIVERSITIES, AND THE K-12 COMMUNITY

The American Meteorological Society has been involved with teacher enhancement programs for over 15 years in the atmospheric, oceanic and related sciences. A key to the success of its programs is the partnerships it has forged. This paper will focus on two programs that promote ocean science education and the groups that form the partnerships. In 1994, the Maury Project was established in partnership with the United States Naval Academy and SUNY College at Brockport, with support from the National Science Foundation, the Navy and NOAA. This program is directed towards improving teacher effectiveness in generating interest and understandings in oceanography. In 2003, AMS initiated a distance learning course called DataStream Ocean. The partners include AMS, graduates of the Maury Project, and subject matter experts who assist as members of local implementation teams to facilitate teaching ocean science topics to precocious teachers. Funding for this program is primarily provided by NOAA. This course is delivered by the AMS education program and taught in a decentralized fashion at nearly 30 sites nationwide. This paper will describe these two programs and how the partners contribute to accomplishing their goals in training teachers on aspects of the ocean sciences.

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VIRTUAL STOWAWAY ON AN OCEANOGRAPHIC CRUISE: AN INTERACTIVE EDUCATIONAL WEBSITE EMPLOYING LINKED SHIPBOARD PAM AMAS

An oceanographic cruise is a part of scientific research few can experience firsthand. We are developing an informal education website, Virtual Stowaway on an Oceanographic Cruise, that uses linked QuickTime panoramas to offer a broad public a virtually first-hand look at scientific research and exploration aboard a dedicated research vessel on the open ocean. Clicking on hotspots within these panoramas may lead to explanatory text, video or audio clips. Underwater shots showing the "jelly animals" that are targets of study on these cruises will be linked to descriptions of the animals depicted. Other hotspots within the panoramas will allow visitors to the site to "move" from one space to another on the ship, seeing the activities that typically take place in each. By showing scientists, crew, and study animals in their respective places at sea, we hope to illustrate how the ship's spaces, functions, and people fit together to help researchers learn about the ocean around them. We will present the latest version of this "Stowaway" site, welcoming suggestions on how it may be made more functional, attractive and interactive.

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RECONSTRUCTION OF THE ATLANTIC MERIDIONAL OVERTURNING CIRCULATION USING A PHYSICALLY-BASED DATA ASSIMILATION METHOD

Our main aim is to produce a high-resolution reconstruction of the global ocean over the last 50 years suitable for the study of ocean climate signals and in particular the Atlantic meridional overturning circulation (AMOC). The relative abundance of colocated temperature and salinity observations provided by Argo are used to develop an assimilation scheme whereby temperature and salinity profiles are assimilated on isotherms and isopycnals. This allows us to exploit the larger spatial and temporal decorrelations of these quantities, compared with assimilation on geopotential surfaces, allowing flow dependent assimilation and recovery of water mass information. The ¼ degree NEMO ice-ocean model developed by DRAKKAR is used to perform a series of experiments over the Argo period, assimilating on depth, temperature and density surfaces. These experiments are evaluated in terms of the ability of the different methods to capture observed water mass properties, and the effect of the Argo data on the AMOC. A 20% spin-up will also be made with estimates of the AMOC from the RAPID Array at 26N. If completed, results from a 50 year reanalysis using this model-data synthesis method will also be shown.

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FLUSHING THE NEAR SHORE

Waves exert a strong influence near shore, notably driving alongshore flows that sometimes exceed 1 m/s. How do these wave-driven flows interact with other dynamics in the nearshore region? Here we consider observations of a fresh water density flow propagating down-coast along the barrier islands past Duck, NC. The primary data set discussed here is a time-series of 2-D horizontal surface velocities estimated over an area several hundred meters on a side of a pair of

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129 TRANSPORT IN THE DEEP WESTERN BOUNDARY CURRENT IN THE NORTH ATLANTIC OCEAN

During the early 1990s, discharges of 129I from European nuclear fuel reprocessing plants increased by 500% resulting in a well resolved, tracer "front" whose spreading beyond the Nordic Seas is presently being observed by 129I-time-series measurements on the WOCE (World Ocean Circulation Experiment) Line W Section in the Labrador Sea. In addition, the 129I tracer in 241Pu levels in the Labrador Sea at depths greater than 3000 m in Denmark Strait Overflow Water (DSOW) increased by about 200% between 1997 and 2001 and by only about 15% since that time, indicating that the 129I tracer front had fully entered the North Atlantic Deep Waters (NADW) by 2001. By May 2007 the 129I concentration and 241Pu-11 ratio in the DWBC on Line W had increased by 20% compared to levels measured between 2004 and 2006 suggesting that the leading edge of the 129I tracer front had arrived. These results indicate that the transit time in the DWBC to Line W is about 8-10 years from the Labrador Sea and 10-12 years from the Nordic Seas.

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PATTERNS OF POTENTIAL TEMPERATURE RISK DURING INTERTIDAL EMERGENCE IN DIFFERENT TIDE REGIMES

Organisms living in marine intertidal zones are exposed to terrestrial conditions during a portion of each day. When low tide occurs during midday in summer, organisms may reach high body temperatures that are physiologically harmful. Therefore timing of the low tide is important for determining thermally risky areas. Past studies have shown variability in the timing low tide across regions and continents using predictions from individual tide stations. However, individual tide stations do not provide the spatial information necessary for determining large-scale patterns in the timing of the low tide. We used the USJ Tidal Inversion Software which is based on TOPEX POSEIDON and Jason 1 altitude data to predict the timing of low tide and the NASA JPL Horizons software for solar elevations to model potential temperature risk. While this method does not account for wind, waves, and local topography, it does provide a useful baseline to select potentially interesting areas for more localized studies on the effects of thermal stress.

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DETRITAL AGGREGATE COVERAGE ON THE DEEP-SEA FLOOR IN THE NORTHEAST PACIFIC OVER A 17-YEAR PERIOD

Long-term monitoring of an abyssal site (Sta. M) in the northeast Pacific has found seasonal and interannual variation in the flux of particulate organic carbon to the seafloor, as measured by sediment traps. A portion of these organic carbon inputs to the benthos occurs in the form of discrete detrital aggregates, which may not be characterized adequately by sediment trap collections. The spatial and temporal coverage of detrital aggregates on the seafloor at this abyssal site were examined with time-lapse photography. These aggregates have chemical compositions similar to sediment trap material at the study site. Seafloor coverage of these aggregates as well as their sizes and densities were compared to particulate fluxes measured synoptically by sediment traps. The temporal relationship between sediment trap flux measurements and seafloor aggregate occurrence and coverage were examined. Surface conditions, including major climatic phenomena such as the El Niño-Southern Oscillation and patterns in primary production, also were compared with sinking particle fluxes and detrital aggregate coverage on the seafloor at this site.
THE VERTICAL STRUCTURE OF PV MIXING ACROSS THE ACC

Satellite observations show that Rossby wave phase speeds in the core of the Antarctic Circumpolar Current (ACC) are at least as fast as the mean current by about 25%, implying a strong shear instability at significant depth. Detailed linear stability calculations from hydromechanical theory reveal a strong unstable mode with maximum amplitude and phase at a similar depth, near the base of the jet, implying preferential eddy generation at the level of the jet. Calculations using a nonlinear model forced by the mean shear and stratification at a series of locations spanning the ACC, confirm this picture. Despite that the instability structure is broadband and complex, the mixing level is dominated by a particular growing mode --- this is the mode that can lead to the most efficient conversion of available potential to eddy kinetic energy. The resulting structure of the PV eddy flux is consistent with an eddy velocity that acts to flatten tilted isopycnals. An important result of this study is that the vertical structure of the PV diffusivity is strongly depth-dependent, and so the diffusivities of eddy PV and eddy buoyancy are not the same.

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PARAMETER ESTIMATION USING AN ENSEMBLE SMOOTHER: THE EFFECT OF THE CIRCULATION IN BIOLOGICAL ESTIMATION

An ensemble smoother is used to estimate the initial conditions and mortality rate for a spatially explicit model of the toxic dinoflagellate Alexandrium fundyense. The skill of this ensemble is assessed through the hindcast of the enzyme analysis carried out with three different representations of circulation: no circulation, climatology and a data assimilative hindcast. While the hindcast to the assimilated data is minimized with no flow, the hindcast of the biological hindcast is better with the hindcast and climatological velocity fields.

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RESPONSE FOR SCIENTIFIC INQUIRY: PROFESSIONAL DEVELOPMENT FOR SCIENTISTS TO SUPPORT THEIR WORK WITH EDUCATION

Funders are asking scientists to become more involved in communicating the "broader impacts" of their work. In addition, scientists wish to contribute to public science literacy and high-quality science education in schools. The ReSciPE Project---Resources for Scientists to Partner with Education---provides professional development workshops and other resources to scientists who are involved in education and public outreach. As of fall 2007, we have reached roughly 400 scientists through our workshops on "Scientific Inquiry in the K-12 Classroom" at professional meetings, laboratories, and universities. The project goals and our model for helping scientists to become more effective in working with students and teachers will be described. Evaluation results from pre- and post-workshop surveys of participants demonstrate that the workshops are effective in broadening participants' ideas of their potential role in education. However, they also have ongoing needs for both knowledge and support. We argue that working with education or other public audiences is an increasingly important professional skill for scientists and offer this project as one experiment in providing appropriate professional development for this work.

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ON THE EFFICIENCY OF A DISTRIBUTED FORECAST SYSTEM FOR THE SIMULATION OF TROPICAL STORM DRIVEN WAVES AND STORM SURGE

The SURA Coastal Ocean and Prediction (SCOOP) program is developing a prototype distributed coastal laboratory linking sensors, software and computational resources. SURA (Southeastern Universities Research Association) researchers are creating an IOOS to improve forecasts of tropical storm driven waves and storm surge with the eventual goals of improving emergency planning, safe maritime operations, and support of coastal security. As part of the system, ensemble forecasts from atmospheric wind models are distributed to a network of computers where they are then used to drive storm surge and wave models. For initial system prototyping, SCOOP is focusing on the use of an ensemble of 30+ analytical wind and pressure fields which are based on a probabilistic analysis of historical hurricane force events. Results are then cross validated. The atmospheric products are distributed to a series of nodes which are responsible for archiving, cataloging and eventual visualization of the products for use by emergency managers. We will examine the speed, latency and efficiency of the distributed data transport in this overall system with emphasis on its response during real hurricane events.

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THE TRI-SPAR: A POSSIBLE OOI GLOBAL-SCALE NODE FOR HIGH-LATITUDE SITES

The OOI Global Network design envisions nodes providing power to seafloor instruments and communications to the shore. Of particular importance are nodes at high-latitudes. Environmental conditions in such locations will make installation and reliable long-term operations challenging. Compared with Alex buoy systems, spar buoy systems provide superior motion characteristics and have been used successfully in the oil industry and for scientific research (FLIP). A modification of the conventional spar design is the Tri-Spar, which comprises three cylindrical columns spaced about three diameters apart, connected by a horizontal spar. As part of the system, ensemble forecasts from atmospheric wind models are used to improve forecasts of tropical storm driven waves and storm surge with the eventual aim of reducing risk to the ocean observing network. SURA (Southeastern Universities Research Association) researchers are creating an IOOS to improve forecasts of tropical storm driven waves and storm surge with the eventual aim of reducing risk to the ocean observing network.

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A COMPARISON OF LIGNIN-PHENOLS AND BRANCHED/ISOPRENOID TETRAETHERS (BIT INDEX) AS INDICES OF TERRITAL ORGANIC MATTER IN SURFACE SEDIMENTS

Recent work has shown that the branched versus isoprenoid tetratera (BIT) index is a useful proxy for determining the fluvial inputs of terrestrial organic matter in the marine environment (Hopmans et al., 2004). To compare this new approach with the long-standing CuO method, first introduced by Hedges and Ertel (1982), sediments collected as part of the pre-Antarctic Sea of Meso acid Benthos (DeGOMB) Project were analyzed using both methods, as well as surface sediments obtained from estuarine fords in southwestern New Zealand. The DeGOMB and Fiordland samples represented sediments with expect low and high inputs of terrestrial-derivative organic matter, respectively. The unusually high inputs of terrestrial-derivative organic matter in Fiordland are primarily due to land-slip and steep fiord slopes that mostly occur during high rainfall events; rainfall typically averages 7 m per year in this region.

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USE OF POP-UP SATELLITE TAGS TO REFINE KNOWLEDGE OF SWORDFISH FEEDING ECOLOGY ON GEORGES BANK, AN AREA OF FISHERY AND RESOURCE CONCENTRATION.

A three year program to tag North Atlantic swordfish on the northeast peak of Georges Bank, off Nova Scotia, Canada has provided depth profile data of swordfish while feeding. The data indicate that swordfish spend much of their time foraging at depths of between 300 and 600 meters. Stomach samples collected in the same waters have shown that swordfish in this area were feeding on several species of meso-pelagic fish and cephalopods and generally exhibited high feeding success. The homing behaviour clearly demonstrated by satellite-tagged swordfish on Georges Bank indicates that this area is used consistently from year to year, and forms an important feeding site for North Atlantic swordfish. The implications of these observations for management of the stock are discussed.

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MULTI-ELEMENT ECOSYSTEM DYNAMICS IN THE SERIES IRON-ENRICHMENT EXPERIMENT: COMPARING FIXED- AND VARIABLE-COMPOSITION VERSIONS OF THE NEMURO ECOSYSTEM MODEL

We model the dynamics of Fe, N and Si during SERIES, comparing a Fixed-Composition (FC) and a Variable-Composition (VC) planktonic ecosystem model and focusing on variations in drawdown ratios and diatom composition. Because nutrient uptake kinetics are key to these two models, we compare the newly developed Upalma Uptake (UY) kinetics to the classic Michaelis-Menten (MM) kinetics. OU kinetics, based on the aclimation of phytoplankton physiology to ambient nutrient concentrations, is similar to the MM equation, but with maximum uptake rate and half-saturation "constant" that both increase with nutrient concentration. When fit to the data, all model versions reproduced well the nutrient and chlorophyll data, but with different patterns of nutrient limitation.
and material flows. Comparing fits started with different initial guesses, the VC model reproduced the observed changes more accurately than the FC model. The different uptake kinetics yielded significantly different biomass of zooplankton (through effects of food quality). In the VC model, MM and OU kinetics yielded very different elemental compositions for phytoplankton. Field data for such changes in composition are needed to clarify multi-element dynamics in the ocean.

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AN ANALYSIS/FORECAST SYSTEM BASED ON THE 4DVAR CYCLING REPRESENTER DATA ASSIMILATION METHOD AND THE NAVY COASTAL OCEAN MODEL

This presentation will overview an ocean analysis/forecast system that is being developed at the Naval Research Laboratory (NRL) that employs 4DVAR assimilation to combine ocean observations with the Navy Coastal Ocean Model (NCOM) to obtain an optimal solution that minimizes a cost function containing the weighted squared errors of data, initial conditions, boundary conditions, forcing, and model dynamics. In order to converge to a global minimum, the ocean model (and its adjoint) must be linear. Since NCOM is highly nonlinear, its model dynamics and adjoint are linearized using tangent linearization. The accuracy and stability of this tangent linearized model (TLM) is a very sensitive function of the background accuracy, the level of nonlinearity of the model, complexity of the bathymetry, and the complexity of the flow field. Therefore, in high-resolution coastal domains, which this assimilation system is designed for, the TLM is only going to be stable for a relatively short period of time. To overcome this problem, the cycling representor method is employed to solve the 4DVAR problem by splitting the time period into short cycles that are within the time frame of TLM stability. This cycling assimilation system will be validated for a Mississippi Bight domain assimilating velocity measurements from an array of ADCP moorings.

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QUANTITATIVE VERIFICATION OF VIABILITY STAIN PERFORMANCE AND PHOTOSYNTHETIC ACTIVITY IN PHYTOPLANKTON

Recent recognition of the sources and magnitude of phytoplankton cell death have heightened awareness of the importance of measuring algal viability. Fluorochrome stains have the potential to streamline viability measurements for incorporation into ecological studies, toxicological studies, and applied problems such as testing the effectiveness of ballast water treatment, but the performance of these stains under variable conditions remains relatively untested. This study tested the effectiveness of some common viability stains under both controlled laboratory and complex environmental conditions. Flow cytometry was used to detect viability in laboratory algal cultures and a field populations of estuarine cryptophyte algae against a known measure of photosynthetic activity determined from 14C-uptake. Controlled laboratory experiments indicate that fluorochrome methods can be remarkably consistent with side-by-side determinations of photosynthetic activity. However, direct transfer of methods to field samples is not necessarily straightforward. These results suggest that increasingly common fluorochrome methods available for measuring viability should continue to be tested for efficacy before incorporation into studies of phytoplankton dynamics, and that the use of other non-fluorochrome assays should be explored for use in complex natural samples.

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THE SHIPBOARD AUTOMATED METEOROLOGICAL AND OCEANOGRAPHIC SYSTEM (SAMOS) INITIATIVE

The status of the shipboard automated meteorological and oceanographic system (SAMOS) initiative will be described. The SAMOS initiative focuses on improving the accuracy and access to quality-assured, high-resolution (sampling rates ~ 1 min.) meteorological and near-surface oceanographic observations collected on research vessels. The SAMOS data assembly center (DAC) and its partners in NOAA and UNOLS have implemented a series of daily data transmission from ship-to-shore using an email protocol. All data arrive at the DAC soon after 0000 UTC and undergo automated quality evaluation. The data review and responses to data demands at sea when problems are identified. All quality evaluated data are freely available to the user community (via http://samos.coaps.fsu.edu). Currently, 12 research vessels are providing routine data transfers. The authors will describe ongoing activities and outline plans to recruit additional vessels, including potential collaboration with voluntary observing ships equipped with automated weather systems. Methods will be discussed to improve metadata retrievals from vessels, expand data distribution, and advance data quality evaluation.

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RESPONSES OF BENTHIC MACROFAUNA TO ENVIRONMENTAL STRESSORS: IS THERE A CHARACTERISTIC STRESSOR RESPONSE?

Benthic macroinvertebrates are frequently used as indicators of ecological health and condition in estuaries. Several tools, such as the multimetric Chesapeake Bay Benthic Index (CBI) and the Marine Biotic Index (AMBI) have been developed to assess the condition of estuarine systems based on generalized responses of benthic macroinvertebrates to environmental stress. One of the component metrics of the CBI classifies individual species into pollution tolerance groups based primarily on expert opinion. An implicit assumption in this approach is that tolerance responses are not strongly species-specific and this classification is intended to reduce potential misclassification. For this study, we evaluated Chesapeake Bay benthic macroinvertebrate community composition, water quality, and sediment contaminant data in order to identify relationships between species abundance and specific stressors such as low dissolved oxygens, contaminated sediments and organic enrichment. Identification of stressor-specific responses will lead to more accurate and refined assessments of Chesapeake Bay benthic condition that can be used by resource managers to more effectively identify and remediate disturbed habitat.

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BLEACHING DURING UNPRECEDENTED WARM WATER IN THE US VIRGIN ISLANDS AND DEGRADATION WITHIN POTENTIAL REFUGIA

The NE Antilles suffered the worst warm water event on record in 2005. Intensive and extensive monitoring of corals around the US Virgin Islands showed that bleaching was severe; during the peak of the event (Sep-Nov), most corals were bleached (73%, N = 1671) with high severity (50-90%) of the colony surface. During the recovery phase (Jan-May), both the prevalence (33%, N = 1881) and severity (10% - 50%) of bleaching decreased, reaching near pre-bleaching prevalence (20%, N = 1363) and severity (<10%) by June 2006. The prevalence of diseases increased during recovery, from 1% to 7%, due largely to an unprecedented, outbreak of white syndrome, with prevalence increasing from less than 1% to 4%. The combination of these disturbances caused recent partial and whole colony mortality to nearly quadruple in prevalence from 7% (prior to and during the bleaching) to 25% (during recovery). The net effect was a 38% reduction of coral cover over all monitored reefs. As predicted, potential coral reef refugia in deep water (~90 m) adjacent to cooler ocean water did not suffer substantial bleaching (27% prevalence). However, they did experience high prevalence of white syndrome (7%) and loss of coral cover (~22%). This suggests strong, but unobvious, stress on potentially naïve corals or the possibility of the spread of disease from shallow coral populations. Deep reefs may only be a partial refuge from the escalating impacts of increasing tropical SST.

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SOUTHERN OCEAN PIGMENTS AND PRIMARY PRODUCTIVITY IN THE SEAWIFS AGE

Sea ice in the Southern Ocean is a major influence on phytoplankton productivity and growth. We used SeaWIFS phytoplankton biomass, PAR and cloud cover data, SIM1 and AATSR sea-ice surface temperature data, in combination with a vertically integrated model, to estimate primary productivity south of 60°S. We found substantial interannual variability in productivity from 1997 - 2005, and this appeared to be driven in part by ice dynamics. The most productive regions of Antarctic waters were the continental shelves, and no large, sustained blooms occurred in waters > 1.000 m. We suggest that this is due to the slightly greater mixed layer depths found in waters off the continental shelf, and that the interactive effects of iron and irradiance result in the limitation of phytoplankton. Annual productivity south of 60°S averaged 23.7 g C m-2 y-1, but yearly means between 1998 and 2004 ranged from 22.1 - 25.5 g C m-2 d-1. Annual primary productivity over the entire Southern Ocean has increased since 1998, and was driven by changes in January and February. Causes for this trend are unclear.

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SLENDER SOLE AS BENTHIC ECOSYSTEM ENGINEERS IN SAAINCH INLET, BRITISH COLUMBIA, CANADA

The muddy seafloor at the VENUS Cabled Observatory in Saanich Inlet, British Columbia, supports high densities of the flatfish known as the Slender Sole. In this study, we tested the hypothesis that Slender Sole are potential agents of disturbance for sedimentary fauna. To test their role as ecosystem engineers, we deployed replicate fish exclusion cages (1-m diameter, 15-cm high) at 92 m depth, and sampled macrofauna inside and outside of cages during deployment in May and ~7 months later. Partial cages were also deployed to test for caging artifacts. Macrofaunal composition and abundance of sediment were similar during both sampling periods, however, faunal composition differed and abundances were significantly higher in full exclusion cages than in ambient sediments or partial cages. Nearby VENUS video records reveal continual sediment disrup-
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SATELLITE OCEAN DATA VISUALIZATION AND MODELS FOR CLASSROOM EXPLORATION

The NASA-sponsored Ocean Motion website (http://www.oceanmotion.org) documents human kind’s experiences, observations and investigations of ocean surface currents. In addition to the information, resources posted on the website, there are also investigations that lead high school teachers and students to explore patterns and relationships through ocean observation data products with an emphasis on OSCAR (ocean surface current analysis - real time). These data products include color-coded maps, time series graphs and data tables. The investigations are done through an interactive browser interface that provides easy access to a wealth of ocean data. This talk focuses on the use of ocean surface current data and models in classroom tested student investigations. The formal education classroom ready investigations are integrated with existing science curriculum and provide application of basic science principles. Video interviews with oceanographers are positioned in the investigations to illustrate their research and the science topic under investigation. Themes of exploration and adventure tie investigations of patterns in ocean data to human endeavors of the past and future. This connection enriches the content and engages students.

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PATTERNS OF PCB DISTRIBUTION IN BIOTA OF PENSACOLA BAY, FL

A spill of Polychlorinated biphenyls (PCBs) was discovered in 1969 in the Escambia River leading to Escambia Bay, Pensacola Bay system, FL. Sediment analyses in 1990’s demonstrated the persistence of these compounds in the Bay. Other areas of known PCB contamination exist in the urban bayous of the system. We have conducted a multiyear screening study for PCBs in harvested biota in the Bay area, including oysters, crabs, croaker, spotted seatrout, red drum, striped mullet, and other finfish. The goal of the study was to assess the safety of these harvested species for human consumption. Results of the work have prompted the State of Florida Department of Health to issue a fish consumption advisory for largemouth bass and mullet from the Escambia River, where muscle tissue samples exceeded 50 Åg kg-1 PCBs. The data also provide some interesting insights into ecological aspects of some of these species, especially with regard to spatial patterns of biota contamination, age and contaminant accumulation models, and accumulation as a function of trophic status. Some species like mullet may have relatively high site fidelity in the estuary, despite an extensive annual spawning migration, and accumulate high levels of PCBs despite a relatively low trophic status. For spotted seatrout, accumulation of PCBs and mercury follow different trends, suggesting contamination dynamics may be species and contaminant specific.

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MONITORING THE STORM TIDE OF HURRICANE WILMA IN SOUTHWESTERN FLORIDA, OCTOBER 2005

Temporary monitoring stations employing non-vented pressure transducers were used to augment an existing U.S. Geological Survey coastal monitoring network to document the storm tide of Hurricane Wilma. On October 22, 2005, an experimental network consisting of 30 temporary stations was deployed over 145 kilometers of coastline to record the magnitude, extent, and timing of hurricane storm tide and coastal flooding. Sensors were programmed to record time, temperature, and barometric or water pressure. Water pressure was adjusted for changes in barometric pressure and salinity, and then converted to depth of water above the sensor. Elevation surveys using optical levels were conducted to reference storm tide water-level data to the North American Vertical Datum of 1988 (NAVD 88). Storm tide water levels more than 1.5 meters above NAVD 88 were recorded by sensors at several locations along the southwestern Florida coast. Temporary storm tide monitoring stations have demonstrated their value by allowing the U.S. Geological Survey to extend the scope of data collection beyond that of existing networks, and serving as backup data collection to existing monitoring stations.

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NITROGEN FIXATION IN THE NORTH PACIFIC OCEAN: RATE MEASUREMENTS AND SPATIAL VARIATION IN SPECIES SPECIFIC ACTIVITY

Nitrogen fixation is an important contributor to export production in the North Pacific Ocean, as evidenced by seasonally low d15N of sinking organic nitrogen at the Hawaii Time-series station. However, relatively few nitrogen fixation measurements exist in the North Pacific. On two cruises there in fall 2002 and summer 2003, the abundance and nitrogen fixation rate of Trichodesmium spp. and bulk water sampled were measured. Trichodesmium spp. was only detected by our methods in the area near the Hawaiian Islands, in similar densities on both cruises. Despite similar densities, the areal nitrogen fixation rate of Trichodesmium spp. in fall 2002 was nearly four times greater than in summer 2003 at stations it occurred. Near the dateline, where Trichodesmium spp. was not present, the areal water nitrogen fixation rates were relatively high (≈100 micromol N m-2 d-1). Presumably uncellular diazotrophs were responsible for activity there. We hypothesize that higher dissolved iron concentrations near the Hawaiian Islands allow Trichodesmium spp. to grow there, whereas uncellular diazotrophs can be active in the central North Pacific at d15N concentrations as low as 0.1 nm.

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INTERMEDIATE CIRCULATION IN THE NORWEGIAN SEA

To study the movement of Arctic Intermediate Waters (AIW) around the Norwegian Sea we deployed 26 isobaric RAFOS floats across the northern slope of the Iceland-Faeroe Ridge. In recent times these waters have increasingly been replacing the Greenland Water in the central Norwegian Sea, to the point where it may be possible to study this water mass in situ to a depth of 3000m. AIW are characterized by lower salinity, higher temperature, low oxygen content, high pH and high heat content. A unique feature of AIW is their high chlorinity, an unprecedented characteristic for a deep water mass. The deep chlorinity is created in the Norwegian Sea by the meridional heat transport through the Denmark Strait Overflow Water (DSONW) and the Arctic Intermediate Water (AIW). The floats moved passively with the current, but did not move along isopycnals. Most of the floats were moved north. The floats were programmed to record time, temperature, and barometric or water pressure. Water pressure was adjusted for changes in barometric pressure and salinity, and then converted to depth of water above the sensor. Elevation surveys using optical levels were conducted to reference storm tide water-level data to the North American Vertical Datum of 1988 (NAVD 88). Storm tide water levels more than 1.5 meters above NAVD 88 were recorded by sensors at several locations along the southwestern Florida coast. Temporary storm tide monitoring stations have demonstrated their value by allowing the U.S. Geological Survey to extend the scope of data collection beyond that of existing networks, and serving as backup data collection to existing monitoring stations.

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STUDY OF POTENTIAL EFFECTS OF CLIMATE CHANGE ON THE ECOSYSTEMS OF TEMPERATE SEAS: THE ALBORAN SEA CASE

We study the inter-annual variability of the circulation in the Alboran Sea and its exchanges with surrounding sub-basins from the Western Mediterranean in the frame of SESAME project. We use ROMS forced by a 40 years re-analysis and MFS boundary conditions to identify global change scenarios and for each one, we study the adjustment processes between Modified Atlantic Water (MAW, S < 36) and denser Mediterranean Water (MW, S>37), in particular in the Eastern Alboran area where the Almeria-Oran front is a major dynamical boundary (1.5 sigma + difference) also characterised by a sig- nificant variability. We analyze the dynamical relevance of mesoscale and sub-mesoscale eddies in the different sub-basins, their relation to enhancing or blocking the north/south energy exchanges between sub-basins and the effects on the ecosystem variability using ROMS NPZD model. We also present first results obtained on the impacts of this variability on fisheries using NEMURO coupled to ROMS.

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CETACEAN HABITAT MODELING IN THE CALIFORNIA CURRENT SYSTEM

Cetaceans, as top predators in the oceans, can be viewed as indicators of changing oceanographic conditions over annual and decadal time-scales. The physical, chemical and biological environment of the California Current System is spatially and temporally heterogeneous and cetaceans respond to these variations. Cetacean spatial and temporal presence suggests the presence of specific environmental conditions required for their survival which are often related to prey availability, predator avoidance or reproductive needs. Using autonomous High-frequency Acoustic Recording Packages (HARPs), we monitor occurrence of cetacean species at a variety of locations throughout the Southern California Bight with high temporal resolution. Incorporating frontal and near-surface oceanic glider and satellite data collected under CCE-LETTER, we developed generalized likelihood models of dolphin occurrence with respect to oceanographic variables to test hypotheses about the environmental conditions that are important for describing their habitat and likelihood of occurrence. Knowledge of preferred dolphin habitat conditions can be used to predict dolphin occurrence over a heterogeneous oceanic system and conversely presence or absence of dolphins at a given time and location may be used to describe the changing oceanographic environment.
Our results are consistent with previous studies in the area. The response of the carbonate than during the second (projected using data from Dec 06–Apr 07; -1.44 mol C/m²). Integrated net annual flux was greater during the first year (-1.24 mol C/m²) to control on primary productivity and impacts local carbon cycling. In addition to variability in change. Rainfall generates pulses of nutrient- and sediment-rich water, exerts strong con...Local climatic forcing in S. Kaneohe Bay, Oahu, affects its biogeochemistry and gas exchange. Phytoplankton productivity and air-sea exchange of CO₂ in southern Kaneohe Bay, Hawaii...Local climatic forcing in S. Kaneohe Bay, Oahu, affects its biogeochemistry and gas exchange. Phytoplankton productivity and air-sea exchange of CO₂ in southern Kaneohe Bay, Hawaii...Sediment accumulation rates in Manila Bay, a marine pollution hot spot in the seas of east Asia...Sediment accumulation rates in Manila Bay, a marine pollution hot spot in the seas of east Asia...Warming affects impact of the invasive ctenophore Mnemiopsis leidyi by increasing interaction strength at intermediate trophic levels...Warming affects impact of the invasive ctenophore Mnemiopsis leidyi by increasing interaction strength at intermediate trophic levels...Sediment accumulation rates in Manila Bay, a marine pollution hot spot in the seas of east Asia...Sediment accumulation rates in Manila Bay, a marine pollution hot spot in the seas of east Asia...Warming affects impact of the invasive ctenophore Mnemiopsis leidyi by increasing interaction strength at intermediate trophic levels...Warming affects impact of the invasive ctenophore Mnemiopsis leidyi by increasing interaction strength at intermediate trophic levels...
variable fractal dimension instead of fixed one adopted previously is utilized here. For breakup, similar concept is adopted in a more empirical manner because breakup is too abrupt to entirely apply variable fractal dimension. New flocculation model using variable fractal dimension shows a reasonable agreement with experiment results in terms of equilibrium floc size. However, the prediction on temporal evolution of floc size requires further investigation. The flocculation model is coupled into a numerical model for fluid mud transport (Hsu et al. 2007, J. Geophys. Res., 112). The numerical model calculates turbulence quantities with a k-epsilon closure, which are then used to calculate flocculation process. Preliminary results for the effects of flocculation on fluid mud transport in tidal/wave boundary layer are presented.

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REMOTE SENSING FOR TSUNAMI RESEARCH AND EARLY WARNING

The key to successful tsunami prediction for saving lives and property during tsunami emergencies lies in the early detection of tsunami generation and its propagation patterns. According to the conventional theory, tsunamis are formed by the vertical deformation of the seafloor during undersea earthquakes. However, numerous false alarms and historical failures in predicting tsunami height indicate that this ubiquitous theory has yet to function effectively. In this talk, I will first show evidence—based on radar altimeter data, GPS displacement measurements and satellite-inferred gravity changes—that the momentum transferred by the horizontal motions of continental slopes is likely the missing force in the conventional tsunami theory. The tsunami propagation patterns are apparently controlled by the horizontal slope motions with asymmetric features with both leading elevation waves and depression waves, and are best explained by the horizontally-forced mechanism. I will then demonstrate how remote sensing in conjunction with the modified theory can be used to detect tsunami genesis and scales for operationally warnings.

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THE ESTABLISHMENT OF THE ATMOSPHERE-WAVE-OCEAN CIRCULATION COUPLED NUMERICAL MODEL BASED ON CCSM3

There are several common problems of the coupled ocean-atmosphere general circulation models (CGCMs) without flux correction, such as too cold tongue, reversed zonal SST gradient in equatorial Atlantic, semi-annual cycle in the eastern tropical Pacific. The causes are not well understood yet. One possible reason maybe is the inaccurate reconfi guration of the lower layer and thermocline structure due to the insufficiency of lateral mixing in the OGCM. It is believed that the wave-induced vertical mixing can greatly improve the simulation of the MLD and thermocline. Based on the surface wave-circulation coupled theory, an atmosphere-wave-ocean circulation coupled numerical model was established, which incorporates the MAXNUM wave number spectral model and the coupled ocean-atmosphere general circulation model, CCSM3. The model reveals that the model with wave-induced mixing could simulate the climate system much better than the original CCSM3, such as the improvements on too cold tongue in tropical Pacific, SST deviation in tropical Atlantic and annual cycle in eastern tropical Pacific. The analysis shows that the wave plays a key role in the climate systems. It is suggested that wave-induced mixing improve the performance of climate models on tropical bias. The wave-induced mixing is critically important for climate research and the improvement of the climate system coupled model.

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OBSERVATIONS OF WINDabile FLOW CYTOMETRY FOR TIME SERIES OBSERVATIONS OF PHYTOPLANKTON COMMUNITY DYNAMICS

Better understanding of many aspects of plankton ecology requires long term, high frequency observations of community structure, which traditional sampling techniques cannot provide. To meet this challenge, we have developed a series of automated submersible flow cytometers for analysis of phytoplankton. The newest development, Imaging FlowCytobot, includes cell imaging capabilities for microplankton. When combined with automated image analysis and classifi cation, this instrument provides unprecedented time series of community structure with taxonomic resolution (often to genus or even species level). Like its predecessors, Imaging FlowCytobot carries out automated standard analysis and anti-fouling procedures, and it has proven capable of 6-month uninterrupted deployment at the Martha’s Vineyard Coastal Observatory, a cable facility on the New England shelf. We document these capabilities with detailed observations of wintertime diatom blooms measured in 2007. The bloom dynamics are complex with multiple event scales fluctuations in diatom abundance and taxonomic composition over several months. Shifts in dominant genus are evident as the season progresses. Multi-year time series of this type will be key to understanding the regulation of these fluctuations and their response to environmental change.

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IMPLICATIONS FOR ORGANIC MATTER PRESERVATION

NON-COMPETITIVE INHIBITION ON EXTRACELLULAR ENZYMES AND ORGANIC MATTER CYCLING IN COASTAL SEDIMENTS: THE IMPACT OF VARIABLE FRAC TAL DIMENSION

As proxies for the hydrolysis of polysaccharides and proteins, the potential activities of \&\beta-glucosidase and leucine-aminopeptidase were measured with fluorogenic substrates in sediments of Aransas Bay, TX. Both enzymes had maximum surface activities with higher

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LAND-REEF AND REEF-REEF CONNECTIVITY IN MESO-AMERICA INFERRED FROM SATELLITE OCEAN COLOR OBSERVATIONS DURING 1998-2006

Weekly time series of Sea-viewing Wide Field-of-view Sensor satellite ocean color images acquired from 1998 to 2006 were used to determine connectivity patterns between land and reefs, and among reefs in the Mesoamerican Barrier Reef System (MBRS). A connectivity matrix was constructed for seventeen domains that cover major reefs in the MBRS and islands off the north coast of Honduras and Nicaragua. Ocean color images were carefully examined, and spatial connections between domains were recorded. The weekly time series of 466 images provided not only a clear view of seasonal distributions of the connectivity patterns, but also evolutions of estuarine plumes and transitions in the aftermaths of major perturbations like hurricanes in the MBRS. For example, river plumes from eastern Honduras reached as far as Chinchorro and Cozumel in Mexico. These results bring new products to be used in quantitatively reassessing long term connectivity in the region and validating fields produced by other modern approaches based on numerical modeling.

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WIND WAVES AND SEDIMENT DYNAMICS IN THE INTERTIDAL MUFLATS OF THE ARACOHN LAGOON (FRENCH ATLANTIC COAST)

In intertidal areas protected from oceanic swell, wind waves can play a key role on sedi ment dynamics, as they can be the only forcing able to generate significant erosion. The Arcachon lagoon is a mesotidal lagoon of the french atlantic coast. 74% of its total area is occupied by intertidal flats. There is little knowledge on the effect of wind on local waves. There is also poor evidence on sedimentary balance, excepted for bathymetric charts showing secular trends of accretion of the order of 10 cm/century. Field experiments were carried out in the Arcachon lagoon in order to characterize wind waves and subsequent sediment transport. Ultrasonic altimeters, ADV velocimeters and OBS turbidimeters were deployed over two months during the winter of 2007. Collected data showed that the surface winds higher than 8 ms^{-1} can generate wind waves of more than 10 cm high. They also gave evidence of an increase of the wave height when tidal currents and wind are in the same direction. In terms of sedimentary forcing, bottom shear stress generated by wind waves is 10 times higher than shear stress generated by tidal currents. Altimeters recorded an erosion of the muddy bed of 1 cm caused by wind waves of a significant height of 40 cm. In the absence of wind, stabilisation occurs and the mudflat tends to recover its initial altitude. These results confirm that in these sheltered mudflats, erosive action of wind waves is effective as an opposite factor to the tidal action.

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CO-OCCURRENCE OF PHOTOSYNTHETIC AND NITRIFYING COMMUNITIES IN CARIBBEAN SPONGES: IMPLICATIONS FOR MICROBIAL INTERACTIONS AND NUTRIENT CYCLING

We investigated the occurrence of nitrifying and photosynthetic microbial communities in sponges on Conch Reef, Florida, USA. Results from DIN flux measurements, chemical inhibition, and 15N tracer experiments with Caribbean sponges show that 12 of 18 species tested hosted nitrification. Of those 12 species, 9 also contained elevated photosynthetic pigments in their outer tissue, indicating photosynthetic microbial associates. Profiles of oxygen concentrations indicated extremely hypoxic tissues in many of the 12 species, a condition that could limit nitrification. Under hypoxic conditions photosynthesis in the outer tissue may partially alleviate oxygen limitation and enhance nitrification rates. Conversely, if ammonia is limiting, then ammonium assimilation by photoautotrophs may decrease nitrification rates. The number of sponge species hosting nitrification and photosynthesis suggest that these processes are important aspects of sponge metabolism. However, little is known about nitrifiers regarding the metabolic exchanges with the host, or with other members of the microbial community. These interactions may be important for sponge nutrition, and they may also mediate the considerable flux of dissolved inorganic nitrogen released by sponges.

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ORGANIC MATTER CYCLING IN COASTAL SEDIMENTS: THE IMPACT OF NON-COMPETITIVE INHIBITION ON EXTRACELLULAR ENZYMES AND IMPLICATIONS FOR ORGANIC MATTER PRESERVATION

A critical step during organic matter remineralization is the transformation of particulate organic matter into dissolved components by extracellular hydrolytic enzymes. As proxies for the hydrolysis of polysaccharides and proteins, the potential activities of k\&\beta-glucosidase and leucine-aminopeptidase were measured with fluorogenic substrates in sediments of Aransas Bay, TX. Both enzymes had maximum surface activities with higher

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leucine–aminopeptidase activities than &beta;-glucosidase throughout the sediment. Non-competitive inhibition reduced maximum enzyme activity by 50%, lengthening substrate turnover time by > 200%. To explore potential non-competitive inhibitors, poly

phr col on the downwelling limb of the thermohaline circulation forced by sur

in-situ particle size and volume concentration data has been used to derive information cal backscatter (ABS and OBS, respectively) instruments along with bottle samples and pension can provide a pathway for nutrients and contaminants to be brought up to the be a dominant source of particles during summer low flow river conditions. This resus

Spahn, E. Y.

Vessel data collected by the RISE (River Influences on Shelf Ecosystems) project, which

CHAnnel Relocatable Mooring (25 m), Southern California Coastal Ocean Observing systems where we have tested various real-time data telemetry technologies: Santa Barbara

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REAL-TIME TELEMETRY TECHNOLOGIES FOR MOORED OCEANOGRAPHIC APPLICATIONS

Long term, sustained oceanographic data collected from moorings capture a broad range of oceanic variability and provide important information concerning episodic and periodic processes ranging in time scales from minutes to decades. The high resolution data are most useful when they are provided in real-time. Real-time data allow scien-

tists and other users to detect important events when they occur in order to, e.g., contact authori-
ties to issue beach closure or shellfish consumption warnings or begin adaptive sampling to better understand ocean processes. We present three different moored sys-
tems where we have tested various real-time data telemetry technologies: Santa Barbara

STABLE III is equipped amongst other things with 3 ADVs and three fast Sampling CT

m, where quarter-diurnal tidal TKE production is evident; there is also indirect evidence they control the exchange of momentum, density and SPM. We have deployed a third gen-

sive interactions. The intensity and location of the upper overturning cell in the Southern Ocean is uncer

The intensity and location of the lower overturning cell, and it is found that horizontal buoyancy mixing plays a major role in determining the cell structure. The analysis is presented and compared with existing data. Chloroplasts were isolated us-
ing nitrogen decomposition and density gradient centrifugation. The spectroscopy models used are based on well established light absorption and scattering theories. Absorption and scattering properties of K. brevis and its chloroplast, such as chemical and physical characteristics, are shown to predict the spectral features observed in the measured spec-
tra. Parameters applied to the interpretation model are established from reported litera-
ture, experimental culture data, and pigment standards. Measured and theoretical spectra are compared to determine the adequacy of the model and to establish multilwavelength spectroscopy as a new detection method for K. brevis.

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REAL-TIME TELEMETRY TECHNOLOGIES FOR K. BREVIS CHLOROPLASTS ON ITS SPECTRAL FINGERPRINT

Hydrodynamic numerical model is used to demonstrate that the downwelling is concentrated in narrow boundary layers that are much thinner than the internal deformation radius. Spear, A. H., University of South Florida, St. Petersburg, USA, aspeear@marine.usf.edu; Huffman, D., University of South Florida, St. Petersburg, USA, dhuffman@marine.usf.edu; Garcia-Rubio, L. H., University of South Florida, St. Petersburg, USA, garcia@marine.usf.edu

The USE OF MULTIWAVELENGTH SPECTROSCOPY FOR THE SPECTRAL CHARACTERIZATION OF KARENIA BREVIS AND THE INFLUENCE OF CHLOROPLASTS ON ITS SPECTRAL FINGERPRINT

Multilwavelength spectroscopy is a rapid analytical technique that can be utilized to detect, identify, and quantify microorganisms such as the red-tide dinoflagellate, Karenia brevis. Preliminary analysis of measured UV-Vis spectra of K. brevis suggests that chloroplasts have the most significant contribution to the total optical density. This research will report on experimental and theoretical analysis of isolated chloroplasts from K. brevis and on the evaluation of their spectral characteristics. The spectral interpretation model resulting from the analysis is presented and compared with existing data. Chloroplasts were isolated us-

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UV-B TOLERANCE OF TWO ANTARCTIC HETEROTROPHIC PROTISTS, THE CILIATE URONEMA MARINUM AND NANOFLAGELLATE PARAPHYSOMONAS IMPERFORATA

Biologically harmful ultraviolet-B (UVB) radiation is increasing during austral spring in Antarctic waters due to seasonal ozone loss. Many organisms have known photoenzymat-

ic repair (PER) ability that offsets UV-B induced DNA damage in the presence of a photo-
terapire view (PBR), 320-700 nm). Photosynthetic, which are important links in aquatic food webs, have varying PER abilities and sensitivity to UV radiation. We determined the UVB tolerance of the ciliate, Uronema marinum, and the heterotrophic nanoflagellate, Paraphysomonas imperforata. Paraphysomonas imperforata with and without UV acclimation and in the presence and absence of PBR. Both species, isolated from the Ross Sea, were sensitive to UVB radiation as demonstrated by decreasing abundance after UVB exposure. Acclimation to low levels of UVB and UVA radiation increased resistance of both species to higher levels of UVB exposure. However, removal of PBR did not significantly alter maximum abundances with or without acclimation, indicating that neither species uses PER to repair UV-B induced DNA damage. We suggest that sensitivity to UV radiation may, in part, prevent these species from reaching high abundance during austral spring, which has implications for microbial trophic interactions.

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THE UPPER CELL OF THE SOUTHERN OCEAN

The intensity and location of the upper overturning cell in the Southern Ocean is uncertain, especially when the cell is associated with subduction centered on the Subantarctic Front or the Polar Front. New eddy diffusivity estimates are used to revise the main balances of the 2-d overturning cell, and it is found that horizontal buoyancy mixing plays a non-

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QUANTIFYING PARTICLE TRANSPORT IN THE COLUMBIA RIVER PLUME

Vessel data collected by the RISE (River Influences on Shelf Ecosystems) project, which sampled the Columbia River plume, have been used to analyze plume-related particle transport. High resolution data show a source of particles in addition to that discharged with the river. Specifically, we find that tidally forced particle resuspension occurs and can be a dominant source of particles during summer low flow river conditions. This resus-

pension can provide a pathway for nutrients and contaminants to be brought up to the surface and thereby impact the coastal ecosystem. A combination of acoustic and optical backscatter (ABS and OBS, respectively) instruments along with bottle samples and in-situ particle size and volume concentration data has been used to derive information about the particle field. ABS is more sensitive to larger particles, whereas the OBS is more sensitive to smaller particles. By using bottle samples and particle size and volume concent-

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ON THE DOWNWELLING LIMB OF THE THERMOHALINE CIRCULATION

This talk focuses on the downwelling limb of the thermohaline circulation forced by sur-

face buoyancy loss. Downwelling in this context refers to net vertical motion, not water mass transformation. Buoyancy-forced convection in the basin interior is contrasted with convection in strong boundary currents. The influences of horizontal advection and lateral boundaries on the location, structure, and magnitude of downwelling are discussed. A non-

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TURBULENCE PROCESSES IN A MACROTIDAL ESTUARY.

Turbulence processes are important for the vertical transport in estuaries and shelf seas; they control the exchange of momentum, density and SPM. We have deployed a third gen-

eration Sediments Transport And Boundary Layer Equipment (STABLE III) at the mouth of the Dee Estuary, a macrotidal estuary in the Irish Sea with tidal range of the order of 10 m, where quarter-diurnal tidal TKE production is evident; there is also indirect evidence that forced convection from the converging part of tidal straining might be important. STABLE III is equipped amongst other things with 3 ADVs and three fast Sampling CT systems, which will allow us for the first time to calculate the full evolution of Turbulent Kinetic Energy (TKE) in the bottom one meter of the water column, e.g. total TKE, pro-
duction, dissipation and buoyancy turbulent fluxes. These in conjunction with an ADCP which measures the production and dissipation for the rest of the water column will allow us to understand how turbulence behaves in estuaries and discern any the effects from tidal straining convection and forced convection.

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an important role near the main fronts of the ACC. The new estimate of kapa allow us to also revisit the estimate of the eddy induced advection through the parametrization of Gent and McWilliam (1990). Below the mixed layer, we find a convergence of the 2-d upper cell centered on the Polar Front. However, we have also shown that one can get a large range of results when working within the 2-d framework. Eddy diffusivity in the Southern Ocean has been estimated from several approaches in order to quantify the role of eddies on mixed layer heat and mass budgets, and to get the role of eddies on the upper cell of the meridional overturning circulation. Estimates were made with surface drifters. The pattern and the order of magnitude of kapa is compared to other studies. We consider the upper cell in a 3-d framework, unveiling strong inhomogeneities of the upper cell convergence. We estimate a proxy of the convergence by computing a budget of transport in the mixed layer based on observational data and mixed layer parameterizations.

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MORE THAN A PIPELINE: COLLABORATIVE STRATEGIES KEY FOR A MORE DIVERSE WORKFORCE

The ocean sciences community is challenged to achieve a diverse and highly trained workforce for the future. Programs that target youth, teachers, science educators, and scientific writers need to go beyond the end-of-the-loop—not a pipeline, which reinforcing research and documents on diversity and science. Support for research in the ocean sciences demands an ocean literate public. The Centers for Ocean Sciences Education Excellence, funded in large part by the NSF, is charged with providing and promoting model programs leading to increased diversity in the ocean sciences workforce. This proposal focuses on how COSEE England and COSEE New England used an aquarium to attract, convert, and retain students from underrepresented populations to ocean themes and careers. The goal is to develop a model for other informal institutions. COSEE Southeast has integrated multicultural pedagogical methods into professional development programs designed for teachers with ethnically diverse student populations. Key strategies include inclusive strategies in planning and partnerships, program design, recruitment, and retention.

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REDUCTION OF DIMETHYL SULFOXIDE BY MARINE PHYTOPLANKTON

Dimethyl sulfoxide (DMSO) is a trace gas produced by marine algae that comprises nearly the entire ocean to atmosphere flux of reduced sulfur. Despite this large flux, the production and removal pathways of DMSO are poorly understood. The primary loss pathways of DMS in the ocean are often photolysis or microbial uptake to form, in part, dimethyl sulfide (DMSO), a potential antioxidant compound. A potential pathway for DMSO removal is biogenic reduction to DMS, which has been documented in a number of organisms, most notably bacteria. We present the first detailed study of DMSO reduction by marine phytoplankton in axenic cultures. Reduction of DMSO was observed in three algal classes, with in vivo rates ranging from 0.256-3.85 fmol/cell/day at 1 mM DMSO. Michaels-Menten kinetic parameters (K_m and V_max) were estimated for three species, and the time course of DMSO reduction activity monitored. Enzyme affinities (K_I) for DMSO reduction were low with values between 0.373-2.36 mM. The ability of marine phytoplankton to reduce DMSO to DMS has implications for how algae utilize cellular DMS, particularly as part of an antioxidant system.

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RESOURCE AVAILABILITY, BIODIVERSITY, AND TROPIC STRUCTURE AFFECT NUTRIENT DYNAMICS IN AN EXPERIMENTAL SEAGRASS ECOSYSTEM

Coastal habitats are influenced by fluctuations in resource availability and biodiversity that affect ecosystem processes, such as productivity and nutrient cycling. Using eelgrass (Zostera marina) habitat as a model system, we assessed the influence of two common disturbances, eutrophication and predator removal, on nutrient dynamics. We manipulate food chain length (i.e. predator presence), invertebrate grazer richness and trophic levels to influence nutrient dynamics in marine sedimentary ecosystems. Spilster, K. D., Oregon State University, Corvallis, USA, kspilster@coas.oregonstate.edu; Holman, R. A., Oregon State University, Corvallis, USA, holman@coas.oregonstate.edu

The RELATIONSHIP BETWEEN 2D CIRCULATION AND SEDIMENT TRANSPORT DURING ONSHORE SANDBAR MIGRATION EVENTS

Sandbars, which act as natural buffers to the beach against wave action, move onshore and offshore in response to changing wave conditions. The transport processes associated with sandbar migration are complex and involve feedback mechanisms between the bar and the fluid forcing [Plant, et al., 2001]. Understanding the relationship between an existing sandbar and sediment transport of California that are induced by that bar is key to being able to predict the natural cycles of sandbar evolution. Plant et al. [2001] were able to invert changes in the alongshore averaged bathymetry to determine unique relationships between the existing bathymetry and sediment transport based on the cross-shore integration of the 1D continuity equation. Sandbars, however, are rarely 1D [Lippmann and Holman, 1994] and the extension of the bathymetry inversion method to 2D is not simple. The technique has two unknown variables (Qx, Qy) and one observable (depth change). A further constraint is needed in order to uniquely invert bathymetry into sediment transport patterns. Plant et al. [2006] found a strong link between alongshore variability of the bar and it’s position, suggesting 2DH circulation may be an important factor in sandbar migration. A 2DH wave-phase-averaged circulation model is used to examine the relationship between current velocities and local bathymetry gradients in order to define the relationship between Qx and Qy in the bathymetry inversion technique.

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EVALUATION OF THE REAL-TIME OCEAN FORECAST SYSTEM IN FLORIDA ATLANTIC COASTAL WATERS

The Real-Time Ocean Forecast System (RTOFS) is validated for the nearshore Atlantic coastal waters of southeast Florida. In situ data were collected as part of a summer undergraduate ocean cruise project conducted by the Florida Institute of Technology (FIT) Department of Marine and Environmental Systems (DMES) and includes ocean temperature, salinity, and current speed and direction. Data were collected in the vicinity of the western boundary of the Gulf Stream during early June 2007. RTOFS forecasts are compared to these data as well as buoy data provided by the National Data Buoy Center (NDBC). Insight from these comparisons provided a basis for further evaluation of RTOFS during Fall 2007 in terms of spatial and temporal biases.

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ENVIRONMENTAL INFLUENCES ON EARLY LIFE HISTORY TRAITS AND POPULATION CONNECTIVITY

Population connectivity of benthic marine organisms depends on larval transit through the ocean as well as successful settlement and survival of young recruits. Thus environmental and oceanographic processes have the potential to play a significant role in population connectivity through their influence on early life history traits such as larval and juvenile growth, pelagic larval duration (PLD), and size and condition at settlement. Examination of these traits in the common coral reef fish Thalassoma bifasciatum at two geographic locations reveals how contrasting oceanic conditions (periodic passage of low-salinity North Brazil Current rings near Barbados, West Indies, and seasonal water temperature variation in the Florida Keys) can lead to differences in early life history traits. Not only can such environmental conditions determine the length of time larvae have to disperse to suitable settlement habitats, but by influencing larval condition at settlement, the hydrodynamic environment experienced by larvae can also affect early survival of recruits.

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A NESTED MODEL OF THE OREGON COASTAL TRANSITION ZONE: SIMULATIONS AND COMPARISONS WITH OBSERVATIONS DURING THE 2001 UPWELLING SEASON

The Oregon Coastal Transition Zone (CTZ) extends several hundred kilometers offshore where shelf flows interact with the California Current. A limited-area model based on ROMS has been developed to study coastal circulation processes over the shelf and in the CTZ. The ~3 km resolution CTZ model obtains its initial and boundary conditions from a lower resolution (~9 km) regional circulation model of the California Current System (NCOM-CCS) and obtains its forcing from a regional atmospheric model (COAMPS). Nested model solutions during May through October 2001 are compared with extensive
in situ and remotely sensed observational data, primarily from the COAST program, to evaluate the impact of boundary and initial conditions. The best model solution skillfully hindcasts variability in shelf flows near 45N due to coastal trapped waves because the CTZ and atmospheric models resolve the strong wind forcing region south of Cape Blanco (43N). Also in that vicinity, the coastal jet separates and forms eddies which move westward, enhancing kinetic energy in a region extending 300 km offshore. The effect of this separation process on shelf/open ocean exchange is quantified.

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THE INDOONESIAN THROUGHFLOW IN THE OUTFLOW PASSAGES AS MEASURED BY INSTANT

A 3-year time series of flow through the 3 major outflow passages between the Indonesian Seas and the Indian Ocean is described based on direct moored measurements as part of the INSTANT program. The mean flow along the sill in all passages is towards the Indian Ocean except for a weak near-bottom inflow into the deep Timor Trench. Each passage has a distinct vertical shear profile and carries different components of the total Throughflow. While Lombok and Ombai Passes share similar variability at the intra-seasonal and seasonal timescales, Timor Passage is very different. The seasonal variability shows complex vertical phasing in all passages, likely reflecting the competing effects of local and remote forcing. Our preliminary record-long averaged transports for Lombok are 2.2 Sverdrups and for Ombai 3.3 Sverdrups and Timor 7.6 Sverdrups, giving a total 3-year outflow average of about 13 Sverdrups into the Indian Ocean.

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SUREZONE DRIFTER DISPERSION DURING THE HB06 EXPERIMENT

Nearshore waves and currents transport and mix runoff pollution that often drains directly into the surfzone. However, tracer dispersion in the surfzone is poorly understood. Rates of horizontal dispersion in the nearshore (within a few 100m of the shoreline, depths less than about 5m) are estimated using drifter observations obtained during the HB06 field experiment (Fall 2006) at Huntington Beach CA. A cross-shore transect of current meters and pressure sensors provide wave and current measurements. The bathymetry was surveyed repeatedly. GPS-tracked drifters released for several days on each of 5 days with different waves, currents and wind. Drifter trajectories and numerical simulations suggest that complex circulation features, including long-lived surfzone eddies and transient rip currents, contribute to mixing on spatial scales of 10-100m. Drifter dispersion statistics within and seawards of the surfzone, and on different days, will be compared and contrasted. The dependence of eddy diffusivities on waves and currents, and the mechanisms of dispersion (e.g. individual bores, shear waves) will be discussed. This work is supported by ONR, CA Seagrant, CA Coastal Conservancy, NOAA, and NSF.

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DEMONSTRATION AND COMPARISON OF SEQUENTIAL APPROACHES FOR ALTImETER DATA ASSIMILATION IN HYCOM

Several sequential assimilation schemes have been developed for HYCOM as part of the NOPP-sponsored HYCOM-GODAE project. These schemes differ primarily in their specification of the background error covariance matrices which is either prescribed empirically as in the multivariate optimal interpolation or generated from statistical analysis of model output as in the Ensemble Optimal Interpolation, Reduced Order Singular Evolutive Filter and the Reduced Order Information Filter. In these schemes, the downward projection of surface information depends on the nature of the background error covariance matrices and is either dynamical or statistical. In this work, the above mentioned data assimilation approaches are compared and evaluated by performing twin experiments assimilating synthetic altimeter data into a 1/12 degree resolution HYCOM configured for the Gulf of Mexico. The evaluation is performed by analyzing forecast and nowcast skill at two times of innovations and residuals and the general consistency of assimilative model solutions.

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THE RAPID CLIMATE CHANGE PROGRAMME (RAPID) – LATEST RESULTS AND FUTURE PLANS

In order to determine whether changes in the North Atlantic meridional overturning circulation (MOC – and so the thermohaline circulation, THC) are occurring, ring-dated deep water is being carried out to global warming, in 2004 the UK RAPID programme (working with US scientists) deployed observational arrays across 26.5E to and along the western margin of the basin. The continuous monitoring of the MOC allows its variability to be measured for the first time and possible changes to be determined. The data from the first year of deployment of the 26.5E array indicate that the MOC is highly variable. The initial results from the array along the western margin show the propagation of signals in the deep western boundary current (DWBC). The DWBC is part of the lower limb of the MOC / THC and the means by which changes further north in the Atlantic propagate south. In conjunction with these observational studies, modelling and analysis of satellite data is being carried out to improve understanding of the processes and mechanisms by which the MOC / THC may be changing. This paper describes latest results that have been obtained by the RAPID programme and describes plans for future work.

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SCIENCE MADE ACCESSIBLE - AN OVERVIEW OF THE SCHOOL OF ROCK

In 2005, teachers experienced a pilot professional development program at sea in the successful JORC School of Rock (SOR) expedition led by a team of research scientists and education specialists. In 2006 the vehicles and audiences are more diverse; this program has evolved to include more professional development at institutions and as part of a competitive NSF-funded program for enhancing undergraduate education. The success of the evolving SOR program stems from synergy which results when research scientists and educators pool their combined skills and resources to make scientific data accessible to classrooms from middle to graduate school levels. This synergy is mutually important to researchers and educators, such as climate change, tectonics, evolution, and geologic time, and the international and interdisciplinary nature of scientific investigation are developed into educational units by team leaders and participants. Exercises are anchored in fundamental practices and discoveries of scientific ocean drilling research programs. This authentic data approach teaches the classroom to original scientific research in a high impact way. An overview of the program evolution, pedagogy, and the products of the SOR will be presented.

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ENERGY DISSIPATION OF LARGE AMPLITUDE NONLINEAR WAVES IN THE SOUTH CHINA SEA

Data collected during recent field deployments in the South China Sea has been preliminarily analyzed, and reveals previously undocumented turbulence and dissipative properties of the large-amplitude internal waves generated in the Luzon passage. As previously documented in many studies, these waves propagate westward towards the continental shelves of China and Vietnam. In deep water, these waves are soliton-like depression anomalies in the thermocline, with vertical displacement amplitudes of order 100 m. The waves propagate with a coherent structure across most of the basin, breaking into trains of depression waves only after considerable shoaling, typically shoreward of the shelf break. However, our microstructure surveys found that turbulent kinetic energy dissipation rates were enhanced throughout the continental slope region, extending from the 1000-m isobath to the shelf break. Surprisingly, dissipation levels occurring in relatively deep water on the continental shelf were larger than those on the continental shelf. This is in contrast to coastal regions, such as the New Jersey shelf and Massachusetts Bay, where nonlinear waves are typically most dissipative in the shallow waters of the coastal zone. Our measurements suggest that the first-order closure of the energy budget for Luzon generated waves occurs primarily in water deeper than 100 m.

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CONTRIBUTION OF CALCIFICATION TO THE CARBON BUDGET IN THE GULF OF Maine

Ocean acidification is a global concern the effects of which will likely impact calcifying ecosystems in this region. In this work we examine the degree to which calcification and calcite dissolution are a control on the dissolved inorganic carbon (DIC) in Gulf of Maine surface waters. A knowledge base is needed against which to measure the impact of acidification on pelagic productivity. Estimates of DIC and calcium carbonate production are compared to primary production data. Such knowledge is necessary for a baseline against which we can measure the impacts of ocean acidification on ecosystems in this region. In this work we examine the degree to which calcification and calcite dissolution are a control on the dissolved inorganic carbon (DIC) in Gulf of Maine surface waters. A knowledge base is needed against which to measure the impact of acidification on pelagic productivity. Estimates of DIC in the Gulf of Maine have been inferred using a suite of TA and pCO2, Ca2+ and Sr2+ measurements. Assuming changes in TA are attributable to Ca2+ dynamics only, we estimate the contribution of calcite production and/or dissolution to the carbon budget. Our methods are applied to a Gulf of Maine dataset (2004-2007) to demonstrate seasonal variations that calcite dynamics impose on DIC2- stocks. Data from the NOAA-GOMECG cruise (2007) provides a broad-scale synopsis of spatial variations of DIC2-.
Finally, we use the basic framework to argue that the spatial variability of the divergence mediating vertical mixing is greater than that of the convergences, so that spatial variation in layer thickness or intensity will be governed by inhomogeneous mixing events created by local instabilities and turbulent patches.

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SPATIAL AND TEMPORAL INPUTS OF FRESHWATER AND SUBMARINE GROUNDWATER DISCHARGE TO A SUBTROPICAL ESTUARY USING GEOCHEMICAL TRACERS, BISCAYNE BAY, SOUTH FLORIDA

Biscayne Bay is a coastal estuary in Southeast Florida that historically has received significant quantities of fresh submarine groundwater discharge. Water management practices in the region have reduced these inputs. In an effort to differentiate the freshwater inputs to the bay, samples of precipitation, canal water, groundwater, and bay surface water, were collected from July 2004 to July 2006 and analyzed for salinity, stable isotopes of O, and H and Sr2+/Ca2+ ratios. These tracers were used in three mixing models and then combined to trace the magnitude and timing of the fresh water inputs to the estuary. The modeling results indicate rainfall dominating freshwater inputs in the wet season with the ratio of canal-precipitation-groundwater inputs of 30%-60%-10%, respectively. In the dry season canal inputs almost equal precipitation with the ratio of canal-precipitation-groundwater inputs changing to 40%-45%-15%, respectively. For a bay wide water budget that includes saltwater and freshwater mixing, fresh groundwater accounts for 2% of the total input. However, most groundwater inputs occur along the western shoreline of the bay, while precipitation dominates in the eastern portion of the bay.

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DETERMINING THE GEOSTROPHIC OCEAN CURRENTS AND EDDIES FROM NEXT GENERATION ALTIMETER MISSIONS.

Knowing ocean surface currents with high space-time resolution is of importance for many oceanographic applications. In the past, however, the direct determination of surface geostrophic currents from space-borne data was hampered since only along-track sea surface height data are available from a single satellite at its nadir foot print. This situation will potentially change with the advent of a wide-swath altimeter. This paper will discuss the need for velocity observations on space scale of the order of 10 km, will discuss necessary sampling scenarios and will review potential future applications of next-generation wide-swath altimeter data. The mission will be guided by understanding surface geostrophic currents as they emerge from the tandem TOPEX/JASON altimeter mission from which geostrophic surface velocities are available simultaneously in horizontal and meridional direction and with 10 km along-track resolution. Highlighted application will range from the seasonal and interannual variation of eddy kinetic energy, to seasonal changes of the flow field to statistical evaluations of the resulting flow field.

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A TIME-SERIES OF FIVE NOBLE GASES AND TRITIgenic HELIUM-3 AS TRACERS FOR BIOGEOCHEMICAL CYCLES

The five noble gases are biologically and chemically inert, have a wide range of solubilities and diffusivities, and thus respond differently to physical forcing. We present a time-series of the five noble gases and the isotope 3He, measured in the Sargasso Sea with monthly resolution at the Bermuda Atlantic Time-series Site (BATS). We combine the noble gas time-series data, hydrographic data, and a one-dimensional vertical mixed layer model (a modified Price-Weller-Pinkel model) in order to quantify air-sea gas exchange processes. We constrain the magnitude of diffusive gas exchange to ±6% and air injection processes to order ±15%. Additionally, the time-series of 3He, tritium, oxygen, argon, and nutrients is used to constrain upper ocean biological production. Specifically, we use the helium flux-gauge technique to estimate new production, apparent oxygen utilization rates to quantify export production, and euphotic zone oxygen cycles to determine net community production. The concurrent use of these three methods allows examination of the relationship between the types of production and begins to address some apparent inconsistencies in the elemental budgets of carbon, oxygen, and nitrogen.

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FIELD OBSERVATIONS OF A WAVE-FORCED, SUSPENDED MUD LUCITOLINE ON THE INNER SHELF

During the last week of a bottom boundary layer experiment at the Monterey Inner Shelf Observatory late in the 2006 summer, a suspended mud layer moved across the 12m deep observation site. Continuous 16 Hz sampled, 1cm vertical resolution measurements of the three component velocity field were made with a Biotaic Coherent Doppler Velocity and Sediment Profiler during the experiment, capturing the turbulent, wave and mean velocity structure spanning the suspended mud layer. A spectral analysis of the velocity structure up from the sandy bed during the advection of the mud layer reveals a deep, highly dissipative boundary layer across the 0(1cm) height of the lutocline. Enhanced
vertical velocities at the dominant surface gravity wave frequency with a phase lag of up to 60 degrees were observed on top of the mud layer relative to the free stream velocity. Comparisons with force-rafted luteline models will be made.

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NUMERICAL AND EXPERIMENTAL MODELLING OF THE INTERNAL TIDE NEAR A CONTINENTAL SLOPE

We have investigated the generation and nonlinear dynamics of the internal wave field resulting from the interaction of the barotropic tide with a continental slope (the so-called internal tide). A joint experimental and numerical approach is used for this purpose. Laboratory experiments were carried out on the Coriolis platform in Grenoble, France, while the finite-volume non-hydrostatic numerical code developed at MIT was used to closely model the experimental set-up. The configuration addressed in the present paper is that of a uniformly stratified fluid in a two-dimensional geometry (i.e. the fields do not depend upon the along-slope direction). In this simplified situation, the internal wave field organizes as a rectilinear wave beam with tidal frequency. We shall address the generation mechanism and structure of the wave beam, relying on theoretical modelling of internal wave emission by an oscillating cylinder. We shall also investigate the nonlinear dynamics of the tide, when harmonics are generated. Energy balance will eventually be considered along with the quantification of mixing induced by the internal tide.

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CONSERVATION GENETICS OF REEF CORALS AND GIANT CLAMS AT THE CENTER OF MARINE BIODIVERSITY

Climate change mediated sea surface temperature fluctuations can devastate coral reef communities by breaking down the delicate symbiosis between marine invertebrates and their endosymbiotic algae, Symbiossion. Recovery from this disassociation, or bleaching, depends on the adaptation or acclimatisation of surviving adults, in essence their ability to harbor more heat tolerant symbionts. Recovery is also dependent on the successful settlement of juveniles from unaffected reefs. We have undertaken genetic surveys in two highly endangered invertebrate taxa, specifically: Pocillopora sp. and giant clams (Tridacna), in one of the world's most biodiverse marine regions, West Papua, Indonesia. Significant variation exists in the spatial distribution of Symbiodinium communities among reefs. There are also significant differences between the genetic patterns of coral populations, which are highly connected by gene flow, and clams which show significant regional genetic structure. These data allow us to assess the impact of climate change on connectivity and coral reef recovery and give insight into the long term stability of coral reef populations in West Papua. These information are currently being applied to conservation management in the region.

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THE OSTIA MULTI-SENSOR, HIGH RESOLUTION SEA SURFACE TEMPERATURE ANALYSIS

The increased availability of high quality satellite measurements of sea surface temperature (SST) has made it feasible to create a near real time analysis combining multiple sensors. The Operational SST and Sea Ice Analysis (OSTIA) system has been developed at the Met Office to take advantage of these observations and is described in detail here. The output is a daily analysis with a resolution of 1/20° (~6km) combining an SST and sea ice concentration product, which is generated in near-real time. The analysis has been designed to meet the needs of applications requiring high-resolution space-time scales including global numerical weather prediction (NWP) and operational ocean models and to prepare for future high-resolution global and regional forecast systems. The analysis is now being used within the operational weather forecast model at the Met Office. Quality control, data filtering and dynamic bias correction within the OSTIA system allow the various contributing sensors to be combined into a homogeneous analysis. Results of validation and intercomparison will be presented, showing the accuracy of the OSTIA product.

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NATURAL ISLAND IRON FERTILISATION IN THE SOUTHERN OCEAN: COMPARISON OF IRON SOURCES AT CROZET AND KERGUÉLEN

The Kerguelen (KEOPS) and Crozet (CROZEX) studies collected data on Fe supply to surface waters around these islands and the resulting blooms. The KEOPS work focuses on vertical diffusion and advective supply from an isolated shallow plateau to the bloom zone above, whilst CROZEX considers the horizontal advection of iron away from the island system source as well as upwelling and atmospheric terms. Both studies show a significant supply of Fe to the upper water column and when light and macro nutrients allow, the observed bloom can develop. The underlying iron-delivery processes will be compared. Whilst overall a similar story emerges from both studies, many details in the processes involved are unclear (e.g. over winter build up of Fe, cycling of Fe and C in the upper water column and possible decoupling), and the potential impacts of these mechanisms are explored here.

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NOAA'S OPERATIONAL OCEAN COLOR PRODUCTS FROM THE COASTWATCH OKEANOS SYSTEM

NOAA generates near real-time operational ocean color products using the CoastWatch Okeanos system. CoastWatch ocean color products are used to determine the location, extent, and potential for development or movement of harmful algal blooms, and are accessed via the web or FTP. CoastWatch operational ocean color products are derived from the Okeanos system include daily mean chlorophyll a concentrations, remote sensing reflectances (Rrs) at 670 or 667 nm, and chl_a and Rrs anomalies from a 61-day mean. These products are generated in CoastWatch hierarchical data format (CW HDF) for continental U.S. coastal regions covering about one third of the globe. Okeanos processes ocean color data daily from a primary data source, SeaWiFS (Sea-Viewing Wide Field-of-View Sensor)/OrbView-2, and a backup data source, MODIS (Moderate Resolution Imaging Spectroradiometer)/Aqua. Ocean color data from MODIS/Terra are no longer processed, because ocean color products from this data source were not of sufficient quality to generate operationally. In 2008, NOAA plans to add the capability to process data daily from another ocean color sensor, MERIS (Medium Resolution Imaging Spectrometer)/Envisat, to mitigate the risk of losing either operational data source.

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DETERMINATION OF SUSPENDED QUARTZ AND AMORPHOUS SILICATE CONCENTRATIONS NON-DESTRUCTIVELY BY X-RAY DIFFRACTION

Determination of the silicon budget in the oceanic system involves accounting for particulate silicon dioxide: both quartz (crystalline) components from river input or sediment reus-}
and for parameterizing turbulence along the equator will be discussed. Equatorial stations of the TAO/TRITON array. Results will be compared with direct estimates of eddy viscosity of the EUC using an inverse model based on linear dynamics. The method is first which are an important driver of climate. The dynamics of the EUC are strongly constrained by current system. It feeds equatorial upwelling and affects variations in sea surface temperature, the Pacific Equatorial Undercurrent (EUC) is a key component of the complex equatorial

**ECOLOGICAL RELATIONSHIPS OF MARINE MICROBES DESCRIBED THROUGH INTERACTION NETWORKS AT THE SAN PEDRO CHANNEL, CALIFORNIA.**

Microorganisms are central to all global biogeochemical processes, but determining the ecological relationships among microbes in natural complex systems, like the sea, is a daunting task that has not been realized despite remarkable advances in this field. A systems biology approach was applied to data collected on community composition (genetic cultivation independent) of Bacteria, Archaea, Protists, and environmental parameters monthly over 3 years at the San Pedro Ocean Time Series, to show mathematical relationships among the microbes. Correlations lagged in time were found by a procedure called local similarity analysis. The resulting interaction network showed, for example, which organisms co-occurred with and without time lags, resembling a succession of microbial guilds that included different members of important groups like the SAR11 cluster and marine cyanobacteria. Negative correlations, perhaps suggesting competition or predation, were common. The networks we observed shared many features with other studied biological networks. Overall, this is a promising new approach that will not only facilitate inclusion of complex microbial assemblages in community ecology studies, but may also assist in determining biogeochemical roles of otherwise unknown microorganisms.

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**DEGRADATION RATES OF EXTRACELLULAR ENZYMES IN POLAR AND SUBTROPICAL SEAWATER: IMPLICATIONS FOR BIOAVAILABILITY OF HIGH MOLECULAR WEIGHT ORGANIC CARBON**

Heterotrophic microbes rely on extracellular enzymes to access high molecular weight organic matter. Degradation rates of these enzymes help to determine the amount of substrate a microbe can receive from the production of such an enzyme. We have assessed degradation rates of xylanase, alkaline phosphatase, and leucine aminopeptidase in arctic seawater (Kongsfjord, Svalbard), coastal subtropical seawater (coastal Gulf of Mexico), and open-ocean subtropical seawater (offshore Gulf of Mexico). We have also assessed the relative importance of photochemical reactions, thermal degradation, and hydrolysis of extracellular enzymes by microbial proteases in setting those degradation rates. Production of extracellular enzymes requires a substantial "investment" in carbon, energy and nutrients. Even when an enzyme substrate is present in the environment, enzyme degradation rates may determine whether that substrate can be "profitably" hydrolyzed using extracellular enzymes. Degradation rates of extracellular enzymes may therefore help explain the presence of semi-labile high molecular weight dissolved organic carbon, which may appear bioavailable based on chemical structure but nevertheless remain unconsumed by heterotrophs over a timescale of months to years.

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**ESTIMATING VERTICAL EDDY VISCOSETY IN THE PACIFIC EQUATORIAL UNDERCURRENT**

The Pacific Equatorial Undercurrent (EUC) is a key component of the complex equatorial current system. It feeds equatorial upwelling and affects variations in sea surface temperature, which are an important driver of climate. The dynamics of the EUC are strongly constrained by vertical turbulent mixing, for which there are few direct measurements in the equatorial Pacific. The goal of this study is to estimate seasonal to interannual time scale changes in the vertical eddy viscosity of the EUC using an inverse model based on linear dynamics. The method is first tested by comparing estimated and actual viscosity from an ocean general circulation model. These tests indicate that reasonably accurate estimates can be obtained in the high vertical shear zone above the EUC core. The method is then applied to long time series measurements at 4 equatorial stations of the TAO/TRITON array. Results will be compared with direct estimates of vertical viscosity from previous field programs. Implications for understanding EUC variability and for parameterizing turbulence along the equator will be discussed.

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**CYCLONE-ANTICYCLONE ASYMMETRY OF LARGE-SCALE ISLAND WAKE**

Large-scale flows are known to present a predominance of anticyclonic vortices. For oceanic island wake such asymmetry could occurs when the typical island size L becomes larger than an eddy deformation radius. We have found by means of laboratory experiments performed in a rotating shallow-water layer, that a large-scale wake could strongly differ from the classical Karman street. Indeed, in a frontal geostrophic regime, the Strouhal number strongly increases and could reach a value up to 0.6. Moreover, for some extreme cases, coherent cyclones do not emerge at all, and only an anticyclonic vortex street appears several wavelengths behind the cylinder. The reason is that when linear stability calculations and non-linear numerical simulations we have found a drastic change in the nature of the wake instability when the island size increase. In the classical quasi-geostrophic regime the wake flow is absolutely unstable while in the frontal regime (Re<<1 and R=Di the wake flow becomes convectively unstable. This changing nature of the wake instability explains both the evolution of the eddy-shedding frequency and the asymmetric vortex street pattern.

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**Ocean Acidification in the Arctic Over the 21st Century**

About a quarter of the anthropogenic CO2 emitted into the atmosphere is currently taken up by the ocean and modifies ocean pH and saturation states of sea water with respect to calcium carbonate minerals. We investigate the natural variability and projected future changes in pH and in the saturation state of the mineral aragonite using the NCAR carbon-bon-cyle climate model CM2.5-carbon and high (A2) and low (B1) CO2 SRES emission scenarios. The simulated seasonal variability of the aragonite saturation state is small at high latitudes and in the tropics. Deviations from the annual mean in the mid-latitudes of the Northern Hemisphere are as large as 15 to 20% of the mean. The annual mean global surface pH drops from 8.17 to 7.77 by year 2100 in the A2 scenario, with the largest changes found in the Arctic Ocean (reduction of up to 0.50 pH units). Surface waters in the Arctic are projected to become undersaturated with respect to aragonite by year 2040 AD. The impact of climate change on ocean acidification is small in most regions, except for the Arctic Ocean and parts of the North Atlantic.

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**A LONG-TERM INCREASE IN ZOOPLANKTON BIOMASS AT THE BERMUDA ATLANTIC TIME-SERIES STUDY (BATS) SITE IN THE SARGASSO SEA**

Changes in zooplankton biomass and species composition over long time scales can have dramatic effects on biogeochemical cycling and transfer of energy to higher trophic levels. We analyzed size-fractionated biomass of mesozooplankton (>200µm) from monthly day and night tows taken in the top 200 m at the Bermuda Atlantic Time-series Study (BATS) site in the oligotrophic North Atlantic subtropical gyre. Total mesozooplankton biomass has doubled over a 12-y period (1994-2006), with higher increases in some...
larger size fractions, and in the nighttime compared to daytime biomass. From 1990-2005 integration of zooplankton cladoceran and copepod biomass and primary productivity ~20%—both significant increases. The mechanisms driving the zooplankton biomass increase are not entirely clear; however, phytoplankton biomass increased most in fall and winter during periods of highest nutrient inputs. The increase in phytoplankton biomass is associated with increased pelagophyte nanoplanckton which may be a better food source for zooplankton than phytoplankton. We discuss these results in the context of long-term changes reported from other zooplankton time series, and the implications of these changes for biogeochemical cycling and food web dynamics.

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OBSERVATIONS OF A PLANKTONIC LAYER IN ITS PHYSICAL ENVIRONMENT
The vertical structure and evolution of a planktonic layer observed via in vivo fluorescence in the Gulf of Aqaba, Red Sea, is investigated in the context of local physical conditions: density stratification, shear, and turbulent mixing. The layer is located at approximately 30 m depth (in a 400 m water column), typically spans 5 - 15 m in vertical extent, and has a fluorescence signal as much as two times background levels. The layer feature persists for more than 10 hours in a 24 hour record. Preliminary analysis shows that the layer is located in a region of relatively strong density stratification (buoyancy frequencies of $10^{-5}$ s$^{-1}$) and low turbulence (diffusivity $(10^{-6}$ m$^2$ s$^{-1}$) inferred from coincident temperature microstructure measurements. Elevated diffusivity $(10^{-4}$ m$^2$ s$^{-1}$) associated with the deepening of the surface mixed layer may be tied to the dissipation of the layer. We consider the potential role of various mechanisms (including shear-induced straining and particle buoyancy) in maintaining the layer structure.

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CHARACTERISTICS OF CDOM ABSORPTION IN UV AND THEIR APPLICATION FOR THE ADVANCED IOP RETRIEVAL ALGORITHMS
Separation of CDOM and phytoplankton absorptions could be significantly improved if UV data are added to existing VIS - NIR satellite measurements. While current Ocean Color satellites like MODIS and MERIS have no UV bands, relationships connecting the UV reflectance together with VIS reflectance to IOPs can be used to construct useful inversion models. We therefore compare and relate field measurements of CDOM VIS absorption spectra in Georgia waters, Long Island Sound, Peconic Bay and NY Harbor using a WET Labs AC-S instrument with 0.2 nm filter with both VIS and UV absorption of collocated water samples measured using a spectrophotometer. Together with measurements of collocated reflectance spectra (in the VIS and UV) as well as measurements of VIS extinction and absorption spectra, [CHL] concentrations, organic and inorganic TSS components, these results are used to explore the impact of including UV data on the retrieval of IOPs and [CHL]. CDOM fluorescence excitation - emission matrices are also developed and compared for some Metropolitan NYC waters to variability and impact on reflectance spectra. Field results are complemented and supported by Hydrodynamics simulations using synthetic datasets for coastal waters.

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INVENTORY CHANGES OF ANTHROGENIC CARBON IN LABRADOR SEA WATER
Labrador Sea Water (LSW) is the most prominent mode water in the subpolar North Atlantic. It is also part of the deep branch of the Meridional Overturning Circulation. Labrador Sea Water is the most prominent mode water in the subpolar North Atlantic. It is also part of the deep branch of the Meridional Overturning Circulation.

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TAXON-SPECIFIC BIOGEOCHEMISTRY: THE SINGLE CELL APPROACH
The identification of predominant microbial taxa with specific metabolic capabilities remains one of the major challenges in environmental microbiology, due to the limits of current metagenomic and cell culturing methods. We used an alternative approach to address this problem, by direct analysis of multiple genes in individual microbial cells. Our protocol employs high-speed fluorescence-activated sorting of single cells, their whole genome multiple displacement amplification and subsequent PCR screening as well as genomic shotgun sequencing. We applied this methodology to generate single amplified genomes (SAGs) from individual prokaryote and protist cells collected from oceanic, coastal, and freshwater environments. Prokaryote SAGs were screened for phylogenetic markers (SSU rDNA) and for genes encoding biogeochemically significant enzymes (proteorhodopsins, bacteriochlorophylls, assimilative nitrate reductases, and nitrogenases). Prokaryote SAGs were analyzed for eukaryote and prokaryote SSU rDNA, providing information on taxa-specific protist feeding preferences. Partial genome assembly and annotation were performed on selected proteorhodopsin-containing Flavobacteria. Thus, single cell DNA analyses open possibilities for a wide range of taxon-specific and cultivability-unbiased microbial ecology and biogeochemistry studies.

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HIGH-MOLECULAR WEIGHT DOM CHARACTERISTICS ALONG THE CONTINUUM FROM RIVER TO RESERVOIR: A COMPARISON OF CHESAPEAKE BAY AND LAKE SUPERIOR TRANSACTS
Attempts to pin down the overarching characteristics of aquatic dissolved organic matter (DOM) often arrive at mere glimpses into its complex nature due to its inherent chemical heterogeneity and difficulties in isolating sufficient material. Still, sampling several locations along a continuum can infer how DOM changes throughout a watershed. Here we compare two transects traveling from terrestrially-dominated upper-river regions to reservo (a large lake and an ocean) characterized by more autochthonous DOM. The natural DOM samples from surface waters are separated into high and low molecular weight (HMW & LMW) classes using ultrafiltration. Mass balances of both classes using DOC and UV-Visible spectroscopic (UV-Vis) measurements indicate good recovery for sampled and freshwaters systems. The HMW fraction is further characterized using DOC, analysis, UV-Vis, Fourier Transform Infrared spectroscopy and Electro spray Ionization Mass Spectrometry. Data illustrate a shift from terrestrially dominated OM in riverine systems to compositionally different material in open waters. Freshwater and saline transect data indicate common underlying trends to OM characteristics as one moves from waters containing primarily terrestrial DOM toward those with more aquatic DOM sources.

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CONNECTIVITY AMONG RESTORED CRASSOSTREA VIRGINICA BARS IN THE SEVERN RIVER ESTUARY: IMPLICATIONS FOR OYSTER RECOVERY EFFORTS
In an effort to improve water quality and enhance the Crassostrea virginica fishery, many oyster restoration bars have been placed in Chesapeake Bay tributaries. Nevertheless, bars containing primarily terrestrial DOM toward those with more aquatic DOM sources.
Successful attachment of macrofuge propagules in the rocky intertidal zone requires that propagules actually arrive at the substrate (settlement). The analysis first considers the small-scale processes occurring at the propagule scale then places these results in the context of long timescale variability in wave forcing due to weather and climate. The non-dimensional scale, developed in terms of a particle Reynolds Number, Reₚ, that depends on both flow and particle scales. Scaling for size, inertia and buoyancy are described in terms of the Reₚ. Settlement mechanisms of several macrofuge species (Dorvillea antarctica, Hormosira banksii and Cystophora torulosa) are compared using direct velocity measurements and placed in context using a twenty year wave hindcast. The forcing is shown to be more closely linked to wave orbital speeds rather than breaker-driven phase speeds, and (negative) buoyancy has the greatest influence, identified through a Buoyancy Travel Ratio (BTR). Differences in these physical scales between the species are only moderate, suggesting supply, mucous and stickiness effects must be considered to fully resolve difference in success.

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COASTAL MONITORING: DEVELOPMENTS AND INSIGHTS ON PROJECT DESIGN
Coastal processes occur on a range of time and spatial scales. Monitoring programs that seek to understand those processes must be designed in a manner to capture those signals. Methods for monitoring coastal change have evolved from time-tested observational to automated and remote sensing. However, there are very few long-term data sets of any one site. Emery first described his profiling method in 1961, nearly 50 years ago, and it remains in practice for its simplicity, minimal gear expense and repeatability. Recent studies have correlated profiles with video and other modern techniques to ensure precision and account for weaknesses in the methods. Using examples from the literature and ten years of daily data from the Gold Coast, Queensland, Australia, this paper provides guidance on temporal resolution in coastal monitoring. Analysis indicates that measurements taken monthly are generally sufficient to capture the changes of interest for management concerns regarding seasonal and inter-annual cycles. Extreme changes such as those resulting from storm events will not be adequately covered by this scheme, but must be accounted for in any development or management plan.

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THE CELLULAR DISTRIBUTION OF PHYTOPLANKTON 210PO AND 210PB AND MARINE ORGANIC CARBON TRACERS
Polonium-210 and lead-210 were measured on phytoplankton cells rinsed with an oxalate solution to remove surface-bound metals (Tovar-Sanchez et al., 2003). Previous laboratory studies suggest that approximately 50% of the 210Po associated with phytoplankton cells is found inside the cytoplasm (Stewart and Fisher, 2003). Our field experiments indicated that this result may also hold true in wild populations as only 20-30% of the 210Po associated with phytoplankton was removed by the rinse. In addition, vertical profiles of zooplankton were compared with phytoplankton concentrations to determine whether zooplankton grazing on phytoplankton was significant. Remarkably, the concentration per gram of sediment ranged from as much as 1.0E+07 to 4.1E+05 for every gram of sediment. Final results are high performance liquid chromatography (HPLC) found a well-dechlorinating community.

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ENHANCED POREWATER DISPERSAL IN SANDY SEDIMENTS SUBJECT TO PHYSICAL FORCING AT KILO NALU OBSERVATORY, OAHU, HAWAI'I
A remotely operated five-channel fiber-optic spectrometer array was used to determine two-dimensional dispersion rates of injected fluorescein tracer under a range of oceanographic conditions and small-scale bedform changes. Experiments were conducted at a water depth of ~10m, and at a sediment depth of 5-10cm during July-October 2007 at Kilo Nalu, a cabled ocean observatory offshore of Honolulu, Oahu, Hawaii. Surface waves during the experiments had significant wave height of 0.4-1.4 m, and periods of 1.9-10 s. Preliminary analyses indicate substantial variability in dye dispersion rates and directions with changes in the prevailing hydrodynamic conditions and the position of sand ripples above the point of dye injection. Hydrodynamic conditions that were monitored included significant wave height, wave period, near-bed current velocity and turbulence. Our results are consistent with those of Hebert et al. (2007), who observed enhanced porewater mixing (as much as 2-3 orders of magnitude faster than sedimentary molecular diffusion) using a single-channel system at this site.

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POST-GLACIAL REBOUND SIGNATURES ON LATTE HOLOCENE AND PRESENT DAY SEA-LEVEL CHANGES ALONG THE COASTS OF ITALY
Solving the sea-level equation for a spherically symmetric Maxwell Earth we investigate the effects of the melting of remote Pleistocene ice sheets on present day relative sea-level variations, vertical movements and geoid anomalies along the Italian coasts. For a suite of plausible viscosity profiles we compare predictions of different global ice chronologies that have been tested against various Mediterranean Holocene sea-level records. On the basis of the sensitivity of North African relative sea-level curves to the Holocene melting of the Antarctica, we study the effects of different assumptions regarding the time-history of this remote glacier. By considering the catastrophic melting of Antarctica at 8,000 years BP, a scenario supported by the relative sea-level data from Djerba (Tunisia), we compare the effects of a sudden declination to those due to a smooth and linear melting phase considered in previous works. Finally, we predict bounds on the glacial isotatic adjustment signal at different Italian tide-gauge and GPS stations and derive a mean value for the ongoing climate related eustatic sea-level rise in the Mediterranean.
ecosystems was evaluated. The basic model included a limiting nutrient, bacteria, two size classes of phytoplankton, two size classes of detritus and explicit microzooplankton and mesozooplankton compartments. Steady-state results in idealized mixed layers configured to represent observed conditions were used to identify parameters and mechanisms influencing each observed quantity. Values of critical parameters were adjusted within their uncertainties to maximize the fit to the observations, and the model results matched trends in ecosystem properties over the majority of observed conditions. Further, the steady-state experiments, unsteady simulations forced at storm-bend and seasonal frequencies were used to determine if unsteady processes can account for the remaining unexplained variance, and 2) identify systematic changes in mean ecosystem properties arising from unsteady dynamics that must be considered during model calibration.

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GEOMORPHIC TRANSPORT LAWS TO GENERALIZE SEDIMENT LOADING TO THE REEFS OF MOLOKAI, HAWAII, USA

We hypothesize that historic conversion of steep Hawaiian watersheds from soil creep to overland flow caused significant changes in sediment magnitude and frequency of fine sediment flooding adjacent reefs. In Molokai’s semi-arid watersheds, transport-limited hillslope lowering rates approach 1.0 cm/a in bare soil. Low matrix hydraulic conductivities (~10-5 m/s) promote overland flow erosion of soils whose median and modal grain size is silt. LIDAR reveals that channel heads have locally migrated above background drainage-area values of ~104 m2 to rippled levees formed by overland flow. Process maps indicate sediment storage within catchment valleys. Cs-137 cores and shoreline progradation indicate most of this material has recently migrated out of catchments onto fans and reefs. To forecast sediment flux, we instrumented a small catchment with soil moisture sensors, overland flow meters, and sediment traps. The goal is to use monitoring with repeat 1-cm ground-based LIDAR to detect magnitudes and patterns of lowering. We will use these data to calibrate an overland-flow erosion law that can be generalized to the catchment by combining 1-m LIDAR with process maps.

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PATCHINESS IN THE MICROBIAL WORLD: INSIGHTS FROM MICROFLUIDIC STUDIES

Marine microbes live in a world of patches, where localized, ephemeral pulses of organic matter can often represent the dominant nutrient resource. In this landscape, motility and chemotaxis allow microbes to exploit and accumulate within nutrient patches, resulting in intense bacterial hotspots that can attract predators and form microhabitats. When scaled up, these complex interactions can strongly affect biogeochemical rates in the ocean, yet elucidation of their dynamics has been hampered by experimental limitations. We report findings from a novel microfluidic platform to investigate microbial dynamics at relevant spatiotemporal scales. Experiments revealed that marine bacteria can be extremely proficient in exploiting nutrient patches, gaining up to a 10-fold advantage from chemotaxis. We present the first evidence that marine bacteria can colonize nutrient plumes behind settling marine particles for moderate settling speeds (50 m/day). Bacterial hotspots formed within tens of seconds, triggering equally rapid and intense aggregations from their predators. A new ecological model linking patch utilization with chemotactic abilities is developed to quantify the effect of this patchiness cascade sweeping through the microbial loop on rates of carbon transfer to the classic food web.

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THE GLOBAL CENSUS OF MARINE LIFE ON SEAMOUNTS (CENSEAM)
The goal of CenSeam (http://censeam.niwa.co.nz/) is to foster global study of seamounts to determine their role in the biogeography, biodiversity, productivity, and evolution of marine organisms, and to evaluate the effects of human exploitation on these systems. Specifically, it is creating networking opportunities for existing and planned research programs, developing standards for sample collection and data sharing to make data more comparable across studies, supporting an online database of seamount biology (http://seamounts.sdsuc.edu), organizing large-scale synthesis review studies, and offering mini-grants to expand the scope of existing work. One example of recent CenSeam work is a report to the United Nations Environment Program predicting that suitable hard coral habitat on seamounts is most likely to coincide with future fishing pressure on large seamounts in the southeastern portion of the Mid-Atlantic Ridge in the South Atlantic, the central-eastern southern Indian Ocean, and some regions of the southern-central Pacific Ocean. Another recent activity, undertaken with the Marine Metadata Interoperability project, is developing MetaSEL, a draft metadata standard (http://marinemetadata.org/im-agemetadata) that will facilitate the finding and sharing of environmental images.

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EMPLOYING SATELLITE-DERIVED SEA-ICE CONCENTRATION TO CONSTRAINT UPPER-OCEAN TEMPERATURE IN A GLOBAL OCEAN GCM

The Southern Ocean sea-ice simulations in a global ocean general circulation model (GCM) depends decisively on the simulated upper-ocean temperature. This is confirmed by assimilating satellite-derived sea-ice concentration to constrain the upper-ocean temperature of the ocean model. The resolution of the sea-ice model is about 22 km and thus comparable to the pixel resolution of the satellite data. The ocean GCM is coarse-resolution to afford long-term integrations for investigations of the deep-ocean equilibrium response. Besides improving the sea-ice-albedo feedback, simulations with constrained upper-ocean temperature yield much more realistic global deep-ocean properties, in particular when combined with glacial freshwater input. Both outcomes are relative insensitive to the passive-microwave algorithm used to retrieve the ice concentration being assimilated. The sensitivity of the long-term global deep-ocean properties and circulation to the possible freshwater input from ice shelves and to the parameterization of vertical mixing in the Southern Ocean is reevaluated under the new constraint.

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PHYSICAL AND BIOLOGICAL HETEROGENEITY ON A FLORIDA KEYS REEF SLOPE: INTERACTIONS OF INTERNAL WAVES AND REEF TOPOGRAPHY

A dense spatial array of synchronized, fast response time, environmental sensors was deployed in two consecutive summers to study biological and physical coupling associated with the run-up of internal waves on the fore reef slope of Conch Reef, Florida Keys. Detailed surveys of the reef bathymetry and sampling of benthic microbial community composition and macroalgal isotopic signatures of carbon, nitrogen, and oxygen revealed strong physical and biological heterogeneity at scales of meters to tens of meters both across and within depths. Visualization through time of thermal anomalies mapped onto the reef bathymetry revealed persistent warm and cool patches associated with variability in the exposure to and duration of internal waves. The observed biological heterogeneity was not well explained by simple gradients in depth alone, but appeared to be related in many cases to within-depth physical patchiness resulting from the interaction of internal waves with the reef topography. These observations point to the importance of 3-dimensional structure even for a relatively low-relief reef slope, and emphasize the interacting and complex processes influencing biological heterogeneity on coral reefs in general.

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SEASONAL OCCURREENCE OF COLLOIDAL BIOPOLYMERS CHANGING THE NANOSCALE SIZE DISTRIBUTION OF P, FE, CU, AG AND PB IN COASTAL SEAWATER

Seasonal variations in nanoscale size distributions of Fe, Cu, Pb and Ag associated to colloidal/macromolecular matter in coastal seawater, is presented. Samples were taken on a 0-40 m depth profile in the Gullmar Fjord (Sweden), during winter, spring bloom and summertime at 29 locations in the 0-50 m region (hydrodynamic elements) determined by Asymmetrical Flow Field-Flow Fractionation, coupled on-line to High Resolution ICP-MS. The colloidal/macromolecular matter was also analyzed for size and shape by Atomic Force Microscopy. Three populations of colloidal/macromolecular matter with different sizes, shapes and element binding properties, were distinguished. Spherical, ~0.5-2 nm CDOM, bound most elements, and was present throughout the sampling period at all
Conducting an evaluation of your education and interpretive programs is essential to assessing the effectiveness of your message delivery system. Explore with the NOAA National Marine Sanitaries staff the process for development and implementation of an evaluation system for a diverse offering of ocean literacy and conservation education programs. Topics include models for evaluating environmental education programs, integration of evaluation in the program planning process, structuring evaluation instruments and implementation challenges with broadly distributed program centers. This presentation is based on the culmination of a two year planning process for the newly developed evaluation toolbox for environmental learning designed in collaboration with the Institute for Learning Innovation.

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SUPPLY PATHS OF AND TIME VARIATIONS IN THE OXYGEN MINIMUM ZONES OF THE EASTERN TROPICAL PACIFIC AND ATLANTIC OCEANS

The oxygen minimum zones (OMZs) in the eastern tropical Pacific and Atlantic Oceans extend from 200 to 800 m depth and are centered at about 10 degrees north and south of the equator. Model simulations of the future predict an overall dissolved oxygen decline and expansion of the OMZs. We describe the supply paths of oxygen to the OMZs by the eastward, tropical current bands through analyses of ADCP velocity observations combined with oxygen measurements. In the Pacific the Equatorial Undercurrent (EUC) provides the major oxygen supply to the OMZs, with smaller contributions from the Southern and Northern Subsurface Countercurrents. In the Atlantic the EUC and the North and South Equatorial Countercurrents provide oxygen to the OMZs. Time series of oxygen profiles from historical data extending beyond recent observations indicate an intensification of the OMZ in the tropical North Atlantic with a vertical extension of the low oxygen layer. A vertical widening of the low oxygen layer is observed in the equatorial regions of the tropical Pacific and the tropical Atlantic, suggesting a reduced oxygen supply.

PARTICLE FUNCTIONAL TYPES IN OCEAN OCEPITS: BEYOND BULK PARAMETERIZATION OF SUSPENDED PARTICULATE MATTER

Seawater is a complex optical medium consisting of a variety of particle types with different optical properties and biogeochemical functions. The traditional approach in ocean optics has been to use an overly simplified parameterization of seawater in terms of a few bulk particulate properties, such as chlorophyll or particle mass concentration. This approach has failed to explain the substantial optical variability in the ocean. I will present a concept referred to as a reductionist approach, in which the particulate matter is partitioned into a number of particle functional types that are optically and biogeochemically significant, such as inanimate colloids, viruses, heterotrophic bacteria, cyanobacteria, nanoplanckton and microplankton species or taxonomic groups, clay- and silt-sized minerogenic particles, and as inanimate colloids, viruses, heterotrophic bacteria, cyanobacteria, nanoplanckton and microplankton species or taxonomic groups, clay- and silt-sized minerogenic particles, and biogeochemical functions. The traditional approach in ocean optics

Why are the densest waters of the North Atlantic formed in the Subpolar Gyre? (and Labrador Sea, in particular)

The densest water mass formed in the Subpolar Gyre is Labrador Sea Water, the densest water mass formed in the Subpolar Gyre. This is counterintuitive given the accepted paradigm that the densest mode waters should be formed the farthest away from the warm water source. It is also counterintuitive given the large heat transport into the Nordic Seas compared to that into the Subpolar Gyre downstream of the bifurcation at the Greenland-Scotland Ridge. In general, no simple explanation for why the Nordic Seas’ densest waters should be deeper is found in the literature. In this study, the relative importance of factors, such as air-sea fluxes, topography, freshwater, sea-ice and ocean dynamics, in influencing the density of the waters formed in the Nordic Seas versus the Subpolar Gyre (and Labrador Sea, in particular) is examined using a combination of observations, idealized thermodynamic and dynamics models. The results presented are relevant not only to understanding our present climate but also to past climate scenarios when the location of connection in the North Atlantic was thought to be different.

Two approaches are described to improve fields of altimeter SSHA within 50km of the coast. One problem in this region occurs when the altimeter footprint hits land. A second class of problems involves the corrections applied to the radar travel time, especially the wet troposphere correction. One approach to overcoming problems with the corrections is to substitute mid-latitude corrections, usually based on models of the coastal atmosphere or ocean. Here we use model-based wet troposphere corrections, allowing us to retrieve along-track SSH data between ~60km to 20km from the coast, where land reflections begin. To produce SSHA fields that reach the coast, we simply ignore altimeter data within 40km of the coast, then interpolate between tide gauge SSH data at the coast and the offshore altimeter data to produce SSH fields that reach the coast. We simply ignore altimeter data within 40km of the coast, then interpolate between tide gauge SSH data at the coast and the offshore altimeter data. Examples of both approaches will be presented, with suggestions for improvements.

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We demonstrate the potential for reconstructing sea surface temperatures along coastal British Columbia, Canada, using four chronologies developed from the growth increment widths of Pacific geoduck clams (Panopea abrupta). The four geoduck chronologies range from the southernmost to northernmost borders of British Columbia and were developed using standard tree-ring (dendrochronology) techniques, including cross-dating. Although each geoduck chronology significantly correlated with local records of sea surface temperatures (SST), correlations were unstable over time. In every chronology, the relationship with SST would occasionally dissolve for a period lasting approximately ten years. The timing of these climate-growth breakdowns was inconsistent and varied among the chronologies. For any one chronology, inconsistent climate-growth relationships represented a significant complication for developing accurate SST reconstructions. However, when geoduck chronologies were combined via multiple regression or simple averaging, irregularities in climate-growth relationships canceled out one another to yield strong and highly stable SST reconstructions. Final SST reconstructions captured more than 60% of the variance in the instrumental record and extended more than 120 years, capturing the historical range of variability and providing context for interpreting recent warming trends.
Several independent data sources suggest that there is a net upper-layer mass flux of order 3 \text{ Sv} to the west in the Gulf of Mexico, even in the western Gulf; it is a closed basin. Because the wind stress is convergent over most of the Gulf, we suggest that the net mass flux is removed from the upper layer by Ekman pumping, as is typical of all mid-latitude anticyclonic gyres. The downward flux can follow isopycnals to depths of order 500 m, and then be advected poleward by the Gulf Stream. More accurately, the mechanism for forcing deep water to the south through Yucatan Channel is provided by the intrusion and ring-shedding cycle of the Loop Current. Potential vorticity maps show that a deep flow from the western Gulf back to the Caribbean Sea, via Yucatan Channel is likely. This deep flow was observed by the long-term CICESE moorings. While almost all numerical models show the observed strong flow to the west in the southern part of the basin, none that we have examined show this observed net upper-layer flow to the west in the central Gulf.

**DEMONSTRATION OF A UHF RADAR IN AN INTEGRAL SALT MARSH**

In November 2005, a RiverSonde radar was deployed in North Inlet, South Carolina to examine the accuracy of UHF radar technology in measuring surface currents in an intertidal salt marsh. In order to validate the river-inspired surface current profiler (ADCP) was deployed in the radar’s footprint. Upon comparison, the radar yielded current measurements consistent with both the ADCP and known tidal variations in this region. The results further demonstrate that increased wind speed, up to a threshold, results in greater radar coverage. However, tidal currents are notable constraints on a UHF radar system in an intertidal salt marsh environment. For example, radar coverage fluctuates throughout the tide cycle as some areas become exposed during low tide, then flood again during high tide. The cordgrass Spartina alterniflora, which forms a thick canopy over the marsh surface, acts as an effective radar target causing energy peaks near zero Doppler shift. However, the peaks are a function of wind speed and are uncorrelated and likely can be filtered. Overall, this UHF radar system performed well in the subtidal channel. A promising future application involves a pair of overlapping radars to measure the total surface current vector field.

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**THE FATE OF SEDIMENTS IN THE TAIWAN STRAIT: A REASSESSMENT**

Five of the 10 largest rivers in the world by discharge are tropical rivers and their plumes extend 100 to 1000s of km off continental shelves. It has been argued that the primary production associated with these river plumes is either due to nitrate introduced by the river or due to recycling of this nitrate. We have calculated a T/river ratio for several rivers and show that nitrate and recycling alone cannot account for the productivity of these plumes. Nitrogen fixation and organic nitrogen play a significant role in tropical river plumes. Only the sinking flux of new production associated with these allochthonous sources of nitrogen can be considered biologically mediated transport of CO2 from the ocean to the atmosphere. Echinoderm is an important carbon source in coastal zones and has been recently the focus of attention in the context of the effect of ocean acidification on the fate of these organisms. Few studies have explored how the changing chemistry caused by a decrease in pH affect physiological traits including calcification. Additionally, limited information at early stages of echinoderm development highlights the urgent need to address the question of how increasing CO2 partial pressure will impact upon echinoderm physiology and population adaptation to environmental change. We present results on the effects of changes in CO2 on the physiology of larvae during early developmental stages. The conditions used in this study represent present-day CO2 (385 p.p.m. V. CO2) and CO2 projections for two future scenarios (750 and 1200 p.p.m.V. CO2).

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Sklar, F. H.; Cline, E.; Scinto, L. J.; Price, R. M.; application of the quasi-normal scale elimination theory to oceanic turbulence. Recently developed Quasi-Normal Scale Elimination (QNSE) theory of stably stratified turbulence has been applied to oceanic flows. QNSE is an analytical theory that fully accounts for the effects of flow anisotropy and internal waves. It yields vertical and horizontal scale-dependent eddy viscosities and eddy diffusivities and various one-dimensional spectra that roughly deviate from the Kolmogorov regime. It is shown that in the Oszmidov scale, the vertical spectrum of the horizontal velocity undergoes transition from the Kolmogorov -5/3 slope to the -3 slope. The numerical coefficients in the transition equation agree well with LES by Carnevale et al. (2001) and with the measurements of the vertical spectrum of the horizontal shear by Gargett et al. (1981) and Gregg et al. (1993). The theory provides a new theoretical basis for the observed collapse of the normalized data to a single curve and the universal scaling of the normalized shear spectrum first suggested by Gargett et al. (1981). A correction to the Kolmogorov-Oszmidov spectrum of temperature fluctuations due to the buoyancy effects is also analytically derived.

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UNDERSTANDING AND PREDICTING CHANGES IN THE OCEAN SCIENCES, TECHNOLOGY, AND OPERATIONS WORKFORCE

Despite efforts of the U.S. Department of Labor to assess workforce status and trends, little is known about the ocean science, technology and operations (OSTO) workforce. Most ocean occupations are intertwined with other sectors of the economy, making it difficult to define, no less make projections about, many aspects of the ocean workforce. Understanding and Predicting Changes in the Ocean Sciences, Technology, and Operations Workforce is a study funded by the National Oceanographic Partnership Program and lead by the Marine Advanced Technology Education Program (MATE) Center and the Naval Postgraduate School that is designed to: produce a more complete description of the present state of the OSTO workforce; anticipate future developments in this workforce; and characterize the educational programs that will be needed to respond to those developments. Preliminary results of this study will be discussed including a description of the current workforce in support of ocean observing systems, positions that are the most difficult to fill, the knowledge and skill sets in highest demand, and general trends on the ocean workforce.

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THREE YEARS OF THIN LAYER OBSERVATIONS IN MONTEREY BAY, CA USA

Fine-scale physical, biological and optical measurements within intense thin layers were made during three different years in Monterey Bay, CA (2002, 2005 and 2006). These measurements were made as part of the ONR sponsored DRI Layered Organization in the Coastal Ocean (LOCO). Vertical profiles of the water masses were made hourly over periods spanning 1 to 3 weeks using autonomous vertical profilers. In-situ measurements included CTD, oxygen, optical absorption and attenuation, (both particulate and dissolved), angular and spectral backscattering, chlorophyll and CDOM fluorescence, horizontal current intensity, shear, turbulence dissipation and phytoplankton species identifications within layers and the surrounding water column. Each of the three years had distinct thin layer formation mechanisms and characteristics. The unique properties of these thin layers and their comparative impacts to biology and optics will be discussed.

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GROUNDWATER-SURFACE WATER INTERACTIONS IN TREE ISLANDS AT LOXAHATCHEE IMPOUND LANDSCAPE ASSESSMENT (LILA), FLORIDA

Tree islands are a natural component of the Everglades landscape, yet over the last century there has been a sixty percent reduction in tree island cover in some areas. This loss has been attributed to an alteration of the natural water level and flow patterns in the Everglades. To gain an understanding of tree island hydrology, a study was conducted on man-made tree islands at Loxahatchee Impound Landscape Assessment (LILA), a large replicated physical model of the Everglades located in at the Arthur R. Marshall Loxahatchee National Wildlife Refuge (LOX). Florida. LILA contains 8 tree islands constructed of either entirely peat or peat over limestone. Monitoring of groundwater levels and temperature in the tree islands relative to the surrounding surface water has provided insight into the tree island's hydro-dynamics. Groundwater levels in peat tree islands were elevated above the surrounding surface water year round, while groundwater levels in limestone islands were above surface water only during the wet season. A diurnal oscillation in groundwater level at times of low surface water level suggests that trees on the islands affect groundwater level via evapotranspiration.

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NORTHWARD TRANSPORT OF PACIFIC WATER ALONG THE NORTHWIND RIDGE IN THE WESTERN ARCTIC OCEAN

A possible mechanism for northward transport of Pacific Summer Water (PSW) along the Northwind Ridge is presented. The recent sea-ice reduction in the Arctic Ocean is not spatially uniform, but is disproportionally large around the Northwind Ridge and Chukchi Plateau compared to elsewhere in the Canada basin. The PSW delivered from the Bering Sea is one of the likeliest candidates causing such disproportional sea-ice reduction. To understand mechanisms responsible for such sea-ice retreat, we examine the dynamics and timing of the delivery of the PSW into this region. A key mechanism is an interaction between the bottom topographies of the Northwind Ridge and annual cycle Rossby waves excited by sea-ice motion in the Canada basin. The analytical results show a quite different structure from those of mid-latitude basin due to the small value of beta effect. Incident barotropic waves cause strong baroclinic current over the topographies, and the current delivers warm PSW into the basin. The estimated timing of the PSW delivery is consistent with the sudden warming observed in the subsurface layer over the Northwind Ridge.

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ENERGY TRANSFER BETWEEN THE SEMIDIURNAL TIDE AND NEAR-INERTIAL MOTIONS AT THE KAENA RIDGE

We investigate the nonlinear energy transfer from the semidiurnal tide to near-inertial frequency in a region of strong barotropic-to-baroclinic tidal conversion. The observations, comprising repeated velocity and density profiles in the nearfield of the Kaena Ridge, were part of the Research Team IIF in September-October 2002 as part of the Hawaii Ocean Mixing Experiment. Depth-integrated energy spectra suggest a fortnightly modulation of near-inertial energy, lagging the semidiurnal tides by 5-10 days. Guided by classical nonlinear interaction models, as well as more recent analytical and numerical studies, we find that triads consisting of an upward- and a downward-traveling near-inertial wave and their sum frequency in the semidiurnal band show a significant biocorrelation. When compared to statistical model trials for zero coupling with random phase, the observed biocorrelation values above the Ridge are significant at the 95% confidence level. The inference is that a semidiurnal to near-inertial energy transfer is indeed at work.

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EFFECT OF INTERANNUAL TO INTERDECADAL CLIMATE VARIABILITY ON MARINE BIOGEOCHEMICAL CYCLE AND OCEANIC CARBON UPTAKE

The overall objective of this study is to improve our understanding of the influence of interannual to interdecadal climate variability on the marine biogeochemical cycle and oceanic carbon uptake using an ocean general circulation model (OEGCM) coupled with a marine biogeochemical cycle models. Studies that the interannual to interdecadal climate variability change the upwelling of nutrient-enriched waters and affect the biological productivity, and thus ocean carbon uptake. Moreover, oscillation on decadal time scales may be able to adjust the primary production of the marine ecosystem through changes in ocean mixing, wind stress, as well as atmospheric iron deposition. The phytoplankton growth and the marine biological pump can also change the temporal response of surface temperature and atmospheric CO2 concentration. In order to achieve our objective we integrate a marine biology model into a 3-D OEGCM. The marine biology model is a second-generation biogeochemical model Dynamic Green Ocean Model. The model includes three limiting nutrients, three phytoplankton state fractions, two zooplankton state fractions and three detritus. The ocean model is the POP general circulation model. The coupled modeling framework is used to conduct a set of sensitivity experiments to examine how the historical variability in factors such as surface heat flux, freshwater flux, sea-ice cover affect the ocean circulation and hence phytoplankton growth and ocean productivity.

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POSITIVE FEEDBACK AND THE DEVELOPMENT OF ECOSYSTEM DISRUPTIVE ALGAL BLOOMS (EDABs), which severely alter or degrade ecosystem function, are occurring with increasing frequency. These blooms are often caused by toxic or unpalatable species that decrease herbivore grazing rates, and thereby disrupt the transfer of nutrients and energy to higher trophic levels, and decrease nutrient cycling. Many factors, such as nutrient availability and herbivore grazing have been proposed to separately influence EDAB dynamics, but interactions among these factors have less often been considered. Here we discuss positive feedback interactions among nutrient availabil- ity, herbivore grazing, and nutrient regeneration, which can substantially influence the dynamics of EDAB events. The positive feedbacks result from a reduction of grazing
rates on EDAB species caused by algal toxicity or unpalatability, which promotes the proliferation of the EDAB species, but also lowers grazer-mediated recycling of nutrients and thereby decreases nutrient availability. Since many EDAB species are well-adapted to nutrient-stressed environments and many exhibit increased toxic production and toxicity under nutrient limitation, positive feedbacks are established which can greatly increase the rate of bloom development and the adverse effects on the ecosystem.

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ESTIMATING RESPONSE TIMES OF OCEANS TO MERCURY EMISSION REDUCTIONS AND IMPLICATIONS FOR EXPOSURE FROM MARINE FISH

We synthesize results from global-scale atmospheric and oceanic cycling models to assess anthropogenic mercury exposure from marine fish consumption. Modeling results suggest that anthropogenic mercury enrichment is greatest in the Atlantic Ocean and Mediterranean Sea, and that global emissions remain at present levels, mean concentrations will decrease in these areas. However, our results also indicate concentrations in the North Pacific Ocean may increase. These modeling scenario runs agree with data from 2006 North Pacific cruises which reveal increases in total mercury concentrations for comparable latitudes to stations sampled in 1987 and 2002. Data from the Mediterranean Sea, on the other hand, indicate decreasing concentrations in recent years. Since almost 40% of human mercury exposure in the US is from tuna harvested primarily from the Pacific Ocean, these data suggest that population wide decreases in mercury may not decline as rapidly as we propose with decreased domestic emissions. This analysis illustrates the complex anticipated response of oceanic fish mercury levels resulting from large-scale mercury emission reductions, and emphasizes the important role scientists have for informing policy makers and resource management agencies.

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OBSERVATIONS OF UPPER OCEAN MIXING USING AIRBORNE LIDAR

We present results from dye release experiments conducted off the east coast of Florida in which airborne LIDAR was used to obtain 3-D maps of the dye patch on times scales of minutes to hours, and spatial scales of meters to 1 km horizontally and 0.5-10 m vertically. In particular, we examine the rapid formation of a banded structure in the dye distributions on scales of the mixed layer depth. In situ observations from an acoustic Doppler current profiler (ADCP) combined with conductivity, temperature, and depth measurements (CTD) show a strongly stratified shear layer overlying a weaker, more uniform flow. We investigate the hypothesis that the bands are the result of shear instability in the upper part of the water column (Langmuir circulation can be ruled out based on the observed wind speed, wave height and stratification). As part of our analysis, we estimate vertical diffusivity and horizontal dispersion coefficients from the rates of vertical and horizontal spreading of the dye layers, and further exploit the ability of the LIDAR observations to track individual features in the dye distributions to account for small-scale features, intermittency, wavenumber spectra, etc.

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IMPACTS ON THE AMERICAS OF MULTIDECadal VARIABILITY IN ATLANTIC AND INDIAN OCEAN SEA SURFACE TEMPERATURES: A MULTIMODEL COMPARISON

Previous work has shown strong evidence that multidecadal variability in Atlantic Ocean conditions influences the climate of the North, South and Central America, affecting patterns of rainfall in particular. However, there is uncertainty as to the strength of these impacts, with notable contrasts between results from different studies. It is unclear to what extent these differences arise from the use of different models, or from differences in experimental setup. As part of an EU project, DYNAMITE, we have carried out controlled experiments in which 5 different atmospheric GCMs have been forced with the same pattern of multidecadal change in Atlantic SST. While there are similarities in the overall patterns of response, we find considerable differences between the model simulations of climate impacts over the Americas, especially with respect to the magnitude of rainfall anomalies. Further studies are providing insight into the causes of these differences and evaluation of which responses may be most realistic. Finally, we have carried out a similar set of experiments forced by the observed multidecadal change in Indian Ocean SST, and will report on these results also.

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BATHYPLAGIC FISH DIVERSITY IN THE SARGASSO SEA, NORTHWESTERN ATLANTIC OCEAN

Of the various marine habitats, one of the (if not the) most daunting to quantify is the largest habitat on Earth. One project addressing this challenge is the Census of
Marine Zooplankton (CMarZ), whose goal is the assessment of biodiversity of animal plankton throughout the world's oceans. The 2006 CMarZ cruise in the Western North Atlantic provided an unprecedented opportunity to sample bathypelagic micronekton using a large midwater trawl (10-m³ MOGNESS) outfitted with fine (0.335-mm) mesh netting. This netting allowed non-destructive sampling of the fragile fish fauna to 5000 m depth, thus facilitating accurate identification and at-sea DNA extraction and sequence- ing. A total of 3,965 fish specimens were collected from at least 127 species (94 genera, 42 families), many rarely caught, and four of which may be undescribed. Of note were male anglerfishes from five families, which are poorly known. Tissue was taken from all males to match with females, thus enabling the construction of a key for the most diverse bathypelagic fish group.

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BALANCED AND UNBALANCED VARIABILITY NEAR TOPOGRAPHY
Various physical mechanisms of topographically enhanced variability are discussed. Given that balanced motions are dynamically controlled by potential vorticity, topographic effects will be most pronounced in mesoscale features with strong potential vorticity anomalies. Analysis of intense vortices evolving near horizontal boundaries and tall sea-mounts is presented. Resonances between Rossby (vortical) and inertia–gravity modes result in unbalanced agostrophic instability which is shown to be related to violation of Ripa's sufficient stability condition.

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UNDERSTANDING PROJECTIONS OF SEA LEVEL RISE IN A MODEL FOR INTERDISCIPLINARY RESEARCH ON CLIMATE VARIATION 3.2 (MIROC3.2)
Sea level changes resulting from CO2-induced climate changes have been investigated in a series of idealized experiments with medium-resolution version of MIROC3.2. Changes in wind stress have important role of the several pronounced local features, while heat flux changes affect sea level rise in the Atlantic Ocean and fresh water flux affect sea level rise in the Indian Ocean. The changes in wind stress and surface fluxes and the following sea level changes are also shown in the high-resolution version of MIROC3.2 with more detailed features. These local features are related to density changes mainly contributed from redistribution of ocean heat content. This work was supported by KAKENHI 18740305.

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FROM BACTERIA TO BIRDS: THE IMPACT OF SULFIDE IRRUPTIONS ON MICROBIAL COMMUNITY STRUCTURE IN A HYPERSALINE LAKE
Numerous water quality problems plague California's largest lake, the Salton Sea. One of the main reasons for the presence of high concentrations of hydrogen sulfide (H2S) in the lake: The development of large phytoplankton blooms and high summertime water temperatures lead to anoxia and H2S formation. Frequent windstorms mix H2S-rich bottom waters into surface waters, causing mass mortality of plankton, macroinvertebrates, and fish. Although similar phenomena have been documented in other lakes and marine ecosys- tems, the extent to which these events affect microbial community structure has not been studied. A mixing event was captured in the Salton Sea in September 2005 by sam- pling along a transect passing through an H2S-rich plume. Physical and chemical water column properties were measured at 12 transect and two reference stations. Community fingerprinting (T-RFLP) was used to determine composition and structure of archaeal and bacterial communities. Archaeal community structure was strongly influenced by H2S concentration, whereas the bacterial community exhibited only minor changes. Aside from the immediate effects of mixing events on the biota, the resulting changes in micro- biological communities may also lead to biogeochemical changes.

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PHOTOCHEMICAL CYCLING OF CHROMOPHIC DISOLVED ORGANIC MATTER (CDOM) IN THE OPEN SEA: COMPARISON OF PHOTOLOYTIC QUANTUM YIELD AMONG THE MAJOR OCEAN BASINS
Solar photolysis of chromophic dissolved organic matter (CDOM) drives the global open-ocean surface CDOM distribution seen from satellite. This process also leaves an imprint on CDOM absorption (in terms of magnitude and spectral shape) in regions of the ocean interior characterized by relatively frequent ventilation (e.g., subtropical mode waters of the North Atlantic and Pacific). Here we present preliminary experimental determinations of apparent quantum yield (AQY) for CDOM photolysis on open-ocean samples from ranging hydrographic provinces within the Pacific, Atlantic and Southern oceans (collected as part of both the CO2/CLIRAP Repeat Hydrography Survey and Bermuda Atlantic Time-series Study). CDOM photolysis rate is measured from a labora- tory-simulated solar irradiation time course and used to solve for parameters describing AQY. Geographic variation in AQYs will be assessed within the context of the oceanic vertical distribution of CDOM and related hydrographic data. We investigate whether variation in AQY can be ascribed to regional biogeography (specifically biological production characteristics) or the geochemical character of source water masses, each of which may influence the chemical composition thus photochemical potential of CDOM.

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SOURCES AND FORCES: WHAT DRIVES VARIABILITY IN SUSPENDED SOLID CONCENTRATIONS AT THE KILO NALU OBSERVATORY
Concern for Hawaiian coastal water quality, especially on Oahu's economically vital south shore, has risen significantly in the past decade. In order to predict variability in water quality, it is necessary to understand the relative importance of the various forcing mecha- nisms and how their combined effects influence the area. The Kilo Nalu Observatory, located on the south shore of Oahu, is ideal for studying water quality variations and their underlying physical forcing mechanisms. Using ADCP acoustic intensity as a relative measure of suspended solid concentration, quantitative analysis of the variance attributed to the major forcing mechanisms (swells, currents, solar irradiance, and tidal cycles) has been carried out. Regression analyses identify the significance of wave forcing in driving low frequency variability, while spectral analyses reveal diurnal and tidal influences in the acoustic intensity time series. Spatial variability in acoustic intensity in the Kilo Nalu area is assessed using AUV surveys.

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STABILITY CHARACTERISTICS OF ABYSSAL OVERFLOWS
Abyssal overflows can progress through a sequence of instability mechanisms. Here, we describe the superimposed frictionally-induced destabilization of supercritical overflows as well as the baroclinic instability of generated abyssal overflows with isopycnal incropings.

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VISUALIZING OCEAN INTERIOR CHANGES FROM THE CLIVAR/CO2 REPEAT HYDROGRAPHY PROGRAM USING JAVA OCEANATLAS
Most CLIVAR/CO2 Repeat Hydrography Program transects are repeats of WOCE Hydrographic Program (WHP) sections. This facilitates inter-expedition comparisons us- ing off-the-shelf software. The ocean profile data exploration application Ocean Atlas (OA) includes an explicit

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POLLUTION IN COASTAL WATERS
VIRUSES FOUND IN SEWAGE AND THEIR POTENTIAL TO INDICATE FECAL POLLUTION IN COASTAL WATERS
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CLIMATE CHANGE, UPWELLING, AND ECOSYSTEM DYNAMICS IN THE GULF OF THE FARALLONES
In eastern boundary current systems, coastal upwelling is predicted to intensify as a result of increasing temperature gradients between land and sea. Along the U.S. west coast, atmospheric-oceanographic coupling in the past decade has been extremely variable, resulting in dramatic, unpredictable responses of the California Current large marine ecosystem. While global warming is predicted to cause increased upwelling in neritic environments, the potential effects on offshore regions is less clear. Herein, we investigate biogeographical change in neritic to offshore zones to test the hypothesis that global warming is differentially affecting these habitats. To test this hypothesis, we examine primary, secondary, and tertiary productivity by depth zone for the wide Gulf of the Farallones continental shelf ecosystem off central–northern California. We find trends in primary, secondary and tertiary productivity which are consistent with our hypothesis of differen- tial ecosystem changes in the Gulf of the Farallones depending on distance from the coast, and relate these to changes in coastal upwelling and offshore wind curl.

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VIRUSES FOUND IN SEWAGE AND THEIR POTENTIAL TO INDICATE FECAL POLLUTION IN COASTAL WATERS
The presence of pathogenic viruses in coastal environments is potentially an important tool in evaluating water quality and human health risks. Millions of viruses are excreted in fecal matter and bacterial indicators do not correlate with the presence of pathogenic viruses. Enteroviruses have been used to identify fecal pollution in the environment; however, other viruses transmitted via the fecal–oral route could indicate fecal pollution.
The purpose of this research is to develop a baseline understanding of the diversity of viruses found in raw sewage, and to assess their presence in the environment. PCR was used to detect Adenoviridae, Herpesviridae, Papillomaviridae, Reoviridae, Hepadnaviridae, Caliciviridae, Paramyxoviridae, Tobamoviridae, and Human Poxviridae in viruses concentrated from raw sewage throughout the US and from five marine environments ranging in their exposure to human influence. Adenovirus, Norovirus, Pepper Mild Mottle Virus, and Human Poxviridae were detected in raw sewage but absent in the marine environment. This baseline understanding of viruses in raw sewage and the marine environment will enable educated decisions to be made regarding the use of viruses in water quality assessments.

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DELTA S AT RISK

The long-term sustainability of deltas is more affected by large-scale engineering projects than eustatic sea level rise associated with global warming. This finding has crept up on scientists, as the subject is both complex and, highly variable around the world's coastlines. On deltas, relative eustatic sea level rise (~2 mm/y) is often smaller than the rate for iso-static-controlled subsidence (0.3 to 3.6 mm/y) on the Mississippi (and of the same order of magnitude: sediment compaction (0.7 to 2.2 mm/y). Accelerated compaction (25 to 125 mm/y) associated with petroleum and groundwater mining can greatly exceed natural subsidence rates (3 to 8 mm/y). The reduction in sediment delivery to deltas due to trapping behind dams, along with the human control on the routing of river discharge across delta plains, limits the aggravation of a delta surface from new sediment deposition. This perhaps is the reason for the world's sinking deltas. Delta from upstream sources is often mitigated through controlled water releases and diversions for irrigation; channels are stabilized to aid in this control. However flooding from the sea is now more common, as a deltas' surface subsides. Consequences include shoreline erosion, threatened mangroves and wetlands, increased salinization of cultivated land, and hundreds of millions of humans put at risk.

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POTENTIAL EFFECTS OF CLIMATE CHANGE ON PARTICLE COAGULATION EFFICIENCY IN THE OCEAN

Marine particle formation and the subsequent export of organic carbon from the pelagic zone is an important mechanism for sequestering CO2. We studied the effect of increased CO2 concentrations and temperature on the coagulation efficiency of phytoplankton, a factor important for modeling aggregate formation. Dissolved and colloidal exudates derived from phytoplankton during blooms are enriched in acidic sugars and have recently been shown to be precursors for abiotically-formed gel particles operationally classified as transparent exopolymer particles (TEP). It has been suggested that TEP enhances aggregation by increasing effective particle size and colloid frequency of particles, and also by serving as organic glue between cells. TEP abundance, dissolved and colloidal neutral and acidic sugar composition, and cellular abundances were measured for diatoms grown in mesocosms at elevated temperatures and for coccolithophores grown in chemostats under different temperatures and pCO2 concentrations. Coagulation efficiency of cells undergoing collisions by shear was determined experimentally using horizontal Couette devices. Here we report our findings and discuss their implications for marine particle dynamics and the marine carbon cycle in the future.

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FEEDING OF CARNIVOROUS ZOOPLANKTON IN WEST GREENLAND WATERS

The aim of the present study is to contribute to a better knowledge about carnivorous zooplankton, their trophic role in the arctic pelagic ecosystem, with emphasis on their predation on Calanus spp. The diet and vertical and horizontal distribution of the carnivorous copepods and chaetognaths were investigated in West Greenland waters during the Arctic spring. Feeding by the carnivorous copepod Paraeuchaeta norvegica was assessed by measuring egestion of faecal pellets and the chaetognaths were analysed for gut contents. Simultaneously, prey composition, prey production and vertical distribution were determined by measuring egestion of faecal pellets and the chaetognaths were analysed for gut contents. The feeding rate of P. norvegica ranged from 1.8 to 5.6 prey d-1. The impact on prey production was even higher. Our study shows that invertebrate predators is an important population regulating factor in West Greenland waters.

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DO GLOBAL OCEAN BIOGEOCHEMICAL MODELS NEED TO ACCOUNT FOR IRON SPECIATION AND ABISTIC CYCLING?

Global ocean biogeochemical models (OBMs) are critical in appraising the response of the marine carbon cycle to changes in climate, but must balance mechanistic realism against computationally efficient model formulations. This is particularly true for iron, which despite exhibiting complex abiotic cycling and speciation, is typically only a single pool in OBMs. However, iron limits phytoplankton productivity (PP) in a variety of important ocean regions (e.g. the Southern Ocean and Equatorial Pacific) and such shortcomings might prove important in governing regional PP and air-sea CO2 fluxes. To that end, we employ a complex iron cycle model to test iron speciation as a function of irradiance and temperature. Over a suite of sensitivity experiments, we find that increased irradiance promotes the conversion of Fe into bioavailable forms. The absence of such processes could be important in OBMs if the irradiance/mixing regime of the ocean were to change. We outline a method by which such effects can be accounted for in an OBM and find that predictions of PP are sensitive to the inclusion of chemical processes, even if we consider no changes in circulation.
data taken by Argo floats and the monthly mean objective data analysis of temperature and salinity (Levitus data). Our new method successfully estimates meso-scale three-dimensional thermal structures in near-real time. We validate the accuracy of the estimation, comparing the estimated isothermal depths with that of in-situ sea temperature taken independently from the data used in the method. We present three case studies. The comparisons show excellent agreement between the estimated isothermal depth and that of in-situ observations. We also developed a statistical technique to estimate the error bar for the isotherm surface. We discuss the conditions of successful cases and the limitation of our method.

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UNDERWAY SAMPLING SYSTEM FOR DETERMINATION OF DISSOLVED AND PARTICULATE TRACE METALS IN OCEANIC SURFACE WATERS (GEOS/I BiOCARBON)

Recent findings on the role of trace metals as a factor controlling primary productivity and biogeochemical processes in the oceanic waters emphasized the need for better understandings of spatial-temporal variabilities in concentration and chemical speciation of trace metals in marine systems. Here, we present an underway-sampling system as a means of sample collection for near-real-time measurements of dissolved and particulate trace metals in surface waters. The underway-sampling system was designed using a Tellow bellows pump, Tellow tubing, and an epoxy-coated “fork” which is towed from a stainless steel wire attached to a winch. To stabilize the fish at a depth of 0.5–1.5 m even at ship speeds over 15 knots, its weight was increased to 75 kg with tungsten alloy rods. Surface seawater was pumped up at a speed of 7 liters per minute to the operation deck level. The system was successfully used during the R/V Hakuko-maru research cruise in the NW Pacific in July 2007. The results confirmed advantages of this method of underway sampling include a reduced risk of sample contamination and enhanced sampling frequencies.

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TRACE ELEMENT COMPOSITIONS OF UPLAND AND SUMMER (2006) TRAPPED FLOOD SEEDBED, HANALEI BAY, KAUAI

Changes in the Hanalei River watershed on Kauai’s north shore have the potential to increase sediment delivery to Hanalei Bay, which in turn may adversely affect adjacent coral-reef communities. Summer floods in Hanalei Bay may pose a significant threat to reef health because residence times of flood sediment may be long when wave energy is low. Two time-series sediment traps (4.5-day intervals) and five tube traps were deployed in Hanalei Bay from June to September 2006 to characterize temporal and spatial variations in trapped sediment quantity and composition, particularly during a flood event. Total elemental ratios of the silt + clay fractions of upland and trap sediment were compared to identify geochemical fingerprints of lower watershed regions; to distinguish flood and non-flood sediments in traps; and to determine whether watershed sediment sources varied during the flood event. Trapped sediment delivery by Hanalei River flood in August 2006 had a distinct Ba/Al ratio, and sediment delivery as the flood ended had elevated Cu/Al ratios compared to early- and non-flood trap sediment and to Hanalei River suspended sediment.

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CHARACTERIZING COHERENT STRUCTURES IN AN ESTUARY USING IN-SITU AND REMOTE MEASUREMENTS

As part of the COHerent STructures in Rivers and Estuaries eXperiment (COHSTREX), we investigate the structure of internal waves and coherent vortices behind a rocky sill using a combination of in-situ measurements and remote sensing techniques. Fluid shear and turbulent energy are estimated by bottom-mounted ADCP measurements, while high frequency (25 Hz) and high resolution (1.8 cm bin) acoustic backscatter from a Bioioscens sensor detects the propagation of internal waves and coherent vortices past the sill. Coherent vortices are simultaneously captured on the water surface using an aerially mounted infra-red camera which detects boils of cool, surface seawater impinging the warmer surface. The location, growth rate and frequency of the surface boils are related to the in-situ flow field, vertical mixing processes, and the coherent structures observed in the acoustic backscatter. The appearance of surface boils coincides with a local increase in turbulence production and the erosion of large stratification. The measured fluid properties are compared to the results of a Kappa-epidon turbulence model, and show that boils significantly alter the expected mixing field. The ultimate goal is to relate the surface signature of boils to fundamental properties of the flow, e.g., roughness, depth, mixing, and fluid velocity, and thus obtain information from rivers and estuaries remotely.

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GLOBAL-SCALE, DECADEL CHANGES IN SALINITY AND OXYGEN BASED ON RECENT REPEAT HYDROGRAPHIC SECTIONS

Salinity and oxygen variations are examined from each ocean basin, using repeat hydrographic data, including chlorofluorocarbons that provide time-scale information. Results are considered with respect to basin-wide analyses of salinity and oxygen trends (Roy et al. and Garcia et al., 2005). Temporal changes in ocean fronts and the formation of water (high latitudes and Pacific Ocean), and became saltier in more saline regions (subtropical latitudes and Atlantic Ocean), suggesting a strengthening of the normal atmospheric water transport. Reported oxygen decreases in the northern hemisphere mid-latitude thermoclines suggest a widespread slowing of thermocline ventilation (Emerson et al., 2004; Deuser et al., 2005; Johnson and Gruber, 2006). However, the upper thermoclines of all three southern basin subtropical gyres show increased oxygen, suggesting a increase in southern hemisphere circulation that could be related to recent observations of increased dynamic height and strengthened southern hemisphere westerlies. These changes are shallower than the Antarctic Intermediate Water and within and above the Subantarctic Mode Water, which originate close to the Antarctic Circumpolar Current. Both the salinity and subtropical oxygen changes are consistent with anthropogenic change.

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THE VARIATION OF WAVE SPECTRAL SHAPE UNDER TYPHOON WIND FORCING INCLUDING WAVE-CURRENT INTERACTION

For the improved estimation of the wave spectra, numerical treatment of the nonlinear transfer function (Snl) is crucial because it controls the evolution of the spectral shape. The Interactive Dispersion Approach has been widely used for the computation of Snl, despite it is not able to properly calculate the Snl. To overcome this discrepancy, we implemented the SRIAM method for efficient and accurate computation of the Snl. In this work, we will present case studies of wave evolution under typhoon wind forcing in the Kuroshio region. Associated with the changes of the strong surface wind, characteristic zonal distribution of wave steepness appears ahead of the typhoon. Moreover, quasi-unidirectional wave field can be seen outside the typhoon. From the perspective of wave-current interaction, the Kuroshio also exerts significant influence on the variation of spectral shape. The wave spectral difference between the cases with and without current indicated that the changes of frequency bandwidth and the directional spreading occur inside the countercurrent region. These results indicate that the spectral shape is highly sensitive to the surface wind and current structures.

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EFFECTS OF NUTRIENT ENRICHMENT ON RELEASE OF DISSOLVED AND PARTICULATE ORGANIC MATTER FROM REEF-BUILDING CORALS

Coral branches of Acropora pulchra were incubated in nutrient-enriched seawater (5 µmol l⁻¹ nitrate, 0.3 µmol l⁻¹ phosphate) for 1-22 d, and effects of the nutrient enrichment on organic matter release from the corals have been investigated. Release rates of dissolved and particulate organic matter (DOM and POM) were measured by bottle incubations in gently stirred seawater for 5 h. The results have shown that the nutrient enrichment enhanced POM release rates per unit surface area of the corals at daytime, while the effect was not found for DOM. Symbiotic algal cells released from the host accounted for only 10% of the released POM, but release rates of chl a were significantly correlated with those of the bulk POM. These suggest that symbiotic algal and other POM such as coral mucus were simultaneously released as a result of the nutrient enrichment. Inorganic nutrients have been considered to enhance symbiotic algal photosynthesis and consequently reduce coral calcification. This study has suggested that the imbalance between the two processes could be alleviated by POM release to the ambient seawater, rather than DOM.

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A ROLE OF MESOSCALE EDGES IN THE FORMATION OF ANTARCTIC IMMEDIATE WATER

Antarctic Intermediate Water (AIAW) formation mechanism is investigated by using an eddy-resolving ocean model. It is found that eddy-induced transport plays an essential role in the formation of AIAW. A surface water with low potential vorticity (PV) in the Polar Frontal Zone of southeast Pacific spreads into Pacific subtropical gyre and also is fed into Malvinas Current through Drake Passage. This low PV water in Malvinas Current encounters Brazil Current at the Brazil-Malvinas confluence and is injected into the Atlantic.

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subtropical gyre by eddy-induced velocity. The downward residual-mean velocity, which is sum of the eddy-induced and usual Eulerian-mean velocity, exceeds 3.1 10^{-4} m/s at the Brazil-Malvinas confluence. This strong downward transport may explain the formation of AAIW in the Atlantic subtropical gyre.

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INTERACTION OF FRONTOGENETIC AND WIND-FORCED INSTABILITIES AND THEIR EFFECT ON SUBMESOSCALE TRANSPORT AND MIXING

In the upper ocean, submesoscale, i.e. O(1) Rossby number, processes develop from wind-forced and frontal instabilities. We examine the dynamical characteristics of the flow and the submesoscale transport of tracers across fronts in numerical simulations where submesoscale processes are at play. We find a correspondence between the conditions for submesoscale processes, such as large Ro and small fRi numbers, and diapycnal transport and mixing. Frontal cups or frontogetic singularities are particularly where submesoscale conditions give rise to large geostrophic velocities and rapid diapycnal transport. Rapid restratification can lead to horizontal spreading. The process of upper ocean re- and de-stratification via frontal instabilities and wind stress are discussed in the context of cross-front exchange. Parameterizations should include both advective and diffusive effects to account for these processes.

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SURFACE CURRENTS INDUCED BY THE WIND ON THE GRAND BANKS - A STUDY OF THE WAVE EFFECTS ON SURFACE CURRENTS

The effects of surface waves on surface currents are investigated using surface drifter data from the Grand Banks and a coupled current-wave drifter model. The theoretical basis of the study is Jenkins’ theory of wave-current interaction in which the surface currents are modified by wind-wave and wave-current momentum transfers. The total surface current is the sum of the wave modified current, the Stokes drift and the tidal current. Jenkins’ formulation was incorporated into the Princeton Ocean Model and applied to the Labrador Sea and the adjacent shelves. The wave energy spectrum from WAVEWATCH III was used to calculate wave transfer and the Stokes drift. A series of model experiments were conducted to simulate the drifter trajectories and examine the sensitivity of the simulations to model parameters. The results show that the Stokes drift is the dominant wave effect, which increases the surface drift speeds by 35% and veers the currents toward the wind directions. The net effect of wind-to-wave and wave-to-current momentum transfers reduces the surface speeds by a fraction. A statistical analysis of the model currents and drifter data shows that the inclusion of the wave effects improves the model simulations significantly. A sensitivity study shows the model surface currents are most sensitive to the surface eddy viscosity and the wave energy spectra.

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IT’S GOOD TO BE BIG!!! - PHAEOCYSTIS ANTARCTICA COLONY SIZE UNDER THE INFLUENCE OF ZOOPLANKTON GRAZERS

The diaptomous Phaeocystis antarctica forms extremely dense accumulations in the Ross Sea, Antarctica, and can account for over 60% of the region’s seasonal primary production. As with the northern Phaeocystis species, P. antarctica exists as solitary cells and mucilaginous colonies that differ by several orders of magnitude in size. Recent experiments with P. globosa suggested that colony formation is a defense mechanism against small grazers. As part of the ESCAP project we conducted incubation experiments at McMurdo Station during the austral summer using natural P. antarctica and zooplankton assemblages. Dialysis bags were used to separate P. antarctica and zooplankton in the incubators but allow exchange of dissolved chemicals. Geometric mean colony size decreased by 35% in the control, but increased by 30% in the presence of grazers even without physical contact. P. antarctica growth rate in terms of chlorophyll a or POC was unaffected, and it ranged 0.26 to 0.28 per day. While our observations support the notion that colony formation is a defense mechanism against grazing, the cost of such mechanism, as predicted by defense theory, remains unknown.

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THE ARCTIC OCEAN SINK FOR ANTHROPOGENIC CO2

The concentration and inventory of anthropogenic CO2 (Cant) in the Arctic Ocean is poorly known despite its relatively large volume of well ventilated waters. We use a synthesis of available CFC and SF6 measurements from close to ten thousand individual tracer samples to calculate the Arctic Ocean Cant inventory. For these calculations we have used the Transit Time Distribution (TTD) method, where the TTD is calculated from the tracer data, and then applied to the known atmospheric CO2 increase, assuming time-invariant air-sea exchange of CO2, to calculate the oceanic Cant content. The Cant field is then integrated over the Arctic Ocean and the inventory is calculated. For this we find that the Arctic Ocean holds about 2% of the total global oceanic Cant inventory. We will show horizontal distributions of Cant as well as depth integrated profiles from the individual basins.

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SIZE SPECTRA OF EUKARYOTIC NANO- AND MICROPLANKTON IN THE CALIFORNIA CURRENT ECOSYSTEM

We examined the size spectra of nano- and microplankton as a function of environmental variability in the California Current system. Water samples were collected during May 2006 at eight depths in five distinct water parcels, varying from eutrophic coastal water to oligotrophic open ocean. For each assemblage, heterotrophic and autotrophic protists were quantified and sized using digital image epifluorescence microscopy, and size spectra were examined as continuous distributions of exceedence. Among the different waters examined, auto- and heterotrophs show similar size spectral patterns in the mixed layer, which may be a general system characteristic. The spectra, however, diverge at depth, with larger heterotrophs and smaller autotrophs becoming proportionally more abundant at the base of the euphotic zone. Predator-prey dynamics underlying these size relationships are being explored experimentally and in food web models.

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EFFECTS OF SUBMARINE GROUNDWATER DISCHARGE ON SEASHELL ECOSYSTEM IN THE COASTAL ZONE

Submarine groundwater discharge (SGD) is recognized as an important pathway from land to ocean, not only for water and dissolved material transports but also for ecosystem in the coastal zone. Strontium isotope ratios of the shell (clam and oyster) in Omaehama and Edajima, Japan, were examined to evaluate the ratio of fresh water component of SGD. The relationships between the size/distribution numbers of the shell and Sr isotope ratio were examined. The seepage meters (for SGD flux), piezometers (for groundwater potential), optical fiber cable (for sea bottom temperature) and resistivity (fresh-salt water distribution) measurements had been also made to evaluate the flux and quality of the SGD. The distribution numbers of the clam in Omaehama agreed with the magnitude of the fresh component of SGD. The relationships between the size of the oyster and fresh water component of SGD have been examined. SGD may be one of the important geophysical and chemical factors for the seashell ecosystem in the coastal zone.

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TAKING IT TO THE STREETS: SEAS MOBILE LABORATORY EXPOSES STUDENTS TO OCEAN SCIENCE RESEARCH

To support inquiry-based field activities in local K-12 schools, Florida Tech recently purchased and renovated a 35 ft recreational vehicle that serves as a mobile laboratory. SEAS Lab seeks to improve ocean literacy by exposing students to the tools and techniques used by marine scientists. The lab also gives schools access to equipment and resources they would otherwise be unable to afford. SEAS can accommodate up to 12 students and includes 22 ft of bench space, five computers, a GPS unit, filtered seawater, and a multi-sensor weather station. The lab also gives schools access to equipment and resources they would otherwise be unable to afford. SEAS Lab offers access to equipment and resources that would otherwise be unable to afford. SEAS Lab offers access to equipment and resources that would otherwise be unable to afford. SEAS Lab offers access to equipment and resources that would otherwise be unable to afford. SEAS Lab offers access to equipment and resources that would otherwise be unable to afford. SEAS Lab offers access to equipment and resources that would otherwise be unable to afford.
TEMPORAL VARIABILITY IN MICROBIAL COMMUNITIES AND ACTIVITIES WITHIN THE PHYSICO-CHEMICAL CONTEXT OF THE CARIACO BASIN

Monthly to semi-annual observations collected for over a decade at the CARIACO time series illustrate that microbial inventories and heterotrophic productivity in the upper 100 m vary to 20-fold annually, similar to primary production but out of phase. Microbial variables within the redoxcline (200-450 m) and in deeper anoxic waters vary over similar ranges, and appear uncoupled from surface processes. Recent phylogenetic analyses using 16s rRNA illustrate that bacterial community structure is also highly variable, suggesting that varying physico-chemical conditions favor different eukaryophytes, thereby altering relative contributions of identifiable ribotypes to the community. Through times series and non-parametric statistical analyses, we explore how microbiological variables relate to physical, chemical and other biological variables, including upwelling intensity, water mass intrusions, nutrient inventories, DO/CPOC, primary production, sources of mortality, and vertical fluxes of organic matter.

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INVESTIGATING THE SOURCES AND TRANSPORT OF ORGANIC CARBON USING INTACT BACTERIAL HOPANOLYS

Intact bacteriohopanepolys (BHPs) are pentacyclic triterpenoids with poyfunctional sided chains found ubiquitously throughout the geosphere. These structurally diverse compounds have been isolated as cell membrane lipids from a range of prokaryotes, including methanotrophs, acetic acid bacteria, cyanobacteria, and purple non-sulfur bacteria. Their recalcitrance allows intact BHPs to be considered as ideal biomarkers for tracing the input and movement of microbial-derived organic carbon within estuarine and marine systems. The Chesapeake Bay and Arctic Ocean are differing sedimentary environments with varied carbon sources and significant amounts of both marine and terrestrial derived organic carbon. In transects of surface sediments from both systems, we determined the distribution of intact BHPs using atmospheric pressure chemical ionization liquid chromatography/multi-stage ion trap mass spectrometry (APCI-LC/MSn). This information is being integrated with a suite of lipid biomarkers to examine the carbon sources, transport and preservation in these two systems.

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OBSERVED OCEANIC RESPONSE UNDER HURRICANE IVAN

Current moorings with wave/tide gauges were deployed on the outer shelf and slope in the northeastern Gulf of Mexico. Fortunately, Hurricane Ivan passed directly over these moorings. Currents greater than 20 cm/s were measured. Strongest currents were found to be to the left of the hurricane path on the shelf but were to the right of the track on the slope. During Ivan’s approach, shelf currents followed Ekman dynamics with overlapping surface and bottom layers. As Ivan passed over the moorings, the shelf currents transitioned to a deepening surface boundary layer. Bottom currents were wind driven near the surface at the onset of Ivan but deeper in the water column subinertial waves with characteristics of topographic Rosby waves and periods of 2-5 days were excited during Ivan’s passage. Near-inertial motion lasting for about 10 days was generated by the storm. A record wave height of 27.7 m and an extreme bottom scour of 0.36 m at 60 m water depth were measured. Surface momentum transfer was calculated from measured currents and peaked at winds of 32 m/s before decreasing.

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ANOMALOUS FAST DRIFT OF A SURFACE-INTENSIFIED EDDY NEAR STEEP CONTINENTAL SLOPE

The first data sets of the EGYPT cruises in the eastern Mediterranean sea reveals a large meso-scale vortex traveling along the Libya-Egyptian shelf. Surface drifters trajectories combined with a CTD transect quantifies the horizontal and the vertical structure of this surface-intensified anticyclone. The observed westward drift speed is significantly faster than expected from the beta-effect only. To investigate the eddy dynamics we used a two-layer idealized model with steep continental slope and zonal boundary. An integral momentum balance for the upper layer is used to derive the vortex center velocity assuming a circular dome interface at the leading order. This approach reduces the problem to the
ASLO/AGU/TOS/ERF

IMPLICATIONS FOR LANDSCAPE SELF-ORGANISATION AND STORM SURGE VEGETATION-FLOW INTERACTIONS IN COASTAL WETLANDS: HERMANS, P. M.

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VAN DE KOPPEL, J.

van Dongeren, A.

Hoekstra, P.

ten Haaf, A.

Terhorsa van Scheltinga, A. D.

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ocean models the sea-ice dynamics is modeled by a momentum balance, which includes a conservative law that relates the ice stress to the strain rate and sea-ice strength. This law requires a parameterization for the sea-ice thickness distribution and sea-ice strength. Most models use simple formulations with spatially constant empirical parameters, which is known to be insufficient in most cases. An improvement is to allow for spatially varying parameters and using data-assimilation to estimate these parameters from observations. We present results of an estimation of local values of a crucial parameter, p, using a local SAR filter to assimilate satellite observations and detailed in-situ observations of sea ice parameters into the high-resolution finite-element ocean model FEMO of the Arctic Ocean. The model is forced by high-resolution atmospheric variables. Furthermore, on a higher level, optimal parameterization formulations of the sea-ice thickness distribution and strength are determined using this highly-detailed observation set.

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**OBSERVATIONS ON THE TRANSPORT AND STRUCTURE OF THE PANAY STRAIT OVERFLOW**
The Philippine Archipelago is composed of deep ocean basins, interconnected by a network of straits. The renewal of the deep waters of the Sulu Sea from the South China Sea by westward overflow with the Panay Strait measurement in June 2007 (Moore et al., 2008) ADCP and an array of lowered ADCP stations observed strong bottom intensified overflow into the Sulu Sea. The mean transport is estimated to be 0.31 Sv, with the maximum and minimum transports during the ~3 week deployment at 0.52 Sv and 0.11 Sv, respectively, and coinciding with spring tides. The estimated residence time of the sub-sill waters within the Sulu Sea is 10 years. Some of the overflow we observed flowed toward the shallower sill at a depth of ~600m, just below sill depth. This counter-current may be induced by entrainment of ambient water into the dense overflow. Substantial geothermal heating influences stratification within the deep Sulu Sea.

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**PIECOLONKTON ABUNDANCE AND DIVERSITY IN A HYPER-EUTROPHIC LAGOON**
Picoplankton (cells with a diameter of 0.2-3 µm) is the dominant contributors to both primary production and biomass in the ocean. Most of the studies on picoplankton were conducted in the oligotrophic open sea but few in the eutrophic area. In this study, we investigated different picoplankton populations (Synechococcus, Prochlorococcus and picocyanobacteria) and their correlation with environmental factors (temperature, NO3, N2O, PO4, and total Chl a) in a hyper-eutrophic marine coastal lagoon (Dapeng Bay, Taiwan). We also used small subunit ribosomal RNA (18S rDNA) gene sequence to investigate the genetic diversity of picoeukaryotes in this area. The results show that all three picoplankton populations varied seasonally, and were significantly influenced by PO4 concentrations. Picoeukaryotes diversity included Alveolates, Stramenopiles, Haptophyceae, Viridiplanetae and Metazoa. Among them Stramenopiles and Metazoa were the dominant ones. Some of the sequences represented previously unknown marine species. Overall the study shows that picoplankton abundance in the eutrophic area was high, however the diversity was relatively low as compared to other parts of the world.

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**A SEVERE NITROGEN DEFICIT IN THE LOWER ST. LAWRENCE ESTUARY: THE IMPORTANCE OF BENTHIC NITRATE ELIMINATION**
Water column nutrient concentration and benthic fluxes were measured in the LSLE and the Gulf of St. Lawrence in order to understand nutrient budgets in the SL system and their potential link to hypoxia the LSLE bottom waters. Using N2 as an integrative tracer of the balance between N inputs and losses, we observed a severe nitrogen deficit (i.e. low N) in and around the hypoxic zone, indicating active nitrate elimination in the deep LSLE. The St. Lawrence River is characterized by high N input from the watershed. Benthic N fluxes were calculated from water column gradients. Nitrate fluxes into the sediments were significantly higher in the LSLE (115-184 µmol.m-2.day-1) compared to the Gulf (84-95 µmol.m-2.day-1), suggesting that hypoxic bottom waters enhance benthic denitrification rates. Benthic O2 fluxes were measured using micro-electrodes, and could be used to estimate the rate of nitrate loss due to coupled nitrification-denitrification. Estimates of total denitrification rates were 4 to 5 times higher than diffusive nitrate fluxes, highlighting the important role of nitrification-denitrification coupling as major N elimination pathway in the LSLE sediments.

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**WORMS AND GLOBAL CHANGE: WHY COULD CLIMATIC CHANGES ALTER MARINE POPULATION CONNECTIVITY AT DIFFERENT TEMPORAL SCALES?**
For most marine invertebrates, dispersal plays a significant role on populations/dynamics, biogeography and speciation. In this context, the present work highlights the influence of both past and present climatic changes on the connectivity of marine populations, focusing on the past demography and the actual distribution patterns of three polychaetes species in the NE Atlantic. First, molecular studies show a strong phyleogeographic break along the Lusitanian/Boreal biogeographic transition zone. Second, the actual impact of climatic changes on larval phenology (spawning period, planktonic larval duration) is assessed from the analysis of Continuous Plankton Recorder data in the English Channel and the Bay of Biscay over the last 4 decades. Third, a 3-dimensional bio-physical model of the study area is developed, including a Lagrangian dispersal procedure with specific larval behaviour; to explore how complex seasonal hydrodynamic features (e.g. gyres, upwellings) could alter larval dispersal and connectivity: dispersal kernels and connectivity matrices for several climatic scenarios are analyzed as a function of spawning release date and larval durations.

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**LARGE, MOTILE EPIFAUNA INTERACT STRONGLY WITH HARPACTICOID COEPODE AND POLYCHAETE AT A BATHYAL SITE**
The strengths of interactions in deep-sea-sediment communities are poorly known. Large, motile-epifauna (~ 1 LME), such as sea cucumbers, occur in the deep sea and have the potential to interact strongly with the infauna. Off southern California at 780 m depth, we excluded the LME from five 75-cm by 75-cm plots with cages. After 143 days, we sampled these plots and five plots of the same size paired with them as controls. The abundances of harpacticoid copepods and polychaetes were significantly lower in cages than in controls. In three cages, the nematodes and kinorhynchus were dramatically less abundant than in paired controls. The results suggest that the LME ordinarily affects the infaunal assemblage in such a way that harpacticoiids and polychaetae (and perhaps nema todes and kinorhynchs) can maintain higher abundances than they can in the absence of LME, indicating that strong interactions can influence the organization of deep-sea sediment communities. In a multivariate analysis of environmental parameters, cage and control samples were intermixed, so how the LME transmit their effect is not clear.

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**BIOGEOGRAPHY OF THE OCTOCORAL GENUS PARAMURICEA ON ATLANTIC SEAMOUNTS: EVIDENCE FOR MULTIPLE INVASIONS OF THE NORTHWESTERN ATLANTIC DEEP SEA?**
The Corner Rise and New England seamount chains extend north-westerly from the mid-Atlantic ridge to the North American continental margin. To understand the biogeography of the deep-sea fauna in this region, we collected 78 octocoral colonies (genus Paramuricea Kölliker, 1865) from depths between 220-2200 m spanning these seamounts and two locations on the continental margin (Oceanographer Canyon; Gulf of Maine). DNA sequencing of the mitochondrial msh1 gene reveals four haplotypes (denoted A-D) and suggests three or four species. Type C is the most geographically widespread, spanning the continental margin seamounts to the easternmost seamounts, and is the only haplotype observed on the isolated, off-shelf Mur Seamount. Type B has a similar distribution to C but does not extend as far west or south. Haplotype A & D, evolutionarily the most recently derived, are associated with continental margin habitats; all colonies sampled from the continental slope are type A. Haplotype A & D are more closely related to a haplotype from Hawaii than to B or C, suggesting possible multiple invasions of Paramuricea species into the western North Atlantic deep sea.

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**COMPARISONS OF CHLOROPHYLL VARIABILITY BETWEEN THE CALIFORNIA AND HUMBOLDT CURRENT SYSTEMS: LINKAGES TO LOCAL VERSUS NON-LOCAL FORCING**
Ten years (Sept 1997 - Aug 2007) of SeaWiFS satellite data over the California and Humboldt Current Systems are used to quantify interannual variability of chlorophyll concentrations. Variability is characterized as both biomass anomalies and as shifts in underlying temporal variance structure quantified and isolated with wavelet analysis. Dominant patterns in each system are summarized first as EOF decompositions. As a function of latitude, concentrations averaged over the 100km closest to the coast capture the majority of upwelling and shelf-related chlorophyll biomass anomaly variability. Maximum negative anomalies are associated...
with the 97-98 El Nino, strongest off Peru, central Chile and the U.S. Pacific Northwest. Strongest positive anomalies are in 2001-2002 and in late 2005 in the California Current, and in 2002-2004 off Peru and 1998-2000 off central Chile. We isolate strongest temporal chlorophyll variance within specific frequency bands and as a function of cross-shelf distance. Dominant interannual signals of both biomass anomaly and temporal variance are compared first to each other and then to concurrent local wind forcing and basin-scale climate-related signals to gauge the importance of local versus non-local forcing.

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FRICION, FRONTOGENSESIS AND THE STRATIFICATION OF THE OCEAN SURFACE MIXED LAYER
The generation and destruction of stratification in the surface mixed layer of the ocean is traditionally considered to result from vertical turbulent transport of buoyancy momentum driven by air-sea fluxes and stresses. However, the magnitude and penetration of vertical fluxes is strongly modified by horizontal gradients in buoyancy and momentum. A classical example is the strong restratification resulting from frontogenesis in regions of confluent flow. In this presentation it will be shown that frictional forces acting on a baroclinic current can also modify the stratification by driving Ekman flows that differentially advect density. Scales are constructed for the relative importance of friction versus frontogenesis in the restratification of the mixed layer. High resolution numerical simulations of mixed layer fronts forced by both wind-stress and confluence are performed to test the scalings. Both the simulations and scalings suggest that for wind-stress magnitudes, mixed layer depths, cross-front density gradients, and confluence typical of the ocean, wind-induced friction is as or more important as frontogenesis in the modification of the stratification of the upper ocean.

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STABLE CARBON ISOTOPE DISCRIMINATION BY FORM IC RUBISCO FROM THE METABOLICALLY VERSATILE BACTERIUM RHODOBACTER SPHEROAREIDES
A major factor influencing δ13C values of autotrophic biomass is the degree to which the enzyme carbonic anhydrase contributes to the isotope discrimination factor δ13C. For autotrophs using the Calvin cycle, the primary carboxylase is Rubisco, of which six forms exist (IA-ID, II, and III). Despite the diversity of these enzymes, an ε value of ~25‰ is commonly assumed for modeling studies. ε values ({{\frac{1}{2}}\epsilon / \{k / 1\} × 1000}) have been published for form IA, IB, and II enzymes, but not form IC, which are particularly relevant to marine and aquatic habitats based on their presence in many algal or bacterial nitrifiers. A substrate depletion method was used to determine ε values for form IC Rubisco from Rhodobacter sphaeroides. The ε value was determined to be 22.9‰, which is within the low end of the range measured for form IA and IB enzymes (22-29‰) but greater than ID enzymes (12-19‰). Sampling the full phylogenetic breadth of Rubiscos for isotopic discrimination makes it possible to constrain the range of δ13C values of organisms fixing carbon using the Calvin cycle.

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PRACTICAL APPLICATIONS FOR NUMERICAL MODELING IN SALT MARTH DESIGN, TEXAS GULF COAST
Numerical models can be applied in the design process to assess the function of designed salt marshes on the Texas Gulf Coast prior to construction. Although analysis of geo-morphology is often not rigorously modeled because of financial and/or time constraints, it is important in areas such as the Texas coast where relative sea level rise (RSLR) is greater than the average rate of sediment deposition. Circulation modeling of proposed marsh designs helps assess tidal exchange and flushing via tidal conveyances such as channels and ponds within the marsh complex, but only provides qualitative information about morphology. Morphologic predictions are inferred from circulation modeling but may not be accurate enough to predict survivability of the marsh against RSLR. This presentation will discuss analyses of designed salt marsh systems both before and after construction including methods to analyze circulation, sediment transport, and morphologic changes. Lessons learned about the practical value of numerical modeling of designed marsh systems on the Texas and Louisiana coast will conclude the presentation with emphasis on future research needs from the point of view of a practicing coastal engineer.

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SURFACE DRIFTERS AND TOPOGRAPHY AT THE TIP OF THE ANTARCTIC PENINSULA
Near the tip of the Antarctic Peninsula, topographically-forced frontal jets are important in transporting nutrients and krill larvae from source regions on the continental shelf into the Antarctic Circumpolar Current. However, our understanding of the circulation in this region is limited due to the effects of complex topographical features, the confluence of the jets with the Antarctic Circumpolar Current and a scarcity of observational data. In February 2007, 40 surface drifters were deployed along a section extending from the tip of the Antarctic Peninsula across the continental shelf and slope into the deep Weddell Sea. The fine spacing of the drifters, ~5 km off the shelf break and ~10 km off the continental slope, has enabled the identification of previously unresolved features of the surface circulation including a series of narrow frontal currents, topographically-controlled standing eddies and regions of strong lateral shear. Through the use of simplified models of the flow field, we investigate how physical mechanisms such as potential vorticity conservation and tidal forcing influence tracer transport in this region, especially in governing cross-topography exchanges.

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THE BIOGEOCHEMISTRY OF MODERN OODS: ASSESSING THE ROLE OF MICROBES IN OOID FORMATION
The origin of ooids remains elusive and controversial despite their geologic and economic significance. In this study drifters were deployed in 2007 and 2008 to examine the role of the Gulf Stream in lowering the transport and heat anomalies that we probe a model of ooid formation requiring a diverse redox-dependent microbial consortium at the site of calcification.

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USING HIGH RESOLUTION PROGNOSTIC AND ASIMILATIVE MODELS OF THE NORTH ATLANTIC TO EXAMINE THE ROLE OF THE GULF STREAM IN INTERANNUAL CHANGES IN HEAT TRANSPORT
A 1/10th of a degree prognostic ocean model and a 1/3 of a degree assimilative model of the North Atlantic is used to evaluate the propagation of transport and heat anomalies from the subtropical gyre to the subpolar gyre through the Gulf Stream Extension and recirculation and around the Northwest Corner. The prognostic model (POF, Parallel Ocean Program) is run from 1800 to 1999 in the North Atlantic with daily forcing based on NCEP forecast winds (National Center for Environmental Prediction) with relaxation to observations at the Northern and Southern Boundary. The assimilative model (MERA11) is a reanalysis from 1992 to 2002 that assimilates a variety of observational data and is forced by ECMWF ERA 40 winds and was performed by the MERCATOR group. The assimilative model along with altimetry observations are used to evaluate the fidelity of the high resolution model. The reanalysis product shows evidence for warm anomalies propagating from the subtropical to subpolar gyre. Intertannual variability of the upper ocean heat content in the prognostic model does not reproduce that in the observation, but because the model physics are internally consistent, it can be used to evaluate whether and how anomalies of mass and heat enter the Gulf Stream extension and remain coherent into the subpolar gyre.

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USING STABLE ISOTOPES TO QUANTIFY DIFFERENTIAL VITAL RATES AND AS A MEASURE OF HABITAT QUALITY
Habitat quality is a important measure for the determination of essential fish habitat. There is no standard measure, nor method, for the quantification of habitat quality.
The most often used measures are abundance, growth, and survival. Survival is the best measure yet also the most difficult to quantify. Therefore the use of growth as a proxy for survival is often the best alternative. Biotic factors, which regulate differential growth, can be divided into two major schools of thought: top-down (preyation) and bottom-up (food quality/quantity). We examined the growth of juvenile spotted seatrout on seagrass beds in Chesapeake Bay to determine whether observed differences in juvenile growth were related to bottom-up (diet) influences. We used stable isotopes and stomach contents to conduct a preliminary analysis of bottom-up control on juvenile spotted seatrout growth in the Bay. We found significant differences in carbon sources among the beds, and also provide evidence that in some beds fish may be feeding at different trophic levels. Preliminary stomach content analysis shows some differences in diet which may be reflected in the nitrogen isotope signatures.

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REMOTE ESTIMATION AND VALIDATION OF WAVE BREAKING ENERGY DISSIPATION

Recent observations suggest that the strength of breaking surface waves can be quantified remotely. Specifically, simultaneous remote and in situ measurements of breaking waves are needed to test the Duncan-Phillips formulation for spectral energy dissipation. Visible and infrared images are used to calculate the distribution of whitecaps on Lake Washington, where swell and other motions can be neglected and in situ measurements are collocated for direct comparison. The images are processed using a new method in which the frequency-wavenumber spectrum is mapped to a distribution of crest speeds and energy biasing is avoided. Both the breaking rates and the dissipation rates measured remotely are consistent with in situ measurements. In addition to the passive imagery, active infrared measurements are used to demonstrate the importance of microbreakers, which do not generate foam but do contribute to the total dissipation.

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ASSESSING ZOOPLANKTON PREY SELECTIVITY USING REAL TIME PCR QUANTIFICATION OF PREY DNA

Due to high predation pressure zooplankton prey selectivity is a major modulator of phytoplankton biodiversity. In the past, the general consensus has been that planktonic consumers are more passive filter-feeders or only in some cases able to switch between different feeding modes. Only recently have we turned our attention to prey selectivity and trophic niche differentiation in marine zooplankton. We have tested a method for measurements of prey selectivity by quantification of prey DNA in copepod guts by real-time PCR. Primers and fluorescent oligonucleotide probes targeting LSU ribosomal DNA have been generated and successfully tested for functionality and species specificity in different phytoplankton species regularly used in laboratory grazing experiments. These probes were then used in mixed grazing experiments using a protocol, which allows calculation of selectivity indices without absolute quantification of number of algal cells in the copepod guts. The protocol employs the concentration ratios of target DNA sequences in water and guts. The protocol is scalable for use in testing the response of individuals to different feeding modes. It is also possible to test the response of individuals to different feeding modes. It is also possible to test the response of individuals to different feeding modes.

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SEASONALITY IN CARBON BIODECAY AND INFLUENCE OF NET ECOSYSTEM PRODUCTION ON CO2 SUPERSATURATION IN EUTROPHIC COCHIN ESTUARY, INDIA

The seasonality in carbon biodecay and the influence of net ecosystem production (NEP) on CO2 supersaturation was assessed in the eutrophic Cochin estuary on the southwest coast of India. Dissolved organic carbon dominated total organic carbon and their ratio to particulate organic carbon ranged between 1 and 5. Increase in the dissolved inorganic carbon (DIC) to organic carbon ratio with suspended particulate matter suggests that the maximum turbidity zones could be potential sites for respiration of organic carbon. The community respiration (R) was consistently higher than primary productivity (P), indicating a strong heterotrophic activity. Both the biochemical and biotic respiration contributed 20% of R, suggesting strong heterotrophy (NEP < 0). NEP increased sharply from pre-monsoon (~ 84 ± 91 mgCm-2d-1) to monsoon (~ 171 ± 147mgCm-2d-1), supporting production of excess CO2 (ECO). The increase in CO2 was correspondingly high (~ 10.9 ± 13.4 % of DIC. Strong relationship between P and apparent oxygen utilization (P < 0.001) indicates that respiration is a major factor for CO2 supersaturation (up to 19 times). Our studies suggest that Cochin estuary sustains net heterotrophy all the year round and hence, is a potential source of CO2 to the atmosphere.

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HOW WILL CHANGES IN FRESHWATER INFLOW (FREQUENCY VERSUS MAGNITUDE) IMPACT THE ECOLOGICAL SYSTEM HEALTH OF GALVESTON BAY?

With a rapidly expanding urban population in Texas coastal regions, policy makers, water regulators and managers are faced with the challenge of meeting human needs, potentially by freshwater diversions, while maintaining critical freshwater inflows to estuaries to preserve their overall health. We used a flow-through boat-mounted Dataflow unit and a PHYTO-PAM (Phytoplankton Pulse Amplitude Modulated fluorometer) to map various primary productivity parameters and phytoplankton responses respectively across Galveston Bay throughout 2006. Tightly gridded transects took two days to complete. An integrated GPS allowed us to reference all measurements for each variable. Discrete water samples were collected for nutrient analysis and light/dark bottle primary productivity measurements. We found complex relationships between the freshwater inflow (frequency, magnitude), water quality (temperature, salinity, dissolved organic matter, chlorophyll, nutrients) and phytoplankton responses (productivity, community structure). Spatial and temporal patterns were deconvoluted with seasonality and the magnitude of a freshwater inflow event being the two principal driving factors regulating primary productivity. Understanding these relationships will provide scientists and regulators with information to assess estuary health in Galveston Bay as well as other estuaries along the Texas coast.

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SILICON CYCLING IN THE CARACIO BASIN, VENEZUELA: SEASONAL VARIABILITY IN SILICATE AVAILABILITY AND THE SCN COMPOSITION OF SINKING PARTICLES

A nine-year time series of water column and sediment trap measurements was used to examine silicon cycling within the Caracibo Basin. Annual production rates as high as 9.8 mmol m-2 d-1 occur during winter-spring upwelling. However, even during upwelling, surface waters tend to be depleted in both Si(OH)4- and NO3- as a result of rapid utilization. Surface waters during the upwelling period are marked by Si(OH)4-=NO3- and Si* values less than one, conditions which may restrict diatom production. During non-upwelling conditions, Si(OH)4-=NO3- ratios in the upper 50 m exceed 10, implying that nitrate is limiting production. Particle collected at 150 m depth have average SiC and SiN values of 0.17 ± 0.01 and 1.14 ± 0.10, respectively. These ratios increase with depth to 400 m and then remain relatively constant. Similar depth-dependent changes in these ratios are seen in seasonal transects from the basin. Seasonally, particulate SiC and SiN values are highest when upwelling is most intense, while both ratios decrease to their lowest values during summer-fall. High SiN ratios (~3.0) during upwelling are similar to values observed in areas where Fe-limitation occurs.

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OVERFLOW OBSERVATIONS ON THE MID-ATLANTIC RIDGE

Observational evidence suggests that there are tens of thousands of overflows located in canyons on the global mid-ocean ridge system. The high levels of diapycnal mixing associated with these overflows makes them important for the abyssal buoyancy budget and, hence, for the global overturning circulation and for the Earth’s climate. In recent years, a variety of physical oceanographic data have been collected at several such overflows on the Mid-Atlantic Ridge. Common characteristics include hydrographic evidence for “Bermoulli suction” upstream of the sills, gravity currents downstream of the sills, hydraulic transitions, as well as lee waves. While the kinetic energy near the sills is typically dominated by the (quasi-steady) overflow currents, there is significant variability, especially at tidal frequencies. At distances greater than a few kilometers from the sills, the tides usually dominate the kinetic energy. There are several well known processes associated with overflows that can account for the high levels of diapycnal mixing observed there, including interfacial shear instabilities, hydraulic jumps and breaking lee waves. However, the thickest layers of static instability in the water column near two different overflows extending over more than 100m were observed upstream of the sills, suggesting a hitherto undetected process probably associated with temporal variability.

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OBSERVATIONS OF THE EFFECTS OF TURBULENCE ON PARTICLE SIZE DISTRIBUTIONS IN AN ESTUARINE BOTTOM LAYER BOUNDARY
Estuarine bottom boundary layers (bbls) are an area of intense interest to physical oceanographers. It is here that model levels of turbulence are found, due to high stress and shear rates. Sediment erosion and deposition also occurs in the bbl. The magnitude of turbulence is critical in determining the vertical flux of suspended particulate matter (SPM) and in the presence of cohesive particles the degree of flocculation as well. Here we present concurrent, concurrent observations of dynamics and SPM performed in the bbl of a macrotidal estuary during a 24-day period. The balance of turbulent kinetic energy is considered, in conjunction with variations in the concentration and size distribution of the SPM and its relationship with the turbulent shear rate. Both the turbulence and the SPM are found to vary over a number of tidal frequencies in addition to exhibiting a tidal asymmetry. Possible explanations for these findings are suggested and their implications considered.

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PRIMARY PRODUCTION IN THE NORTHWESTERN SARGASSO SEA: 19 YEARS OF DATA FROM THE BERMUDA ATLANTIC TIME-SERIES STUDY.
Measurements of primary production using in situ 14C incubations have been carried out at the Bermuda Atlantic Time-series Study (BATS) site monthly since October 1988. Strong seasonal variations in depth integrated primary production (PP) values have been shown to exist, characterized by a marked increase in surface layer productivity from February to March, from 7.2×10^{-2} Wm^{-2} to 7.2×10^{-3} Wm^{-2} in the winter, and a gradual decrease to 7.2×10^{-5} Wm^{-2} in the spring and summer. These results are compared to PP values for the Sargasso Sea obtained from measurements off the Bermuda Rise (BRL). Both BATS and BRL show very high variability in PP values, especially in the surface layers, with seasonal variation and interannual trends. Additionally, we report continuing experiments comparing differences between sampling from CTD Niskin bottles and trace metal clean GoFlo deployments. Initial experiments have shown very high variability between the CTD and GoFlo methods (Ncv = -70), however more recent comparisons suggest a closer correlation (typical Ncv = -25).

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MIXING ON CONTINENTAL SHELF AND SLOPE OF THE NORTHERN SOUTHERN CHINA SEA
A mixing experiment was performed from 20 April to 5 May 2004 on the continental shelf and slope of the northern SCS. The observation shows that the intensified turbulent mixing on the shelf is due to the internal wave breaking and the salt finger mixing on the slope, which is attributed to the intrusions of North Pacific Tropical Water and North Pacific Intermediate Water. The mixing is more intense on the shelf, with both the dissipation rate of TKE ε (7.2×10^{-6} Wm^{-2}) and of thermal variance χ_{θ} (1.1×10^{-5} Wm^{-2}) one order larger than that on the slope. The eddy diffusivity for density K_{θ} in doubly stable regions is 2.3×10^{-4} m^2 s^{-1}, almost equivalent to the eddy diffusivity for heat K_{θ} (2.3×10^{-4} m^2 s^{-1}). The study results demonstrate that turbulence also contributes to the mixing even in the finer-scale favorable regime. Furthermore, the mixing efficiency was estimated, giving 0.08-0.27 in doubly stable regions, and 0.7-1.5 in salt finger regions.

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MODEL-BASED ANALYSES OF NUTRIENT AND CARBON CYCLING ON THE U.S. EASTERN CONTINENTAL SHELF
Continental shelf systems represent an important, but poorly quantified component of the global nitrogen and carbon cycles. In this study, simulations obtained from a one-dimensional biogeochemical model developed for the U.S. eastern continental shelf are analyzed to assess nitrogen and carbon cycling processes. The one-dimensional model includes lower trophic level interactions with and without explicit dissolved organic matter dynamics and is forced by advective fields obtained from a three-dimensional implementation of the same biogeochemical model. Taylor diagrams are used to compare simulation results from specific regions of the continental shelf with observations. These provide an evaluation of model skill as well as insights into adjustments that are needed for the rates and parameterizations used to simulate phytoplankton processes. Analyses of preliminary simulations suggest strong regional variability in the skill of the model to predict surface chlorophyll concentrations. However, for clarity, we focus on a few of these data assimilation studies, provide an approach for understanding regional differences in model skill.

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USE OF REMOTE SENSING AND PROCESS-BASED MODELS TO EXAMINE THE DISTRIBUTION AND TRANSPORT OF DISSOLVED ORGANIC CARBON IN WATERSHEDS AND ADJACENT COASTAL WATERS
We introduce a GIS-based integrative modeling approach to examine the sources and transport mechanisms of dissolved organic carbon (DOC) from terrestrial ecosystems to coastal oceans. The modeling is based on a set of in situ measurements collected monthly from the last two years. A soil and water assessment tool (SWAT) was adopted as a framework to predicting DOC transport processes and linking them with terrestrial biophysical properties. First, the paper discusses a statistical analysis of in situ measurements of fresh-water DOC endmember samples and examines their spatial variability with precipitation, season, hydrological processes, and soil physical characteristics. Then we present a predictive model describing the seasonal and spatial patterns of terrestrial DOC sources as well as daily fluxes to coastal water. Our study shows that terrestrial sources of DOC can be associated with biophysical and climate conditions that are obtainable using GIS and remote sensing. The model has been tested in the Neponset and Hudson watersheds in the northeast USA.

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ATMOSPHERIC FE DEPOSITION MODES AT BERMUDA AND THE ADJACENT SARGASSO SEA
Atmospheric fluxes of Fe were determined from bulk (wet + dry) and wet deposition, and aerosol concentrations at Bermuda from 1999 to 2001. Dry deposition dominates (>70%) total Fe deposition during this period from proximate continental dust sources and sausal pattern of precipitation. Longer Bermuda records show dry deposition positively correlates with the North Atlantic Oscillation (NAO) winter index. Conversely, wet Fe deposition dominates during negative NAO as the Bermuda high relaxes promoting wet deposition of summer. Dry Fe deposition velocities (DDV-Fe) calculated from measured bulk-wet fluxes show a large range but consistent seasonal trend. During the summer, the DDV-Fe ranged from 0.1 to 0.3 cm/s, but during the fall and winter ranged from 2.0 to 6.0 cm/s, averaging 1.7 cm/sec annually and close to model assumptions. Increase humidity and wind speeds at Bermuda during fall and winter could cause local marine particle aggregation as shown elsewhere, when mineral aerosols internally mix with sea salt and gaseous pollutants. This could increase the apparent DDV-Fe in the fall and winter atmosphere of the subtropical North Atlantic.

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INTERANNUAL VARIABILITY IN THE INDONESIAN THROUGHFLOW
A times series of the monthly Indonesian Throughflow (ITF) velocity and transport from 1958 through 2004 is calculated from interoscean pressure differences in the Simple Ocean Data Analysis (SODA) output. The 2004 velocity and total transport are compared to in situ mooring data from the Makassar Strait, providing validation for the relationship between interannual variability of the ITF transport and the Southern Oscillation and the 1993-1997 El Niño event. These results demonstrate that variability of the ITF transport is correlated to the NINO3.4 index, showing an increase (decrease) in transport in La Nina (El Nino) years. The relationship between the ITF, both in terms of its profile and its total transport, and the Indian Ocean Dipole has been investigated via EOF and Fourier analyses.

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ICE-TETHERED PROFILER OBSERVATIONS OF A DOUBLE-DIFFUSIVE STAIRCASE IN THE CANADA BASIN THERMOCLINE
Ice-tethered Profilers (ITP) deployed between 2004 and 2007 provide year-round temperature and salinity measurements of a double-diffusive staircase centered around 200 m depth at the boundary between water of Pacific origin and the relatively warm and salty Atlantic Layer in the Canada Basin (Arctic Ocean). A well-formed staircase found throughout the central Canada Basin indicates that double-diffusion is the dominant mechanism for upward heat transport from the Atlantic Layer in this region. The double-diffusive staircase supports heat fluxes of 0.2-0.3 W/m^2, with lowest values in the eastern sector of the basin, and with no apparent seasonal dependence. Heat fluxes are about 50% greater than found in a study of the region two decades ago, a manifestation of the recent warming of the Atlantic Layer. The staircase is absent in near-boundary regions of the basin (ice-breaker CTD data from the Beaufort Gyre Freshwater Experiment), where it appears that enhanced turbulent boundary mixing could yield a greater regionally-averaged heat flux.
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The influence of mariculture on microorganisms in the water and sediment around the fish cage in the Gulf of Trieste

A multidisciplinary approach was used to identify and quantify the most relevant physical, chemical and biological indicators to determine the impact of a fish farm on the surrounding ecosystem in the Gulf of Trieste (Northern Adriatic) within ECASa project. A synoptic sampling system was designed to provide accurate data at different sampling locations (water column, sediment) and different time intervals (before and after feeding in October 2005, April and July 2006). A set of environmental parameters: basic oceanographic parameters, currents, total suspended matter (TSS), nutrients, redox potential, chlorophyll a, phytoplankton pigments, bacterial chlorophyll a and phaeopigments, bacterial abundance, and bacterial production were assessed. Preliminary results showed significant differences in bacterial abundance, community composition and growth rates related to pre-feeding and post-feeding around the fish cage. Analysis of bacterial phyto-plankton biomass, nutrients and redox potential showed a high influence on sediment below the fish cage.

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NUTRIENT DISTRIBUTION ACROSS THE INSULAR SHELF OF PUERTO RICO: ASSESSMENT BY ALGAL TISSUE NITROGEN

A survey was conducted to investigate possible presence of an inshore to mid-shelf gradient in %N and delta 15N tissue content of Acanthophora spicifera in coastal waters of La Parguera, southwest Puerto Rico. Percent N was highly variable along the shoreline (1.26% (SE = 0.08) to 3.25% (SE = 0.10)). Higher values were associated with well developed mangrove stands and lower values corresponded with less developed mangrove areas. The higher values were also significantly greater than A. spicifera collected at mid shelf. The reverse trend was observed for delta 15N inshore (2.06ppt (SE = 0.04) to 8.16ppt (SE = 0.14)). However delta 15N was generally lowest (1.86ppt (SE = 1.2) to 2.03ppt (SE = 0.05)) at mid shelf. The exception was delta 15N inshore downstream (delta 15N increased by secondary sewage input and a bird rookery. Results from both %N and delta 15N algal tissue content indicate low transport of nutrients from the coast to mid shelf.

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PHYSICAL AND BIOLOGICAL OBSERVATIONS IN SAN PEDRO BAY, CALIFORNIA USING SPRAY GLIDERS

Two Spray gliders measured physical and biological characteristics in San Pedro Bay, California during September-October 2006 as part of the Huntington Beach 2006 experiment. Measurements at 3 km or smaller resolution revealed a subsurface salinity minimum throughout the region at depths of 20 to 40 m. Fluorescence measurements indicated a subsurface chlorophyll maximum near the base of the salinity minimum. Acoustic backscatter showed most populations coincident with the chlorophyll maximum at night, and migrating to approximately 200 m during the day. Mean currents were generally northwestward along the coast. Two cyclonic eddies were identified based on salinity anomalies. The physical and biological observations allow us to better understand a region that is heavily influenced by anthropogenic activity.

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MENDING THE MAMMOTH AND THE MOMENTUM - CHAOS IN THE THERMAL BOUNDARY LAYER

Experiments in open channel flume are conducted to observe the effects of a live plant canopy on mean and turbulent flow structure under low speed flow conditions. Since flow structure is strongly affected by plant morphology and canopy density, real flexible plants are used to more realistically represent natural features and thus investigate the dependence of the flow field on the underlying vegetation. A detailed analysis is carried out using particle image velocimetry (PIV) techniques to measure the velocity field at the edges and within the canopy, and laser induced fluorescence (LIF) is used to look at advection and dispersion processes to determine both momentum and mass transport. The experimental results are discussed and comparisons made to predictions based on existing models in an effort to verify the model's usefulness. Additionally, we investigate typical assumptions that have been made in the literature to simplify the problem.

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UNDERSTANDING THE PREDICTABILITY OF CLIMATE SIGNALS IN OCEAN MODELS

Quantifying the behavior of system and its ability to predict future states depends partly upon how skillful a model is in replicating a known state. The large scale, inter-annual variability of ocean models is assessed to quantify their ability to predict future states. First, statistically stationary areas that are important to climate are identified from observations examined over a given period (in this case before and after feeding in October 2005, April and July 2006). A set of environmental parameters: basic oceanographic parameters, currents, total suspended matter (TSS), nutrients, redox potential, chlorophyll a, phytoplankton pigments, bacterial chlorophyll a and phaeopigments, bacterial abundance, and bacterial production were assessed. Preliminary results showed significant differences in bacterial abundance, community composition and growth rates related to pre-feeding and post-feeding around the fish cage. Analysis of bacterial phyto-plankton biomass, nutrients and redox potential showed a high influence on sediment below the fish cage.

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PHOSPHORUS FLUX IN THE DEEP SARGASSO SEA AND PARTITIONING BETWEEN LABILE AND REFRACATORY CARRIER PHASES

We report a 1-year record (July 2004–July 2005) of phosphorus (P) flux at the Oceanic Flux Program (OFP) time-series site off Bermuda. We measured P in both the particulate and dissolved (sorphenant) phases in sediment trap samples from three depths (500, 1500, and 2500 m). P-flux varied seasonally, with highest fluxes in the late winter/spring. P concentration and flux decreased an order of magnitude with depth, from an average flux of 260.3 mg m$^{-2}$ d$^{-1}$ at 500 m to 27.1 mg m$^{-2}$ d$^{-1}$ at 3200 m. P partitioning between the solid and dissolved phase also varied with depth. At 500m, 76.9% of P is dissolved, while at 3200m, only 23.2% is dissolved. There was no correlation between the dissolved fraction and the duration in the trap cup before recovery, indicating that P leached from the sediment/organisms reached a stable equilibrium within two weeks. The decrease in the leached P fraction with increasing depth suggests that mesopelagic depths, most P flux is associated with labile, easily–solubilized carrier phases, whereas bathypelagic depths most P flux is associated with refractory phases.

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CONTRASTING GLOBAL AND LOCAL SATELLITE-DERIVED SST ESTIMATES IN A MARGINAL SEA

Global SST estimates commonly exhibit near-zero bias almost independently of the sensor used. Going down to regional scale can notably increase it, suggesting spatial dependencies in retrieval accuracies. To assess the performance of IR radiometers in the Adriatic Sea a validation exercise of several days during the autumn period was performed for the year 2003, whereas platform-measured SST was used for the year 2004. Validation results for the SST derived from locally–received NOAA 16 and 17 HIRPT temperature have been also compared to Level2 MODIS Aqua and Terra as well as Pathfinder v5 SST products. Night time results have considerably shown small (less than 2.1$^\circ$C) and rather large (less than 7.3$^\circ$C) increases around the spiral, depending on the distribution of the water mass and the change in water mass age and the rate of increase is variable in space and time depending on the distribution of the water mass age and the change in the rate of atmospheric CO$_2$ increase. The rates of increase of the water column inventories for anthropogenic CO$_2$ at 28N as are 5.6 gC m$^{-2}$ yr$^{-1}$ (1987–1992), 9.6 gC m$^{-2}$ yr$^{-1}$ (1992–2001), and 11.8 gC m$^{-2}$ yr$^{-1}$ (2001–2006).
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**EFFECTS TOWARD FORECASTING HARMFUL MICROCYSTIS AERUGINOSA BLOOMS IN WESTERN LAKE ERIE**

The toxic cyanobacterium, Microcystis aeruginosa, has become a dominant component of the summer phytoplankton assemblage in the Great Lakes. Regional blooms have caused concern due to the use of these waters for recreation and as a source of drinking water. Research efforts are now underway to develop the capability to detect and monitor M. aeruginosa blooms in western Lake Erie. M. aeruginosa blooms have unique optical properties, due to the production of surface scum and the presence of phycocyanin, an accessory pigment. MERIS, a European ocean color satellite, has increased spectral resolution relative to MODIS and SeaWiFS, which aids in differentiating cyanobacteria from other phytoplankton. Various satellite derived products that have shown promise in detection are being combined through a rule-based model in an attempt to distinguish M. aeruginosa blooms from other non-harmful blooms. In addition, a hydrodynamic model has been developed for Lake Erie. These tools will be combined through the General NOAA Operational Modeling Environment to determine the usefulness of these models for monitoring M. aeruginosa in the western Lake Erie, through a retrospective case study.

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**VALIDATING THE INTERNAL TIDES OF OPERATIONAL OCEAN MODELS USING QUANTITATIVE PROFILE DATA**

Operational ocean models with astronomical forcing, similar to the real ocean, generate internal baroclinic gravity waves when barotropic tide distorts stratified water near abrupt bathymetric features. These waves, commonly referred to as internal tides, are challenging to reproduce in ocean models because phase, amplitude, and modal structure all depend on the current state of the ocean. Methods to compute and quantify model accuracy from ocean profile sequences of adequate temporal resolution are developed.

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**SEASONAL VARIABILITY IN DMS AND DMSP BIOGEOCHEMICAL CYCLING RATES IN THE SARGASSO SEA: A MONTHLY TIME-SERIES**

Monthly vertical profiles of dimethylsulphide (DMS) and dimethylsulphonpropionate (DMSP) biochemical cycling rates are sampled in the Sargasso Sea at the Bermuda Atlantic Time-series Study site. Sampling commenced in September 2005 and consists of 475 radioisotope determinations of DMS photochemical loss rates, biological DMScassumption rates, biological dissolved DMSP consumption rates, and the DMS yield from DMSP accumulation. Clear seasonal cycles are evident in biological DMS consumption with seasonal minima and maxima observed above and below the mixed layer depth respectively during strong summertime stratification. Photochemical DMS loss rates are well correlated to the availability of ultraviolet light suggesting similar chemical precursors across each season. No clear seasonal cycles are evident in DMSP consumption rates or DMS yield. With the exception of shallow summertime depths, microbial activity has the largest impact on common vertical modes allows the complex internal wave structure to be decomposed. Model fidelity is then obtained for individual components. Results include an error analysis of the Relocatable Navy Coastal Ocean Model using glider data.

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**LINE W: A SUSTAINED MEASUREMENT PROGRAM SAMPLING THE NORTH ATLANTIC DEEP WESTERN BOUNDARY CURRENT AND GULF STREAM ABOUT 39Â° N 70Â° W**

Well-resolved records from multiple latitudes documenting interannual signals in water properties and transport of the North Atlantic Deep Water (NADW) system help build understanding of how variations in high-latitude water mass transformation are transmitted equatorward, and the impacts such signals may have on the Meridional Overturning Circulation. These issues motivate the Line W program presently returning observations of the DWBC and Gulf Stream about 39Â° N 70Â° W. The study combines a slope-spanning, hydrographically moored array and twice-yearly hydrographic sections extending along an altimeter satellite track from the continental slope towards Bermuda. Highlights from the analysis of historical and modern data about Line W include: the 2004-2006 estimated time-mean equatorward transport of intermediate and deep waters is 24.4 Sverdrup with 5-day samples ranging between 1.5 and 59.5 Sverdrup; Changes in Labrador Sea water convection products are manifested in Line W intermediate water salinity, PV and CFC within 5 years. A somewhat longer transit time (8-10 years) for deep waters is indicated by Cline-129 concentration data, possibly suggesting a different spreading path.

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**MONITORING SEDIMENT RESUSPENSION IN CORAL REEFS AND SEAGRASS BEDS WITH IN-SITU OPTICAL MEASUREMENTS**

Island ecosystems may be significantly affected by human activities in or near areas of previously pristine environments. Navigation channels have been created in the Bermuda Islands to allow the access of large commercial and cruise ships from outside the reefs in order to transport towards the main ports. Ship traffic overloads sediments which then are transported to reefs and seagrass beds. Variations in the inherent optical properties (IOPs) as well as in the particle size distribution (PSD) were measured in order to estimate the amount and composition of dissolved and suspended materials being resuspended from the sediments. The navigation activities, the amount of those materials reaching coral reefs and seagrass, and the period of time that these resuspension events occur. Two permanent stations were located, one close to the main navigation channel in a coral reef/seagrass environment, and the other in a control area far from navigation activity. Temporal variations of IOPs and PSD were evaluated between high and low traffic periods of cruise ships.

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**THE ENSEMBLED KALMAN FILTER IN ECOSYSTEM FORECASTING: CAN SATELLITE PRODUCTS IMPROVE FORECASTS?**

The localized Ensemble Kalman Filter (EKF) implemented in a 3-D coupled hydrodynamic-ecosystem model (POLCOMS-ERSEM) is evaluated in the Western English Channel (WEC, UK). The WEC encompasses coastal shelf, water, and open ocean inputs. The complex ecosystem model resolves the light-diffuse attenuation at three spectral bands: blue, green and red. Weekly assimilation of 5 day composites of satellite derived surface chlorophyll-a or multispectral attentuations at 440, 550 and 680 have been performed during 2006 and compared with in-situ observations at two stations. The observations include nutrients, diffusive attenuations, chlorophyll-a and phytoplankton biomass of several functional groups. The two year-long stations represent both the coastal regime (L4, weekly data) and the shelf waters (E1, monthly data). A collection of model skill metrics shows both assimilation experiments improve the performance of the system with respect to the "free simulation". The system capability to resolve the phytoplankton successional dynamics coupled with Multidimensional Scaling analysis (MDS). Further analyses include the impact of assimilation on the main carbon pathways therefore highlighting changes to the ecosystem functioning introduced by the sequential assimilation of satellite data.

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**MODELING NEARSHORE HYDRODYNAMICS AND SEDIMENT TRANSPORT USING COBRAS-UC**

Recent advances in numerical modeling provide an opportunity to overcome the limitations of traditional nearshore hydrodynamic models. The volume of fluid (VOF)-type model based on the Reynolds-Averaged Navier Stokes equations, COBRAS, has been applied mostly for laboratory-scale monochromatic wave condition. However, its performance for wave zone processes owing to random wave breaking on field scale sandy beaches has not been investigated. It is the aim of this work to demonstrate the improvement in modeling of wave transformations on beaches using a modified version of COBRAS (COBRAS-UC, Torres-Frevermouth et al. 2007, J. Geophys. Res., 112) which reduces the computational effort, making it suitable for field-scale applications. By extending the numerical model to solve the mixture equations for fluid mud transport (Hsu et al. 2007, J. Geophys. Res., 112) along with a closure of sediment stresses using Bingham rheology, the model can simulate wave propagation, sediment-laden wave boundary layer, fluid transport and wave energy dissipation continuously with one single set of balance equations and closures. Model results obtained here are encouraging for future applications of various cohesive and non-cohesive sediment applications.
Tropical Instability Waves in HYCOM

Evolution and structure of tropical instability waves (TIWs) in HYCOM experiments are compared with those derived from satellite-derived sea surface height (SSH), sea surface temperature (SST), and surface currents in the Pacific Ocean. The wavenumber-frequency-spectral analysis of SSH anomalies shows significant spectral peaks along the dispersion curve of first baroclinic mode Rossby and Kelvin waves. A prominent peak in SSH fields at around 33 days and 1500 km wavelength along the Rossby wave dispersion curve is evident, and a similar peak is also found in SST fields. This upper ocean variability on these space and time scales is shown to be associated with TIWs. The spatial variation of 33-day TIWs are examined based on an analysis of time series filtered in the frequency-wavenumber domain. The maximum variability of SSH associated with TIW is located around 130°W, while that of SST is found around 2N, 100W. The phase relationship between SSH, SST, and surface velocity associated with TIWs is described based on the cross-correlation analysis. SSH and SST anomalies from HYCOM show similar peaks to those in satellite observations. Spatial and temporal structures of TIWs in HYCOM are also described by the same statistical analyses and discussed based on the comparison with those from satellite observations.

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High Resolution Ross Sea Phytoplankton Primary Production Estimated by Multiple Variable Fluorescence Approaches

As part of CORSACS (Controls on Ross Sea Algal Community Structure), we characterized the phytoplankton photosynthetic processes during two cruises to the Ross Sea polynya during the austral spring and summer. Measurements of variable fluorescence were made with a bench-top Fast Repetition Rate Fluorometer (FRRF), a FRRF linked to the CTD, and a Pulse Amplitude Modulated fluorometer (PAM). All measurements were paired with hydrographic profiles and nutrient analysis. FRRF and FAM measurements were consistent and showed an increase in F_Fv/Fm at depth. Spatially, F_Fv/Fm ranged from 0.20 to 0.65, suggesting that micronutrient stress may occur in all seasons. A subset of these measurements were in parallel with 132C-based primary productivity incubations. We quantified the relationship between the measured and derived productivity estimates in order to predict productivity from fluorescence measurements, therefore allowing a higher spatial and temporal resolution of primary productivity to be obtained.

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New Perspectives in the Si Marine Biogeochemistry

Global scale: So far, the best estimates for the net inputs of silicic acid to the world ocean overwhelm those for the net outputs of biogenic silica in sediments. The question of the steady state of the silica cycle in the modern ocean is still an open question. Regional scale: studies in the Southern Ocean and the East Equatorial Pacific show that the dissolution of biogenic silica can be as intense in cold surface waters as in warm in vitro studies. In vitro studies show that bacteria can accelerate the dissolution processes on the short term, only when their population contains the appropriate cell density and bacterial cells are attached to aggregated siliceous material. Aggregation is a key process for the control of the Si recycling in the mesopelagic layer. Recent studies show that the particle dynamic has the key role in the transport of biogenic silica from the surface to the ocean interior. Thus, the dissolution rate of biogenic silica and the ballast effect due to diatom frustules are minor factors to determine the depth of Si recycling. Modeling studies using both models and field works, the impacts of physical processes on the biogeochemistry of surface waters are described for the Southern Ocean, the northwestern subtropical Atlantic, and the subtropical Pacific Ocean. To better describe the cycle of Si and of other nutrients, and the pelagic ecosystem, at mesoscale is a new frontier for marine biogeochemistry.

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Defining Natural River-Shelf Interactions for Trace Metals in the Coastal Beaumont Sea

As oil development continues to move offshore in the Alaskan Arctic amidst signs of climate change, studies are being conducted to define natural biogeochemical cycles in the context of potential future changes. Results for rivers obtained from 2001-2006 showed that more than half of the annual amounts of water, suspended sediment and dissolved solids were carried to a frozen Beaufort Sea in 2-3 weeks. Riverine concentrations of dissolved Fe and other trace metals including Cu and Zn, along with DOC and suspended solids, increased by 3- to 25-fold to reach peak values within 7 days after runoff began. A 1-2 m thick river plume was traced >15 km offshore under ice and the fate of river-borne particulates, metals resulted from scavenging and plankton blooms.

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Varyability of the Meridional Circulation of the Southern Ocean: The Role of Eddy Fluxes

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Varyability of the Meridional Circulation of the Southern Ocean: The Role of Eddy Fluxes

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Impact of the South China Sea Throughflow on the Indonesian Throughflow

The Indonesian Throughflow plays a crucial role in the heat budget of the western tropical Pacific. One striking feature revealed by recent mooring observations in the Makassar Strait, the major pathway of the Indonesian Throughflow, is the subsurface maximum of the meridional current profile with strong vertical shear. Using OGCM experiments with and without the South China Sea throughflow (SCST), which is an anticyclonic circulation around Philippines Borneo, it is shown that the SCST plays a critical role in generating the subsurface maxima in the meridional velocity of the Makassar Strait throughflow. The maximum southward current in the Makassar Strait occurs at around 110 m depth when the SCST is allowed, but it surfaces when the SCST is inhibited. This is especially dramatic in boreal winter as the SCST is at its maximum due to the Asian winter monsoon. The heat transport is reduced by 0.18 PW owing to the SCST, indicating that the SCST may play an important role in climate variability.

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As oil development continues to move offshore in the Alaskan Arctic amidst signs of climate change, studies are being conducted to define natural biogeochemical cycles in the context of potential future changes. Results for rivers obtained from 2001-2006 showed that more than half of the annual amounts of water, suspended sediment and dissolved solids were carried to a frozen Beaufort Sea in 2-3 weeks. Riverine concentrations of dissolved Fe and other trace metals including Cu and Zn, along with DOC and suspended solids, increased by 3- to 25-fold to reach peak values within 7 days after runoff began. A 1-2 m thick river plume was traced >15 km offshore under ice and the fate of river-borne particulates, metals resulted from scavenging and plankton blooms.

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Varyability of the Meridional Circulation of the Southern Ocean: The Role of Eddy Fluxes

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Varyability of the Meridional Circulation of the Southern Ocean: The Role of Eddy Fluxes
The meridional circulation across the Antarctic Circumpolar current is thought to consist of an upper flow and a deep flow related to the AME. This study was cancelled by an eddy flux in the opposite direction. We demonstrate that this view emerges from eddying numerical models only when the meridional circulation is integrated across streamlines, and not in a zonal average. The calculation in a zonal average gives a completely different view and underestimates the eddy fluxes, especially in high resolution models. We apply the streamline framework to the eddying global model ORCA025 implemented by the DRAKKAR modelling group. We evaluate the variability of the meridional circulation and of its time-mean and eddy components over the last 30 years, and compare our estimates with those of low resolution climate models where eddies are parameterized.

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ORIGIN AND DISPERSION OF MARINE AND TERRIGENOUS ORGANIC MATTER IN THE CONGO DEEP-SEA FAN

The Congo Canyon, fed by the second largest river in the world, extends over hundreds of km off the West Equatorial African margin, and is still affected by turbidity currents. These unique characteristics make it an ideal location to study the dispersion and fate of terrigenous and marine organic matter. We present a model analysis of linear alcohol biomarkers of surficial sediments taken on a transect along the Congo Canyon. We can thus infer bioavailability, onset of sedimentation, and the migration of organic matter. We also compare this model to the dynamics of the global ocean, as inferred from the broader Atlantic and Indian Oceans.

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MECHANISMS RESPONSIBLE FOR THE TROPICAL THERMILOCINE COOLING IN THE INDIAN OCEAN

The vertical structure of temperature change in the Indian Ocean Basin during 1961-2000 indicates that an isolated region of tropical thermocline cooling accompanies the upper level warming of the Indian Ocean. The cooling appears in the Levitus data, SODA-POP data assimilation products, results from the HYbrid Coordinate Ocean Model (HYCOM), and is a robust feature of the POP model hindcast solution. The persistence of the cooling signal exceeds the data uncertainties and cross-model differences. Our results suggest that enhanced Ekman pumping velocity associated with the tropical winds mainly causes the cooling. The enhanced tropical upwelling appears to be consistent with the strengthening of the Southern subtropical cell (STC) of the Indian Ocean. The strengthening of the meridional overturning circulation is captured by SODA-POP and HYCOM results, with both datasets consistently indicating that the strengthening of the Indian Ocean subtropical cell is largely dominated by the spin up of the STC, and spin down of the equatorial flow. The cooling in the upper thermocline enhances toward the west in both SODA-POP and HYCOM. This westward enhancement results from Rossby waves that strengthen toward the west. Influence from the Pacific via wave transmission through the Indonesian Throughflow does not seem to be a major mechanism for the strongest cooling in the upper thermocline.

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HYDROLOGIC CHARACTERISTICS OF TWO HAWAIIAN WATERSHEDS

Two Hawaiian watersheds are being studied to understand linkages between terrestrial and marine ecosystems. They differ in their physical and ecological characteristics. These differences illustrate how watershed approach affects the delivery of water and sediment to the ocean. Moving from coast to headwater in the Hanalei watershed (windward Kauai), rainfall increases from 2 to 11 meters annually. The Hanalei River is perennial, with a median flow of about 3.8 m³/s from 48.4 km² of the watershed. The highest recorded flow is 1.286 m³/s. The watershed is heavily vegetated. Moving from coast to headwater in the Kawela watershed (leeward Molokai) rainfall increases from 0.5 to 2.5 meters annually. Near the mouth, Kawela Stream (13.7 km²) is ephemeral, flowing about 38% of the days during 2004-06 with the highest flow recorded flow about 90 m³/s. The watershed is arid and heavily grazed by feral ungulates. During 2004-06, sediment yield (normalized to area) from Hanalei was over twice as high as from Kawela. However, 90% of the sediment load occurred during 3 days at Kawela compared to 34 days at Hanalei.

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QUANTIFICATION OF COPEPOD GUT CONTENT BY DIFFERENTIAL LENGTH AMPLIFICATION PCR (DLA-qPCR)

Quantification of feeding selectivity and rates for key organisms such as zooplankton is an important step towards understanding of marine ecosystem functioning. Classical methods to assess feeding all have various limitations and there is a need to develop quantifiable methods that reliably estimates in situ rates. Recent studies using nucleic acids as biomarkers to investigate copepod feeding has yielded promising results, though are still semi-quantitative as they suffer from significant underestimation. To approach this problem, we developed a new method called differential length amplification qPCR (dLA-qPCR) that used to assess genomic prey DNA digestion in the gut of predators. Digestion profiles generated from this method was further used to correct for DNA digestion leading to absolute estimates. Applying the method on the calanoid copepod Calanus finmarchicus fed Emiliania huxleyi and Rhodomonas sp. yielded significant improvements of feeding rate estimates compared to standard qPCR. This technique therefore represents an important advancement towards the aim of developing a non-intrusive quantitative method for assessing zooplankton gut content in situ.

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RECENT PERSPECTIVES ON TURBULENCE IN OCEANIC BOUNDARY LAYERS

Recent measurements indicate that existing paradigms and models fail to represent important aspects of turbulence in oceanic boundary layers realistically. In particular, near-bottom measurements indicate a potentially dominant role of Langmuir circulations, which are not necessarily represented adequately in existing, widely-used, Reynolds-averaged numerical simulations (RANS). Similarly, recent near-surface measurements suggest that the energetics and scales of turbulence generated by wave breaking and Langmuir instability are inconsistent with existing conceptual and mathematical RANS models. The existence of these nonrandom circulations in both top and bottom boundary layers have implications...
for flow effects on biota as well as coagulation kinetics and particle settling. The recent
measurements are reviewed and placed in context with RANS and large-eddy simulations
(LES). The implications for turbulence intensities, scales, and transport are discussed.

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SEASONAL VARIABILITY AND THE DYNAMICS OF KUROSHIO PATH AND ITS
INTRUSION INTO THE LUZON AND TAIWAN STRAITS.

A fourth-order fully two-way-coupled duo-grids Pacific Ocean Model (DUPOM) is de-
veloped to simulate the regional circulation in the vicinity of Taiwan and Asian Marginal
Seas. The model uses 1/4° and 1/8° horizontal resolution for western and eastern Pacific
Ocean domains, respectively. Many important features in the Asian Marginal Seas are
reproduced. These include seasonal Kuroshio intrusion in the Luzon Strait compares well
with the observations. This feature is also included Kuroshio intrusion and retreat through Luzon Strait. It is found that the Kuroshio intrusion into Luzon and Taiwan Strait relates closely to the Kuroshio path variation east of Taiwan. The mean correlation is more than 0.6 whereas the highest value is 0.75. The throughput flow transport in the Taiwan Strait and Luzon Strait is also consistent with the field measurements. Results also show the importance of Kuroshio path on the throughput in the Luzon and Taiwan Straits, which affects the complex SCS circulation.

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COMPARISON STUDY OF SPATIAL STRUCTURE OF SUBTROPICAL MODE
WATERS IN THE WORLD OCEAN.

We describe the characteristics of SubTropical Mode Waters (STMW) in the world ocean
using unified criteria, and discussed what factors determine the thickness of STMW
in each of the five basins: North Pacific (NP), North Atlantic (NA), South Pacific (SP),
South Atlantic (SA) and Indian Ocean (IO). We use the isopycnally averaged temperature
and salinity dataset (HydroBase) in summer of each hemisphere. STMW is defined as a
thermocline with temperature lower than 2.5°C and the thick-
ness greater than 100 m. First, STMWs revealing a single type of water characteristics
(NPSTMW, NASTMW and IOSTMW) are distributed mostly within the recirculation
area (RR), while STMWs having a several types of water characteristics (SPSTMW and
SASTMW) are distributed within and outside the RR. Second, it is shown that NASTMW
has the thickest STMW (276±21.1 m) in the South Atlantic Ocean. The thickness of
SASTMW and IOSTMW have almost the same thickness (168±15.8 m; 155±16.1 m; 149±14.8 m).
SPSTMW has the thinnest STMW (108±7.7 m) in the world ocean. The vertical structure
of SASTMW is unique in that its T/S stratification shows highly density-compensating
nature. It is presented temperature layer having the core layer temperature ±1°C, and the thick-
ness greater than 100 m. These characteristics of SASTMW are unique among the
three major subtropical gyres, resulting larger RR and thicker STMW.

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TEMPERATURE AND ULTRAVIOLET RADIATION INTERACT TO CONTROL
INVASIVE WATERFISHES.

Climate induced changes of important environmental drivers may exacerbate other global
change problems. We demonstrate how temperature and ultraviolet radiation (UVR)
conditions can control the stability of nearshore spawning habitat for invasive waterwar-
ter fish species in Lake Tahoe USA. We surveyed a number of nearshore sites that varied in
temperature and UVR transparency. DNA dosimeters were incubated in each site to
assess ambient levels of DNA damage and larval waterfish were incubated in two sites
that differed greatly in temperature and UV conditions. Our data suggest larval fish
survival is high in low UV/low temperature conditions and decreases in high UVR/low
temperature conditions for some species but not others. Changes in temperature and UV
conditions of nearshore environments could facilitate the spread of invasive species
for some species but not others. Changes in temperature and

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HOW DOES THE USE OF TECHNOLOGY AND SUPPORTING ORGANIZATION
DESIGN PRINCIPLES SUPPORT THE DEVELOPMENT OF THE COSEE NETWORK
AND COLLABORATIVE PARTNERSHIPS?

“Communities of Practice are groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis” (Wenger, McDermott and Snyder, 2002). The COSEE network has the potential to be a community of practice. The deliberate design of a
community of practice helps support the internal direction, character and energy. Wenger has established 7 principles for guiding a community of practice design. The College of Exploration (TCOE) has incorporated these 7 principles and other organizational design principles to support our partnerships with many ocean science and ocean educa-
tion organizations and currently as active partners in 5 COSEEs. We have introduced technologies to advance collaborative actions and encourage open and transparent commun-
ication. Over 10 years we have networked and encouraged collaborative learning between 225 ocean related scientists and over 8000 educators. This session will present our experiences and these design principles and related organization and network theories and practices and offer suggestions for best practice for developing sustainable and col-
laborative partnerships.

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SHALLOW SPECTRA AND BAROCLINIC INSTABILITIES AT THE OCEAN
SURFACE.

Recently it has been shown that, at sufficiently high effective vertical resolution, quasigeo-
stratification and instability in the presence of both surface and interior mean gradients produces a forward energy cascade at the surface, with a shallow (~5/3) spectrum. Charney or
Eady-like instabilities are necessary to excite this cascade, but need only generate energetic conversion in a narrow band of wavenumbers. Here we explore, using balanced numerical simulations with observed stratification and shear profiles, the degree to which this effect can explain observations and how it relates to submesoscale dynamics in the thermocline scale. We describe the detailed linear stability of a region, identify the vertical structure of the instabilities, and simulate the resulting turbulence with a model that completely resolves the surface modes (within a balanced model framework). The spectrum at the surface flattens at a scale deter-
dined by the competition between the forcing of interior and surface mode instabilities.

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ECOLOGICAL DISTURBANCES IN THE ST. LUCIE ESTUARY AND THE
SOUTHERN INDIAN RIVER LAGOON, EASTERN FLORIDA, ELUCIDATED
THROUGH MACROBENTHYC MONTI ONING.

Benthic infauna are important indicators of aquatic environmental quality and are used in
many monitoring programs to assess overall estuarine health and to follow long-term
trends in estuarine communities related to anthropogenic impacts. Soft-bottom macro-
fauna off South Florida have been monitored quarterly since February 2005 from 13 sites in the St. Lucie Estuary (SLE) and the Indian River Lagoon (IRL). Frequency discharges of nutrient-rich freshwater from the C-44 Canal (Lake Okeechobee) have contributed to very poor envi-
ronmental conditions in large parts of the SLE, with an infrequent community dominated by a few opportunistic (r-strategic) species. However, the diversity and abundance of the benthic community further downstream at the St. Lucie Inlet. Under the Comprehensive Everglades Restoration Plan (CERP), managed freshwater
inputs and decreased sedimentation in the SLE are expected to improve the environmen-
tal conditions in the entire SLE. The data clearly indicate that the benthic communities respond quickly to environmental changes and that they reflect changes in discrete zones
within the studied areas in the SLE and IRL.

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CALCIFICATION OF MUSSEL SHELLS IN A SETTING OF HIGH CARBON
DIOXIDE RELEASE ON A SEAMOUNT IN THE MARIANA VOLCANIC ARC: BIOTIC
RESPONSES TO A LOW PH OCEAN.

On the summit of Eifuku Seamount, vents of liquid CO₂ and H₂S are surrounded by ex-
tensive fields of the vent mussels Bathymodiolus brevis. Water samples collected directly
in mussels had pH ranging from 5.36 to 7.29 at 2.4 to 2.9°C. Calcification of shells is
compared to the same species from Luab Basin vents at pH 7.8 to 8.4. While mussels at
the two sites grow to similar sizes, Eifuku shells are 65% lighter and less than half the
thickness. There is no preferential thinning of the outer aragonite shell layer at Eifuku nor are there differences in crystal size or formation compared to Luab. As no secondary dis-
solution of aragonite is evident, the calcification process appears limited by the initial ion
availability. The calcitic layer forms daily micrometer thickness and showed constant growth
CONSEQUENCES OF EUTROPHICATION TO SALT MARSH BELOWGROUND BIOMASS

We conducted field experiments at a combination of geographically diverse and regionally-specific sampling areas and belowground plant biomass in western Atlantis, and Gulf of Mexico salt marshes to understand the belowground responses of Spartina alterniflora, the dominant salt marsh plant, to N, P, and Fe additions. The results indicate that nutrient enrichment will lead to lower root and rhizome biomass, and belowground production, and organic accumulation. Phosphorus additions, more than nitrogen, seem to reduce root and rhizome biomass accumulation. Higher soil respiration and a lower Eh are anticipated additional soil property changes. The cumulative effects of increased nutrient loadings to salt marshes may be to decrease soil elevation and accelerate the conversion of emergent plant habitat to open water, particularly at the lower elevation range of the plant. Eutrophication may be detrimental to long term salt marsh maintenance and development, especially in organic-rich wetlands soils such as the Mississippi River deltaic plain where large-scale river diversions are being developed.

TURBULENCE DRIVEN NITRATE FLUXES OVER SUBMARINE BANKS IN THE SEASONALLY STRATIFIED CELTIC SEA

In situ data, collected during two interdisciplinary cruises (July/August, 2003 and 2005) in the seasonally stratified Celtic Sea, were used to evaluate vertical turbulent nitrate fluxes \( (\tilde{\Gamma}_{NT}) \) into the subsurface chlorophyll maximum located within the thermocline. A combination of CTD, nitrate (N) and vertical diffusivity (K) measurements allowed calculation of \( \tilde{\Gamma}_{NT} \) using \( \tilde{\Gamma}_{NT} = -K\Delta N/\Delta z \). was increased over submarine banks (2.9 (near) - 15.7 (spring) mmol N m\(^{-2}\) day\(^{-1}\)) as compared to a flat seafloor (1.1 (near) - 2.8 (spring) mmol N m\(^{-2}\) day\(^{-1}\)), contributing a mean increase in annual new production of ~4% over the whole Celtic Sea. The data suggests the mechanism driving the increased nutrient flux is the formation and subsequent dispersion of a lee wave over the bank slopes. There is further evidence, supplied by chlorophyll concentrations measured by SeaSoar, to suggest lee waves formed over opposing sides of several banks due to the semidiurnal reversal of tidal currents. These regions of higher \( \tilde{\Gamma}_{NT} \) are of apparent importance to fisheries, with fishing efforts often concentrated over banks.

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COMPARING EXPORT OF SHELF CARBON IN WHALE BIOMASS WITH CARBON FLUX IN OFFSHORE JETS OF THE CALIFORNIA CURRENT

Carbon budgets for shelf food webs have rarely included complete pathways for the communities of apex predators. In particular, the regionally and seasonally significant influence of whales in shelf systems are often missing in models of carbon flux. The ecological role of whales in the trophic transfer of shelf carbon was examined during GLOBEC Northern California Current (NCC) process cruises off Oregon (41.9°–44.7°N) during summer 2000 and 2002. Line-transect surveys of cetaceans were conducted across the shelf and slope, in conjunction with multidisciplinary investigations of the NCC. During the upwelling season, humpback whales Megaptera novaeangliae move onto the shelf, especially at ecological ‘hotspots’ such as Herceta Bank (44°N). There, they forage on high densities of euphausiid and fish prey, removing large amounts of carbon from productive coastal waters, and sequestering carbon in whale biomass. The amount of carbon that is seasonally sequestered in whale biomass, and ultimately exported from the shelf during the whales’ migration, is comparable with the amount of carbon transported cross-shelf by a jet of the NCC. Even the reduced numbers of an endangered population of whales contributes significantly to carbon flow in a coastal shelf ecosystem.

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ROLE OF DIATOMS IN NICKEL BIOGEOCHEMISTRY IN THE PACIFIC OCEAN

Single-cell x-ray fluorescence (SRXF) analyses of phytoplankton cells collected from the equatorial Pacific Ocean reveal significant inter-taxa differences in cellular nickel quotas. Diatoms contain nearly 3-fold more Ni (per mole P) than autotrophic picoplankton cells, which in turn contain approximately 2-fold more Ni than larger autotrophic flagellated cells. Mapping of sub-surface Ni distribution suggests that cells with higher Ni may be concentrated in diatom frustules, which would explain the close correlation of dissolved Ni and silicic acid in vertical profiles reported previously. SRXF measurements of Ni/Si in newly deposited frustule material during grow-out experiments are comparable to water column Ni/Si remineralization ratios reported previously. Approximately 35-40% of the Ni in diatoms is calculated to be associated with the frustule. Frustule-bound Ni accounts for all of the Ni remineralized below ca. 1000 m but only 50% of the Ni remineralized above ca. 1000 m in the Pacific Ocean. Quotas of cytoplasmic Ni in diatoms (excluding frustule-bound Ni) are approximately 2-3 fold higher than those in other co-occurring cells. These higher quotas are needed to reproduce observed Ni profiles in the upper water column.

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HYDRO_DYNAMIC CONTROLS ON THE MOLECULAR-LEVEL COMPOSITION OF ORGANIC MATTER IN SEDIMENTS ALONG WASHINGTON MARGIN AND CASCADIA BASIN TRANSECT

Fluvial systems discharge complex mixtures of particulate and dissolved terrogous organic materials to the oceans. Upon entering the marine realm, these materials are subject to a range of physical and biochemical processes. For particulate matter, hydrodynamic properties play a critical role as how this material is distributed and deposited on the sea floor. A suite of surface sediments collected along a transect were separated according to their grain size and hydrodynamic properties, and the organic matter characterized in terms of its bulk elemental, isotopic, and molecular properties. Systematic variations in the molecular-level composition of organic matter are observed across the transect, and these variations are manifested in different tracers of terrestrial organic matter, including the abundance and isotopic composition of higher plant waxes and soil microbe tetratheral lipids. Similarly, marine-derived lipids including alkenones and marine archaeal tetratera show strong distributional and isotopic variations across the transect. Together, these variations in terrestrial and marine biomarker properties inform on the sources, particle dynamics, and transport history of organic matter buried on river-influenced continental margins. The implications of these findings for the application of molecular markers as proxies of organic matter input, and of marine and continental environmental conditions will also be discussed.

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SUBMESOSCALE INSTABILITY IN SUBTIDAL INNER SHELF CIRCULATION OFF PALOS VERDES, CALIFORNIA

A new class of submesoscale variability is simulated in a realistic, shelf-scale, high-resolution regional configuration with ROMS (Shepheitkin and McWilliams, 2005) for Palos Verdes (PV) Shelf, California, encompassing Santa Monica Bay (SMB) and San Pedro Bay (SPB). The variability comprises energetic submesoscale eddies detached from the cape PV and "filament" structure visualized by meandering fronts right at the shelf in both of SMB and SPB. The offshore extent of the filament is computed to be of O(1 km), and it is totally different from a classical view of offshore transport process by rip current, undertow, or shear waves associated with shear instability in longshore currents. Barotropic shear instability within the upwelling zone and baroclinic instability along the fronts are considered to be a key processes in generation of these submesoscale eddies and variability. We will discuss on further mechanism causing the submesoscale filament structure, and its role in cross-shelf mixing that links nearshore littoral dynamics to inner-shelf circulation.

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ESTIMATION OF HEAT AND FRESWATER TRANSPORTS IN THE NORTH PACIFIC USING HIGH RESOLUTION XBT DATA

The mean heat and freshwater transports in the North Pacific subtropical gyre during 1996–2002 are estimated. High-resolution XBT/XCTD transects (PX-40 Honoluluhu, PX-37: San Francisco-Honolulu, PX-10: Honolulu-Guam, PX-44: Guam-Taiwan/Hong Kong) are used to calculate geostrophic transport across each of the ship tracks. Ekman transport is estimated from satellite-scatterometer wind stress. The mean heat and freshwater transport convergences (HTC and FTC) into the northern box bounded by the PX-40/37 transects and the Tsushima and Bering Straits are 0.26 +/- 0.16 pW (peta watts) and -0.26 +/- 0.11 Sv (10^6 m³/s/eqc), respectively. HTC and FTC into the western box bounded by the PX-40/10/44 transects and the Tsushima Strait are estimated to be 0.32 +/- 0.17 pW and 0.08 +/- 0.07 Sv, respectively. In both boxes, warmer waters transported inward by the Ekan flow and by the Kuroshio are compensated by the export of waters at cooler temperatures, whose peaks are found in the temperatures of the mode waters formed in the North Pacific. The salt budget is also described to consider the mechanisms of freshwater transport. Since, in particular, the western box includes the region with the strongest heat loss to the atmosphere and is possibly a key region for climatic decadal variation, it is necessary to continue the HRX measurement and to make an effort at improving the estimation of heat and freshwater transports, in order to contribute to advancing climate studies.

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SALINITY VARIATION OBSERVED WITH TRITON ARRAY

Salinity variation in the Pacific warm pool is investigated by Triangle Trans-ocean Buoy Network (TRITON) data. On interannual time scale, a distinct feature appears in sea surface salinity (SSS) variation. During La Nina, higher salinity is recognized near the equator, whereas lower salinity appears between 5N and 8N, producing large salinity front between 2N and 5N. This front becomes weak during EI Nina. The front structure is mainly depending on zonal advection near the equator and fresh water flux by Intertropical Convergence Zone activity around 5N to 8N. In addition to SSS variation, another large variability is found near pycnocline especially between the equator and 2N, which de-
pend on a front of two water masses corresponding to North Pacific Tropical Water (NPTW) and South Pacific Tropical Water (SPTW). During La Niña (El Niño), NPTW (SPTW) indicates higher salinity value and increased thickness. These large salinity varia-
tions affect ocean dynamics through density changes of seawater. The high contribution of salinity variation to geotrophy evaluated by observed data requires further understanding of salinity variation in the Pacific warm pool.

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SEISMIC REFLECTIONS WITHIN THE WATER COLUMN SOUTH OF SOUTH AFRICA: INDICATIONS FOR THE AGULHAS RETROFLECTION

With the publication of Holbrook et al. (2003) the field of seismic oceanography expe-
rrienced a major momentum. Several authors since then (Nandi et al., 2004; Holbrook and Fer, 2005; Paramo and Holbrook, 2005) could show that those reflections within the water column correspond to thin layers with strong vertical temperature gradients. Those reflections hence represent a chance to trace those temperature gradients over large dis-
tances. Weak seismic reflections within the water column south of South Africa gave rise to the question whether here traces of the Agulhas Current or Agulhas Retroflection can be observed. A careful reprocessing of the data led to the imaging of fields of reflections pointing upwards with amplitudes between 135 km broadband and about 1000 m deep reaching well stratified areas with strong reflection amplitudes and several weaker reflections extending down to at least 1500 m water depth over the whole area of investigation. To image both the boundaries between the water masses as reflections and the different properties of the long wave-
length velocity variations in depth special imaging techniques like pre-stack depth migra-
tion analysis were performed. Further, the temperature gradients from the short wave-
length properties as velocity and density contrasts were determined by a two step inversion of acoustic amplitude versus angle analysis to better quantify the variations of the water masses of the Agulhas Current.

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NORTH ATLANTIC CARBON CYCLE RESPONSE TO CLIMATE VARIABILITY IN THE SUBTROPICS

Air-sea CO2 flux variability in the North Atlantic has been found to be small in a vari-
ety of observations and biogeochemical models and at least one atmospheric CO2 inversion study (McKinley et al. 2004), yet the mechanisms that damp variability in this region of large net carbon uptake are poorly understood. A biogeochemical general circulation model was used to assess the impact of climate variability from 1980-2006 on the CO2 flux and surface pCO2 in the North Atlantic. Results show a strong correlation between flux and pCO2 variability. Model output reveals that the influence of dissolved inorganic carbon (DIC), alkalinity (Alk), phosphate, nitrate, sea-surface temperature (SST), and sea-surface salinity (SSS) to assess the mechanisms driving pCO2 variability. These pCO2 components were regressed onto the North Atlantic Oscillation (NAO) index, the main mode of climate variability in the region. The effects of SST and Alk on pCO2 vari-
ability balance each other in the eastern subtropical gyre, such that the overall variability of pCO2 is small. Driving forces behind Alk/SST variability in the eastern subtropical gyre are evaluated in the context of ESTOC observations.

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VELOCITY STRUCTURE AND EDDY PROPERTY FLUXES IN THE MID-SHELF FRONTAL ZONE OF THE NEW YORK RIGHT

Hydrographic fronts oriented roughly along isobaths at mid-shelf locations have been observed along a number of coastal margins during the winter months. The mechanism(s) responsible for the formation of these fronts and their influence on cross-shelf transport are not presently understood. Modeled observations of currents and temperature in the mid-shelf frontal region of the New York Bight during winter 2007 are used to describe the cross-frontal structure of velocity and hydrography. Preliminary results show strong wind forcing of the current and temperature fields. Mean and eddy heat fluxes are computed using the time series of velocity and temperature and are separated into tidal and subtidal components. The cross-shelf structure of the fluxes will be compared with the stratified area in two potential models of front formation, tidal dispersion and bottom boundary layer advection models, each of which predict or assume very different cross-shelf flux variability.

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LIMNOLOGY AND AQUATIC FOOD WEB STRUCTURE OF A LARGE TERMINAL LAKE

Walker Lake is a large, terminal, saline lake in the Western Great Basin of the United States. Diversions have greatly reduced river inflow which has lead to a decrease in vol-
ume by 75% since the 1880’s. As a result there has been a concomitant increase in salinity levels and alteration to biotic community structure. This study provides a contemporary snapshot of the water quality, phytoplankton- zooplankton biomasses, and the lake’s food web structure. Water quality and chorophyl a and zooplankton were sampled monthly (March to October 2007) from six locations at discrete depths. Nutrient concentrations were highly variable (ammonium levels- 0 to 30 ppb, nitrate- 0-12 ppb, total and dissolved phosphorus-500 - 1000 ppb, and soluble reactive phosphorus-400 - 600 ppb). The food web structure determined from stable isotope measurements (carbon and nitrogen) and stomach contents suggests benthic resources contributed greatly to fisheries energetics.

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BASIN-SCALE POPULATION GENETIC STRUCTURE OF CALANUS FINMARCHICUS IN THE NORTH ATLANTIC

Calanus finmarchicus is a cold-temperate copepod species that is seasonally abundant throughout the North Atlantic Ocean. The species has been hypothesized to inhabit three semi-distinct gyre systems in the North Atlantic: the Norwegian Sea, the northern North Atlantic, and the western North Atlantic. Although C. finmarchicus shows significant geographic variation in many life history traits, basin-scale population genetic variation of the species has not been comprehensively characterized. For this study, C. finmarchi-
cus was sorted from zooplankton samples collected during 2005 from diverse locations across the geographic range of the species. A total of 15 Single Nucleotide Polymorphisms (SNPs) were detected in three different nuclear protein-coding genes using multiplexed ABI SNaPshot protocols. Spatial patterns of the SNP allele frequencies were described, and patterns of population genetic diversity and structure were characterized in light of the three-gyre hypothesis.

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CONTRIBUTIONS TO THE CO2 EFFLUX FROM THE LAURENTIAN GREAT LAKES

Several approaches (direct flux measurements, whole lake mass balance, concurrent photosynthesis and respiration measurements, stable isotope ratios, coupled ecosystem-
hydromodynamic model) have all indicated that Lake Superior is a net source of CO2 to the atmosphere. pCO2 concentrations in the lake follow a seasonal cycle with higher values in spring than in summer. Similar seasonal cycling of pCO2 in the other four Great Lakes has also been documented. The magnitude of the seasonal oscillation in pCO2 varies considerably among the lakes, being lowest in Superior and highest in Michigan. In this presentation we assess the relative roles of changes in temperature, pH, alkalinity, and DIC in driving the seasonal oscillations in pCO2 in the surface waters. If temperature or pH are the major driving variables, there will be little net emission of CO2 from the lake on an annual basis. In this analysis, we utilize both empirical correlation analyses as well as theoretical modeling to quantify the contributions of each factor.

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DETECTION AND FATE OF ZOOPLANKTON PRODUCED FDOM IN MONTEREY BAY

Biological sources of colored dissolved organic material (CDOM) in seawater are poorly understood both in terms of rates of production and the types of material produced. Previous work has shown that copepods and larvae produced fluorescent dissolved organic matter (FDOM). During a thin-layer cruise in Monterey Bay, California in July 2006 we examined the production and fate of zooplankton produced FDOM. Grazing experiments were conducted with separate species to learn what types of FDOM different species produce. Bacterial and photo degradation experiments were conducted to exam-
in the turnover rate of zooplankton produced FDOM. These results will be discussed relative to water column FDOM profiles.
FORMATION PROCESS OF THE KUROSHIO LARGE MEANDER USING A REGIONAL ASSIMILATION SYSTEM MODE/LMCOM-WNP

Formation of the Kuroshio large meander (LM) in 2004 has been examined using a regional assimilation system (MOVE/LMCOM-WNP). The small meander (SM) that triggers the subsequent LM occurred in December 2003. A cyclonic eddy propagating westward and a frontal wave from the East China Sea play important roles in the SM generation. The SM remains stationary until the spring of 2004. Examining a vorticity balance, the advection and the bottom pressure torque on the continental slope is balanced. This balance is achieved as a result of reduction of the advection by a westward propagating negative temperature anomaly. The SM starts moving eastward around May 2004, when an anticyclonic eddy east of the Tokara is amplified by coalescing two eddies. At that time, an anticyclonic eddy in deep layer is generated below the Kuroshio. The upper and lower layers are well stratified due to inhomogeneity in the LM. A baroclinic analysis indicates that this process can be understood by baroclinic instability. From some sensitivity experiments, sufficient conditions for the stationary LM will also be discussed.

DISTRIBUTION OF TRACE METALS IN THREE VENEZUELAN ESTUARIES

Marine sediments and organisms, can be a sensitive indicator for both spatial and temporal trend monitoring of contaminants in the estuaries, since they can accumulate (concen- trate) trace metals and others substances. The estuaries of Cuare, Buche and Mochima are located within the subtropical environment of Venezuelan coastline. In this work, we report concentrations of selected major and trace elements in recent sediments, mangrove and oysters collected in these estuaries. Environmental factors as temperature (T), dissolved oxygen (DO), total dissolved solid (TDS), pH, conductivity (L) and salinity were also determined. Our results suggest that the variation of anthropogenic sources is the most important factor influencing the spatial variation of trace metals. Statistical analysis (one-way ANOVA) indicated that sediments, mangrove and oysters considered selectively can accumulate certain elements. Sampling of estuaries different along the Venezuelan coast revealed significant site-specific concentration differences for the elements Cd and Cr. This study, we investigate how well it is possible to define different water types from the in situ measured reflectance spectra and from MODIS and MERIS products. Also we explore different errors (sensor calibration, wind speed, cloud cover etc.) influence for capability to discriminate between the estimated water types. We show that despite the differences in optical active substances, reflectance spectra in Moderate and Turbid types cannot be distinguished by the standard processing scheme of the MODIS sensor. MERIS sensor was able to do that. Calibration errors were relatively small comparing other errors.

As a result of reduction of the advection by a westward propagating negative temperature anomaly, the SM starts moving eastward around May 2004, when an anticyclonic eddy east of the Tokara is amplified by coalescing two eddies. At that time, an anticyclonic eddy in deep layer is generated below the Kuroshio. The upper and lower layers are well stratified due to inhomogeneity in the LM. A baroclinic analysis indicates that this process can be understood by baroclinic instability. From some sensitivity experiments, sufficient conditions for the stationary LM will also be discussed.
that a positive mentoring experience is strongly correlated with success in science, and as such, the initiative promotes early exposure to professional oceanography throughout the pipeline from late graduate school through their early careers. MPower (Mentoring Physical Oceanography Women to Increase Retention) is a community-based program comprised of online and face-to-face mentoring opportunities. The MPower website (www.mpowercr.org) includes resources as well as online forums where junior and senior scientists interact. In May 2008, we will hold the first Pattullo conference to bring mentors and mentees together. In addition, statistics from institutions and survey responses from individual graduate students provide quantitative and qualitative measures to determine the program’s effectiveness at attaining its goals and objectives.

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TERRESTRIAL BIODYNAMIC SILICA: AN OVERLOOKED SOURCE OF NUTRIENT SILICON TO THE COASTAL MARINE ENVIRONMENT

A recent reassessment of the global biogeochemical silica (Si) cycle indicates that about 15% of the riverine supply of reactive Si to the ocean is under the form of biogenic silica (bSiO2). The fate of land-derived bSiO2 upon entering the coastal zone is poorly known. We measured the dissolution rates of various biosiliceous materials in flow-through reactors supplied with seawater or freshwater. Although the rates varied among the different materials, for any given solubility the rate was systematically higher in seawater than freshwater, on average by a factor of five. This significant rate enhancement is attributed to the higher pH of seawater, and the catalysis by seawater cations of the hydrolysis of surface silicic acid. Enhanced dissolution at the land-ocean transition of bSiO2 produced by terrestrial plants and freshwater diatoms may represent a significant, but largely overlooked, source of nutrient silicon for nearshore marine ecosystems receiving large river inputs. In addition, river damming, land use changes, and global warming are causing major perturbations in the river supply of bSiO2, thereby affecting siliceous productivity in the coastal zone.

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REAL-TIME MICROWAVE OCEAN SURFACE SPECIFIC HUMIDITY

The Naval Research Lab has undertaken the development of a real-time quality-controlled system with the goal of providing a remote-sensed global estimate of latent and sensible heat flux. The first real-time product was developed to be specific humidity, based upon the algorithms proposed by Jackson, Wick, and Bates (2006) using the individual microwave sensors flying on the DMSF and NOAA satellites. Validation was performed against collocated NCEP ship and buoy observations relative to predictions from the Navy Operational Global Atmospheric Prediction System (NOGAPS). 0.5-degree global model. Validation data were analyzed from October 2004 through June 2007, with each month providing over 300 separate observations. The data redundancy allowed statistics to be developed to characterize the accuracy and bias of these satellite observations compared with both the ship/buoy observations and the NOGAPS product.

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FIRST EVIDENCE FOR HYDRAULIC SUBSTANCES AS IMPORTANT LIGAND FOR IRON IN COASTAL AND DEEP OCEAN WATERS

The mechanism that maintains a relatively constant iron concentration in deep ocean waters (~0.8 nM without inter-ocean fractionation is based on the hypothesis of control by unknown organic complexing ligands. Hydraulic substances (HS) are well-known to bind metals including iron in freshwater, but surprisingly little is known about their importance to the biogeochemistry of iron. Using a new method we have determined HS concentrations in coastal waters (Irish Sea) and a sample from the central deep Pacific. HS concentrations were found of 50 – 370 µg L-1 in the Irish Sea with an iron binding capacity of 1.4-12 nM, and 36 µg L-1 in the deep Pacific with an iron binding capacity of 0.8 nM without inter-ocean fractionation. The preliminary data suggests that such substances may be playing a critical role in controlling iron bioavailability and iron concentrations in surface waters of coastal and deep oceanic waters.

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THE PLANKTONIC FEEDER WEB OF THE SCHELDT ESTUARY: ZOOPLANKTON FEEDING PREFERENCES REVEALED BY 13C ANALYSIS.

THE PLANKTONIC FOOD WEB OF THE SCHELDT ESTUARY: ZOOPLANKTON FEEDING PREFERENCES REVEALED BY 13C ANALYSIS.

SPM. Water samples were analysed for 13C of dissolved inorganic and organic carbon. Data were sampled monthly during one year in 2005. Mesozooplankton, suspended matter from late graduate school through their early careers. MPower (Mentoring Physical Oceanography Women to Increase Retention) is a community-based program comprised of online and face-to-face mentoring opportunities. The MPower website (www.mpowcr.org) includes resources as well as online forums where junior and senior scientists interact. In May 2008, we will hold the first Pattullo conference to bring mentors and mentees together. In addition, statistics from institutions and survey responses from individual graduate students provide quantitative and qualitative measures to determine the program’s effectiveness at attaining its goals and objectives.

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THE ORIGIN OF INTERANNUAL SALIVITY ANOMALIES IN THE SOUTHWESTERN INDIAN OCEAN

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BEACH WIZARD: BATHYMETRY ESTIMATION BY REMOTE SENSING

A data-model assimilation method called Beach Wizard is presented with which the nearshore subtidal bathymetry can be accurately estimated based on video-derived observations of wave roller dissipation and variation of the intertidal shoreline, and radar-derived observations of wave celerity. Using many consecutive images, these observed properties are compared with the computational bathymetry and the best agreement is estimated based on the numerical simulations. The method can deliver coastal state information (i.e., simultaneous updates of bathymetry, waves, and currents) with high temporal and spatial resolution and can be used in conjunction with or instead of in-situ measured data.

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FLOW INTERACTIONS OVER PLANT- AND ANIMAL ASSEMBLAGES: IS THE OVERALL EFFECT EQUAL TO THE SUM OF THE CONSTITUENTS?

Benthic organisms vary widely in flexibility, protrusion height, shape and size. Rough, hard structures create turbulence in the boundary layer. Filter feeding bivalves can add to this

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by the effect of the interaction of their exhalent jets with the boundary layer flow. Aquatic plants may also reduce a phytoplanktonic canopy. Although turbulence intensity inside the canopy is increased, the flow reduction is large enough to create a relatively calm environment. Most studies to date have been devoted to the interaction of individual species and flow. Most natural systems consist of communities of species. E.g. in the Mediterranean, bivalves (Pinna nobilis) grow inside seagrass meadows, creating a substrate of large, rough elements submerged inside a flexible canopy. In the Oosterschelde lagoon, the movement of individual water masses. Alternatively, the SSOM explicitly tracks individual water masses, offering a new view of heat and tracer transport. Furthermore, the Lagrangian model is computationally efficient in transporting multiple tracers. Using an idealized wind stress and an imposed surface temperature similar to a zonally averaged Atlantic profile, the model can reproduce major features of the subtropical gyre circulation. We examine how a few leads are transported and cycled in the subtropical gyres. The results of these simulations are compared with companion experiments using a co-ordinate Eulerian ocean model (MITgcm). Further, we discuss implications for diagnosing the transport and air-sea exchange of various chemical species, such as CO2.

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AN INDEX FOR THE INTER-ANNUAL VARIABILITY IN AGULHAS LEAKAGE

The Agulhas region, where the Indian and Atlantic Ocean meet, is of particular interest as it is an important part of the global scale Thermohaline Circulation. The high degree of nonlinearity of the region comes from the interplay of the equatorward flow, strong and varied winds, and the advection of heavy water, which would normally be found in the Antarctic Circumpolar Current, into the Agulhas region. As a result, the Agulhas Leakage Index is defined based on the location of the Agulhas front. The index is validated using the NCOM model. Almost 2 million isotopic drifters, released in the Agulhas Current, are tracked to determine the inter-ocean flux. As altimetry data is available in near real-time, the Agulhas Leakage Index can be used as a tool for monitoring the state of the interoceanic exchange on inter-anual time-scales.

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OUTREACH AT THE COOPERATIVE INSTITUTE FOR OCEANOGRAPHIC SATELLITE STUDIES (CIOSS): SUPPORTING THE SMILE PROGRAM

CIOSS outreach activities include its partnership with the Science and Math Investigative Learning Experiences (SMILE) Program. SMILE helps to support the SMILE high-school program and to develop its Oceanography and Remote Sensing curriculum for after-school club activities, which prepare for the annual High-School Challenge. The SMILE Program addresses issues of higher education readiness, access and diversity through academic enrichment and outreach in science and mathematics for under-represented students in grades 4-12. SMILEs programmatic aims are to 1) Promote teacher professional development through workshops; 2) Provide the activities and materials for the after-school SMILE clubs; and 3) Hold a college-connection event - the annual High-School Challenge - where teams of students solve a scenario-based problem. By holding the Challenge on college campuses, high-school students envision themselves as potential college students. CIOSS/SMILE goals are to 1) motivate undergraduate students and researchers in creating and delivering ocean-related outreach; 2) increase teacher understanding of ocean science and remote sensing; 3) provide learning opportunities for high-school students in applied ocean sciences and remote sensing; and 4) promote students’ interest in ocean science, science careers, and higher education.

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A MULTI-YEAR SURVEY OF SURFACE LAYER CARBON DIOXIDE DYNAMICS IN THE GULF OF MAINE

The Gulf of Maine represents a coastal ecosystem with a dynamic carbon cycle attributed to strong tidal mixing, seasonal stratification, coastal shelf exchange, and land-ocean export. An ongoing shipboard program, started in 2004, is providing a new data set for ocean surface layer pCO2 to address questions surrounding the impacts of biology and land-ocean interaction on the ocean carbon cycle and greenhouse gas exchange. Surface layer pCO2 and CO2 being collected along the Maine coast are used to create a multi-year continuous record of pCO2 and further chemical data from underway, discrete sample, and profiling systems. The program is complemented with an autonomous pCO2 buoy measurement system, two 5000 km² vector Oceans surveys in fall 2006 and 2007, and the summer 2007 NOAA Gulf of Mexico and Northeast U.S. Carbon Cruise. We will present data showing strong seasonal and shorter time scale pCO2 and DO signatures and evaluation of their covariance with riverine input and biological productivity. The composite data set provides a wealth of new spatial and temporal information for future modeling and observing system design efforts related to monitoring carbon dynamics in the coastal zone.
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OCEAN BIOGEOGRAPHIC INFORMATION SYSTEM: EXPLORING ITS CONTENT

The Ocean Biogeographic Information System (OBIS), established by the Census of Marine Life programme, is an on-line, freely-accessible system for absorbing, integrating, and assessing data about life in the oceans. OBIS aims to stimulate taxonomic and systematic research, and to generate new hypotheses concerning evolutionary processes, maintenance of species distributions, and roles of marine organisms in marine ecosystems. Today, OBIS contains more than 13.4 million records of 82,000 species from 222 databases. Analysis shows geographic gaps in the data for the mid-oceans and deep-sea, and taxonomic gaps for invertebrates; a significant part of the bias is due to real differences in observer effort between countries. However, the present content makes it possible to start analysing the data so as to reveal global biodiversity patterns. Several biodiversity measurements are calculated and presented. Care was taken in interpreting such metrics because of sampling bias. A major effort of data cleaning, in collaboration with all data providers, is under way, to remove outliers and to harmonize taxonomic names and classification.

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CO2 VARIABILITY WITHIN RETENTIVE EMBAYMENTS: THE NORTHERN CALIFORNIA UPWELLING REGION OF COOP WEST

From satellite imagery and shipboard data, retentive embayments stand out as warmer, elevated surface chlorophyll features within the CoOP WEST (Coastal Ocean Processes---Wind Events and Shelf Transport) region north and south of Point Reyes. Coastal carbon cycling research in the past has overlooked the contribution of these smaller, highly variable coastal features that are typically influenced by prevailing upwelling conditions. This area is unique in that it is subjected to the strongest recorded summer wind stresses along the U.S. west coast, yet maintains high biological productivity. The combination of strong upwelling winds and highly productive coastal waters also allows for phytoplankton to be retained and observed topographically extents north and south of Point Reyes. Here we evaluated how these specialized regions facilitated the outgrowth or drawdown of CO2, during three wind stress periods (upwelling, transition, relaxation) for 2001 and 2002. We quantified changes in CO2 concentrations from MODIS (sea surface temperature) and SeaWiFS (chlorophyll a) satellite imagery by deriving a satellite-based model of POC fluxes. Results highlighting the processes and relative importance of these coastal features will be presented.

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THRESHOLDS OF HYPOXIA FOR MARINE BENTHIC COMMUNITIES

Hypoxia is a mounting problem affecting the world’s coastal waters with severe consequences on benthic communities, including death and catastrophic changes. Hypoxia is linked to eutrophication and it is forecasted to increase further in the future due to the combined effects of the use of synthetic fertilizers and the increase in temperature caused by global warming. We used a broad survey of the published literature to assess the thresholds of hypoxia for sublateral and lethal responses across a range of contrasting marine benthic communities. We conclude that the empirical sublateral and lethal thresholds of hypoxia are above the conventional definition of 2 mg O2/L to diagnose hypoxia for all groups tested. We further show that hypoxia thresholds vary greatly across organism groups.

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CLIMATE VARIATION AND BIOTURBATION ON THE SEA FLOOR IN THE ABYSSAL NORTH PACIFIC

This research examined how the links between climate variation, phytoplankton activity, POC flux and benthic community activity affect deep-sea bioturbation and carbon sequestration. Echinocore nereidus, a deep-sea epibenthic echinoderm, was used as a proxy to study these changes because it is common at the study site and leaves distinctive trails that allow quantification of the amount of sediment covered. A long-time-series photographic record from 4100 meters depth in the northeast Pacific Ocean, showed a recent rapid increase in E. rostrata abundance coinciding with a small decrease in the average size of the observed individuals. The data from the photographic record was used to create an index of bioturbation potential (as seen in Solan, et al. 2004) which assigns scores to the size, mobility and abundance of the animals as they relate to sediment particle movement. Changes in the bioturbation potential over time allowed us to track particle mixing, availability of surface-derived POC and the incorporation of surface-derived carbon into the food chain and potentially back to the surface in the form of greenhouse gases.

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BIODIVERSIC SILICA PRODUCTION IN EQUATORIAL PACIFIC SURFACE WATERS FROM 140°W TO 180°E

Diatom growth and production in the eastern upwelling sector of the equatorial Pacific are affected by insufficient concentrations of iron and may be further limited by silicon availability. A comparison with a limited number of studies in the western warm pool indicates that diatoms in the eastern equatorial Pacific are more active than those in the western equatorial Pacific. We determined the surface distributions of silicic acid, biologically-produced silica, diatom productivity and Si uptake kinetics between 2°N and 2°S from (140°W) to west (180°E) in the Pacific. Silicon uptake rates were assessed with the radiotracer 44Si. Euphotic-zone silicic acid concentrations, and biogenic silica concentrations and production rates decreased from 2 to 0.8 µM, 150 to 42 µM and at respectively, from 140°W to 180°E. Biomass-specific Si uptake rates also decreased (0.31 to 0.04 d-1) from 140°W to 180°E. In addition, we examined the effect of added Si on the rates of silicic acid uptake by diatoms. Results indicate that uptake rates were Si-limited along the length of the study area, with limitation most severe in the west.

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PHYTOPLANKTON PHENOLOGY FROM SATELLITE OCEAN COLOR OBSERVATIONS

Climate change affects the timing and magnitude of numerous environmental conditions, such as temperature, wind, ocean circulation, and precipitation. These changes, in turn, are likely to cause a response in ecosystem productivity. In marine ecosystems, these changes are likely to affect the timing and magnitude of phytoplankton biomass and primary production. In order to establish a baseline from which to assess any future changes, we are constructing a climatology of the phenology - the timing of recurring natural phenomena - of global oceanic phytoplankton biomass using data from Sea-viewing Wide Field-of-view Sensor (SeaWiFS). Specifically, we are estimating bloom onset, maturity, decay and termina- tion from models of pentad (5-day) mean SeaWiFS chlorophyll concentrations in 3x3 bins fit by Generalized Linear Models. Preliminary results for the North Atlantic show that satellite remote sensing methods are able to monitor phytoplankton phenology with good results. In the future we plan to examine how the annual anomalies correspond with cli- mate variability, such as ENSO and the North Atlantic Oscillation (NAO).

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PHYSICAL AND NUMERICAL MODELLING OF FLOW THROUGH THE EVERGELDES

We use measurements from a large-scale tracer release in the Florida Everglades to motivate and evaluate two different modelling techniques. The first is a numerical technique that is well suited to the Everglades, namely Lattice-Boltzmann modelling. This numerical technique can directly incorporate the spatial structure of vegetation, rather than using a bulk resistance technique. The new computational cost is modest, and the approach given in this paper must be considered to inform policy decisions. The second model we evaluate is a laboratory model designed to improve the utility of quantitative imaging in examining the small-scale details of flow through aquatic vegetation. To improve optical access in laboratory models, we introduce a new methodology for creating inexpensive refraction-index matched models of macrophytes and periphyton with flexibility resembling the actual plants.

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COMPARISONS OF THE PATHFINDER SEA SURFACE TEMPERATURE DATA SETS

The Pathfinder Sea Surface Temperature (SST) time series provide the longest satellite derived climate data records, spanning 1885 to 2006. The work focuses on two versions, Version 5.0 (V50) of the data set were calculated at a 4km resolution while Version 4.1 (V41) were gridded at 9km. RMS differences between V50 and V41 and insitu data from the World Ocean Database (WOD) were calculated in the Gulf Stream (GS) and off the California Coast (CC). For the GS, V41 RMS differences greater than 1.0 degree Celsius peaked in June. Using V41 in the CC warm biases consistent with the summertime CC coastal upwelling were found. Maximum in SST gradients were consistent with periods of pentad (5-day) mean SeaWiFS chlorophyll concentrations in 3x3 bins fit by Generalized Linear Models. Preliminary results for the North Atlantic show that satellite remote sensing methods are able to monitor phytoplankton phenology with good results. In the future we plan to examine how the annual anomalies correspond with cli- mate variability, such as ENSO and the North Atlantic Oscillation (NAO).

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TROPICAL PACIFIC SIGNATURE OF GLOBAL WARMING

The response of the tropical Pacific to increasing CO2 is a central topic in climate change research, as tropical climate conditions have far-reaching effects and they set the background for changes in the character of El Niño. The theoretical and modeling under-
standing, and observational evidence for long-term changes to the tropical Pacific climate system is high. In models with a simplified representation of atmospheric physics, feedbacks originating in the ocean drive the system to a "La Niña-like" state. In models with atmospheric general circulation components, thermodynamic constraints result in a reduction of the strength of the atmospheric overturning circulation – manifest primarily in the zonally-asymmetric (Walker) rather than zonal-mean (Hadley) compo- nent. In these models changes over the tropical Pacific Ocean resemble "El Niño-like" conditions, although the mechanisms are fundamentally different from those of El Niño. Even though modeling studies can help reconcile aspects of the diverging theoretical understanding, a true reconciliation requires observational evidence. Observations of sea level pressure indicate that over the 20th Century the Pacific Walker circulation has weak- ened; however, different reconstructions of historical SST are inadequate to distinguish between an increase or decrease in East-West SST gradient across the Pacific. We outline what a way forward, with paleo-proxy observations, to reconcile these diverging views.

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INFLUENCE OF TIDES AND WINDS ON NEARSHORE HYDRODYNAMICS AND MORPHOLOGY DURING MILD WAVE CONDITIONS

Numerous studies show that bathymetry and currents in the nearshore region respond strongly to changes in wave conditions in the surf zone and its vicinity. In mixed wave-tide dominated coasts, the few studies that are available are primarily experimental, focusing mostly on tidal flats and macrotidal beaches (Kidd and Orford, 2002). Maiti et al. (2004) concluded that detailed examination of the sedimentation requires at the very minimum a crude coupling between wave and tide models. In this study, we will investigate the combined influence of waves and tides on the hydrodynamics and morphology during periods of wave action. At the FRF, Duck, NC, we will compare the hydrodynamic and morphological changes resulting from the combined forcing of waves, winds and tide to the individual forcings. The circulation model DELT3D will be used to simulate the hy- drodynamic and morphological response of the domain forced by the waves in the domain obtained from SWAN with the boundary conditions derived from the 8m array. The tides in the domain will be forced by specifying the dominant tidal harmonics at the boundaries

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RELATIONS BETWEEN NORTHWARD OCEAN AND ATMOSPHERIC ENERGY TRANSPORTS IN A COUPLED CLIMATE MODEL

The climate general circulation model HadCM3 is used to analyse the relation between northward energy transports in ocean and atmosphere at centennial timescales. In a transient water hosing experiment, where suppressing the Atlantic meridional overturning circulation (MOC) causes a reduction in northward ocean heat transport of up to 0.75 PW (i.e. 75%), the atmosphere compensates by increasing its northward transport of moist static energy. This compensation is very efficient at low latitudes and near-complete at the equator throughout the experiment, but is incomplete further north across the northern mid-latitude storm tracks. The change in atmospheric energy transport enables the model to find a new global-mean radiative equilibrium after 240 years. In a perturbed physics ensemble of HadCM3 it was found that time-averaged meridional energy transports in ocean and atmosphere can act opposingly. Where model formulation causes an unbal- anced mean climate state, e.g. an excessive top-of-the-atmosphere radiative surplus at low latitudes, the atmosphere increases its poleward energy transport to disperse this excess. MOC and ocean poleward heat transport tend to be reduced in such model versions, and this offsets the increased poleward atmospheric transport of the low-latitude energy surplus. Model versions that are close to net radiative equilibrium also have ocean heat transport and MOC close to observed values.

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REMOTE SENSING OF A NATURALLY IRON FERTILIZED PHYTOPLANKTON BLOOM AROUND THE CROZET PLATEAU, SOUTHERN OCEAN

A combination of Argo float, ocean colour, irradiance and alinity data are used to ex- plain the temporal and spatial structure of the chlorophyll distribution around the Crozet Plateau (50°A, 46°A). The area can be split into different productivity regimes, their characteristics determined by the physical and chemical interactions between the circula- tion and topography. From the chlorophyll response, the eastern islands are identified as the primary iron source. The bloom occurs north of the plateau due to the circulation pat- terns advecting water northwards and westwards from the islands. The bloom initiation is controlled by latitudinal gradients in light availability. High chlorophyll values persist immediately downstream of the islands, but further away concentrations remain low after the spring bloom. Iron, rather than light, is dominant in controlling the distribution of peak chlorophyll values. The area south of the plateau is upstream of the islands and has low chlorophyll, the concentration typical of the open Southern Ocean. Light is not limiting in this area for at least four months. Despite the shallow topography, the area over the plateau has relatively low chlorophyll concentrations.

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SIMULATIONS OF MIXING AND TRANSPORT OF DISSOLVED WASTE DISCHARGED FROM NEAR-COASTAL AQUACULTURE PENS

The present study focuses on understanding the transport and fate of dissolved wastes from aquaculture pens in near-coastal environments using the hydrodynamic code SUTANS, which employs unstructured grids to compute flows in the coastal ocean at very high reso- lution. Simulations of pollutant outfall fields (in time and space) as a function of the physical setting and the local environment (bathymetry, stratification, rotation), flow conditions (tides, currents), and the location of the pens were performed to study their effects on the evolution of the waste plume. The presence of the fish farm pens cause partial blockage of the flow, lead- ing to the deceleration of the approaching flow and the formation of downstream wakes. Results of both the near-field (area within 10 to 20 pen diameters of fish-pen site) as well as the far-field behavior of the pollutant field will be presented. These results highlight for the first time the importance of the wave vortex dynamics on the evolution of the near-field plume as well as rotation of the earth on the far field plume. The results provide an under- standing of the impact of aquaculture fish-pens on coastal water quality.

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ADJOINT SENSITIVITY STUDIES OF THE CENTRAL CALIFORNIA CIRCULATION

We use the Regional Ocean Modeling System (ROMS) to model the circulation of the Central California region, and its associated adjoint model to study the sensitivity of the circulation to different driving mechanisms. The adjoint model is particularly suitable for sensitivity analyses because it allows one to determine how a certain metric representative of a physical aspect of interest, evolves due to linear variations of the system variables, the external forcing, the initial state, and the open boundary conditions. We have identified various metrics that represent the upwelling processes of the Central California region, and the energetics and mean level field of the coastal circulation. The adjoint model results allow us to investi- gate the temporal and spatial distribution of the sensitivity of each metric to time-averaged external forcing and state variable initial conditions. This is invaluable information both for theoretical reasons and for practical applications such as the planning of observational efforts and data assimilation experiments. We show that sensitivities to large-scale and remote forc- ing for the coastal mean sea level metric are significant, whereas upwelling indices are locally driven. We also compare the results obtained using differently sized coastal domains.

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EXAMINING PARTICLE FLUX WITHIN MESOSCALE EDDIES USING 210PO 210PB DIS-EQUILIBRIUM

The impact of mesoscale eddies on particle flux was examined in the Sargasso Sea and the lee of the Hawaiian Islands using 210Po-210Pb disequilibrium. Seawater samples for total activities were collected along transects through the eddies and at targeted stations. Particulate carbon, nitrogen and biogenic silica export fluxes were determined using the 210Po and the elemental-210Po ratio and/or the residence time of 210Po in the water column inventories of PC, Pb-N, and BSi. In the Hawaiian lee waters, elemental fluxes at 150 m within the eddies averaged 1.65 ± 0.10 mmol C m-2 d-1 and 0.30 ± 0.02 mmol N m-2 d-1 and 0.15 ± 0.01 mmol Si m-2 d-1. Relative to surrounding waters, eddy induced PC and PN export were not signifi- cantly different, whereas BSiO4 fluxes were enhanced by more than 6-fold. These results agree with other methodologies, i.e. 210Th-derived fluxes, sediment traps and 234Th mass balance, and reinforce the idea that 210Po as tracer of particle fluxes in these areas may be used as another independent and robust approach and investigated more fully.

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COLLECTIVE MOTION OF ANTARCTIC KRILL IN A TURBULENT MIXED LAYER

We simulate schooling behavior in an individual-based model to investigate the ecologi- cal consequences of collective motion in krill. We formulate a coupled biological-physical
model of zooplankton foraging on a variable resource. The model includes a two-dimen-
sional patch model as a source of environmental variability; the circulation patterns affect the distribution of phytoplankton by upwelling nutrients into the euphotic zone, where the algae can grow, and by stirring the patchy algal concentrations. In the intermit-
tent resource field, schooling can represent a successful foraging strategy. We also examine how the emergent properties of schools depend on the parameters describing individual movement. Phase transitions occur when the swimming speed is varied; the density and spatial scale of groups are found to be inversely proportional to speed. Modeled schools are compared to observed aggregations of Antarctic krill. It is argued that acceleration patterns linked to the foraging behavior of krill might explain the observed qualitative changes in the depth and density of aggregations that occur over the diurnal cycle.

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SOURCES AND SINKS OF HYDROGEN PEROXIDE IN THE GULF OF ALASKA

While photoproduction of hydrogen peroxide is likely the dominant source in coastal regions with high CDOM, dark (biotic) production has been proposed as a significant source in CDOM-poor waters. In this study, rates of dark and photochemical hydrogen peroxide pro-
duction were measured and compared in samples collected from a variety of seawater types in the Gulf of Alaska. While often net production of hydrogen peroxide was not observed in 24-hour dark incubations of unaltered seawater samples, decay was apparent in subsamples spiked with 100-250 nM hydrogen peroxide. Dark production rates were calculated assuming H2O2 decay rates in spiked and unspiked samples are equal and ranged from 0.5 to 8 nM/hr; faster than photochemical formation in some cases. Decay rates ranged from 1.5 to 20 hr^-1. Calculated hydrogen peroxide steady-state concentrations from these dark production and decay rates were 10 to 100 nM. Rates of dark production generally decreased with depth from a surface maximum down to 50 meters. A direct correlation exists between the rates of dark degradation and dark production of hydrogen peroxide.

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PRIMARY PRODUCTION WITHIN THE SEA ICE ZONE WEST OF THE ANTARCTIC PENINSULA

In shelf waters west of the Antarctic Peninsula (wAP), with abundant macro- and micro-
nutrients, water column stability due to freshwater input from sea ice melting has been suggested as a key factor controlling primary production. The area is subject to the annual advance and retreat of sea ice characteristic of Antarctic waters. A 12-year time series (1995-2006) was analyzed to study spatial and temporal patterns in primary production as well as major environmental determinants. A strong onshore-offshore gradient is evident along the Peninsula at the height of the growth season with higher production observed in inshore waters. Regional production varied inter-annually by a factor of 7. Mixed layer depth shows the higher correlation with production while late sea ice retreat explains 58% of the variability in space and time. No regional trend in primary production was detected during this period. We discuss the influence of sea ice retreat and water masses in determin-
ing summer mixed layer depth.

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FAKE OF CARBON AND NITROGEN IN MICROBIAL BIOMARKERS IN INTESTINAL SEDIMENT

The fate of microbial carbon and nitrogen in sediments has primarily been studied by compound-specific stable isotope analysis in combination with stable isotope labeling. These studies so far generally focused on either C or N, meaning that the direct coupling between the fate of microbial C versus N has remained largely unstudied. Recently, we compared the fate of microbial C and N by labeling the microbial community (bacteria and benthic microalgae) in estuarine, intestinal sediment with both 13C and 15N and its effect on larvae of the west coast native oyster Ostrea lurida. Sea water pH was lowered to an average value of 7.74 by increasing pCO2 with a CO2 incubator. Fluorescently tagged velger larvae were subjected to lowered pH water for three days; shell growth was measured and compared to control growth (larvae in 380 ppm pCO2). We saw a 23.5% decrease of larval shell growth in elevated pCO2 condi-
tions. Data from a Tomales Bay study over the period of 1987 to 1995 support the idea of a C/O2 heavy atmosphere decreasing pH. Oyster broodstock collected from Tomales Bay were assumed to be offspring of generations that withheld a 142 ppm pCO2 increase and a decrease in pH of 0.1 during the nine years.

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UNDERSTANDING IMPACTS OF SEDIMENTATION ON MANGROVES AND CORAL REEFS TO IMPROVE LAND USE IN A WET TROPICAL ISLAND, PohnPelmicronesia

Pohnpei is one of the wettest places on earth. Rapid deforestation of upland watershed areas and plant salakas, Piper methysticum, resulted in the degradation of coastal coral reefs and the loss of fisheries resources. The Pohnpei Conservation Society (CSP), armed with quantitative data collected by regional researchers was able to work with local commu-
nities and traditional leaders to effectively address the impact of soil erosion on coastal marine areas. Researchers from the Palau International Coral Reef Center, the Australian Institute of Marine Science, and the University of Hawaii conducted a study to determine the impacts of sediment on mangroves and on coral reefs along a gradient of sedimentsa-
tion. CSP then used these biophysical data to conduct a series of community meeting/ presentations to rally the support of community to change farming practices. This has been one of the successful examples of using scientific data through a locally connected NGO to influence environmental practices and policy in Micronesia.

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EXPLORING TIDE GAUGE LONG SEA LEVEL RECORDS FOR OCEAN AND CLIMATE STUDIES

Tide gauges provide unique in-situ measurements of monthly and longer period sea level variability going back many decades, but all records are confined to coastal and island locations. To make best use of these long tide gauge records in ocean modeling and assimilation efforts, it is essential to understand how representative they are of the large-scale sea level variability over the deep ocean. An attempt to address this issue is made using detailed com-
parisons of the tide gauge variability with that observed by satellite altimeters for the last 15 years, taking advantage of their near-global spatial coverage, and also with a number of different model simulations. Tide gauge/altimeter/model differences are explored as a function of location, temporal and spatial scale, model resolution and physical parameterizations, etc., with the goal of being able to extract maximum information from the tide gauge records. Analyses include the provision of error estimates that might be used to appropriately weight tide gauge data when using them as constraints in ocean climate models of the last century.
HIGH-RESOLUTION SEA SURFACE TEMPERATURE ANALYSIS SYSTEM IN THE GULF OF MAINE

High-resolution sea surface temperature (SST) fields are crucial for estimating upper ocean circulation and air-sea fluxes. To meet these critical needs, SST products are often constructed by combining measurements from a variety of sources. Here, we describe one such application that produces a regional SST product for the Gulf of Maine, and provide the results from an ongoing study to validate this product. These SST fields are derived using measurements from the geostationary operational environmental satellite (GOES) and analysis from the real-time global sea surface temperature (RTG SST) and the ocean surface temperature analysis (OSTA) system. This algorithm has been implemented into a prototype near-real-time production system that, since May 2007, has produced SST fields four times per day on a 4-km grid. This system also provides daily validation data constructed by collocating estimated SST values with in situ measurements from buoys. The average bias in the domain from May to August 2007 is found to be 0.02°C. The system was applied to analyze diurnal variability in the region, which revealed significant amplitudes and complex spatial distribution.

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DESIGN AND VALIDATION OF AN OFFLINE OCEANIC TRACER TRANSPORT MODEL FOR CARBON CYCLE STUDY

An offline passive tracer transport model with self-operating diagnostic mode vertical mixing and horizontal diffusion parameterizations is used with assimilated ocean currents to find the CFC-11 cycle in oceans. This model is developed in NIES under carbon cycle research project inside the GOSAT (Greenhouse gas Observing Satellite) modeling group. The model borrows offline fields from pre-calculated monthly archives of assimilated ocean currents, temperature and salinity, and evolves a prognostic passive tracer with prescribed surface forcing. The model's performance is validated by simulating CFC-11 cycle in the ocean starting from the pre-industrial period (1938) with observed anthropogenic perturbations of atmospheric CFC-11 to comply with OCMIP-II flux protocol. The model results are compared with ship observations as well as the results of candidate models of OCMIP-II and a performance is assessed. The model simulates the deep ventilation processes in the Atlantic Ocean appreciably well and yields a good agreement in column inventory of CFC-11 amplitude and phase compared to the observation. The statistical skill test shows that this model outperforms other candidate models of OCMIP-II because of its higher resolution and assimilated offline inputs feeding and shows a potential role in improving transport calculation in the ocean with cost-effective computation.

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DEEP WESTERN BOUNDARY CURRENT VARIABILITY OBSERVED IN THE WESTERN LABRADOR SEA

Since 1993 moored current and temperature-salinity observations have been carried out in the western Labrador Sea near 50°N (western end of WOCE-AR7 line), 53°N (exit of Labrador Sea) and east of the Grand Banks (at 43°N) as part of SFB 460. The time series at 53°N are continued under the NORDATLANTIK project. All moored, shipboard and Argo observations are evaluated for transport and water mass variability of the different Deep Water layers. While altimetry and model studies have suggested a decline of the overall sub-polar gyre circulation since the 1990s, direct current measurements at the 1500m level along the western continental slope of the Labrador Sea show interannual variability of the order of 10-20% during the 1996-2007 period. Alongshore correlations and relations to local forcing and boundary wave activity in response to upstream forcing changes are discussed.

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DISSOLVED INORGANIC CARBON (DIC) IN THE MID-ATLANTIC BIGHT: CLOSING THE CARBON BALANCE

Carbon cycling on continental shelves is an important, yet poorly constrained, component of the global carbon cycle. Here we present an analysis of dissolved inorganic carbon (DIC) cycling along the Mid-Atlantic Bight (MAB). Samples were collected on three Oceans Margins Program (OMP) cruises including March and August of 1996 giving a seasonal comparison of total shelf DIC. The high spatial resolution of these measurements reveals clear gradients of DIC with depth and distance from shore. Results show a net deficit (consumption) of DIC on the shelf between 11 and 32 MTC/year for all three periods. This deficit is within the range of total organic carbon surpluses calculated for the same period of study. Air/sea transfer estimates indicate net uptake of atmospheric CO2 in March 1996 and net release of CO2 in August 1996. The air/sea flux of CO2 is dominated by temperature driven changes in solubility but there is a significant contribution by biological productivity. Results support the OMP hypothesis of net autotrophy in the MAB and illustrate a complete carbon budget approach to addressing the net trophic status of coastal margin systems.

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THE MID-DEPTH CIRCULATION OF THE NORDIC SEAS FROM PROFILING FLOATS

The circulation of the Nordic Seas advects warm and saline waters to regions of water mass transformation and supplies the dense overflows that feed the North Atlantic Deep Water. This makes it an important element of the meridional overturning circulation. We use the surface position data of profiling floats, collected in the Nordic Seas from 2001 till now, to infer their subsurface displacements at parking depths of 1000 and 1500 m respectively. The subsurface float trajectories are then Lagrangian measurements of the mid-depth circulation. The multi-year mean circulation of the Nordic Seas at mid-depth is obtained from the space-time average of the float drift velocities. Cyclonic gyres with strong topographic steering are found in the four deep basins. Spatial averages over each basin shows a seasonal variation of the gyre speeds with maxima in winter. This is roughly in phase with the wind stress curl from NCEP/NCAR reanalysis data integrated over the basin areas. The results are compared with velocity fields from a high resolution data assimilation model of the Nordic Seas.

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ACCUMULATION AND CYCLING OF TRACE METALS BY HETEROTROPHIC MARINE BACTERIA

The uptake and subsequent trophic transfer of metals in marine phytoplankton have been well-characterized, but fewer data are available regarding metal accumulation in marine bacterioplankton. Heterotrophic bacteria are ubiquitous and abundant in surface waters and can account for much of the particulate surface area in these waters. Particulate-reactive metals are therefore expected to associate appreciably with bacteria, which can then serve as an enriched source of metals for microbial loop food webs. We used gamma-emitting radioisotopes to experimentally determine the rate and extent of bacterial uptake of six metals (Mn, Fe, Zn, Cd, Cu, As) with varying chemical properties and biological uses. Six strains of gram negative bacteria showed little difference in uptake of any one metal, but there were significant inter-strainal differences. Steady-state was reached within 12 hours, at which time concentration factors ranged from 102 for Cs to 105 for As. Additionally, data on the trophic transfer of metals from bacteria to protozoa was presented, as well as the effect of viral lysis on the release of bacterial metal and its bioavailability to bacteria and phytoplankton.

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COMBINING CTD-YOYO DATA WITH SEISMIC REFLECTIONS

Small scale ocean mixing processes like interleaving or internal waves are difficult to image by traditional oceanographic methods. With its much higher lateral resolution, reflection seismics is an important tool in the horizontal domain. The joint analysis of these datasets gives both, high temporal and spatial resolution, and can account for much of the particulate surface area in these waters. Particle-reactive metals are therefore expected to associate appreciably with bacteria, which can then serve as an enriched source of metals for microbial loop food webs. We used gamma-emitting radioisotopes to experimentally determine the rate and extent of bacterial uptake of six metals (Mn, Fe, Zn, Cu, As, Cd) with varying chemical properties and biological uses. Six strains of gram negative bacteria showed little difference in uptake of any one metal, but there were significant inter-strainal differences. Steady-state was reached within 12 hours, at which time concentration factors ranged from 102 for Cs to 105 for As. Additionally, data on the trophic transfer of metals from bacteria to protozoa was presented, as well as the effect of viral lysis on the release of bacterial metal and its bioavailability to bacteria and phytoplankton.

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THE COUPLED DUST AEROSOL (AOT) AND SURFACE PHOTOPHYSIS ON THE REPRODUCTIVE PERFORMANCE OF MARINE MOLLUSCS

CARBOSCHOOLS – CARBOOCEAN AND CARBOEUROPE’S COMBINED INITIATIVE TO EDUCATE SECONDARY SCHOOL STUDENTS IN LATEST MARINE AND TERRESTRIAL CARBON CYCLE RESEARCH

The European educational initiative CarboSchools is based on interdisciplinary school projects and has been successfully connecting latest carbon cycle research and education over the last 2 years. The project has been driven by the two European Integrated Projects (IP) CARBOOCEAN and CarboEurope working on the generation of the missing scientific knowledge that is essential to a global quantitative risk/uncertainty judgment on the expected consequences of rising atmospheric CO2 concentrations. Both European Commission-funded IPs make their latest knowledge available to pupils via the interactive website http://www.carboschools.org and the implementation of individual school projects. The website acts as a multimedia portal and allows for downloading of science-based education material and teacher-participants’ methodology. The Norwegian CarboSchools project was recently successfully performed in Bergen with secondary school pupils on board of the RV Hans Brattstrøm. A short video was prepared to visualize how a marine school project could be realised. To order the dvd and further educational material, please visit http://www.carboschools.org

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ADAPTIVE MANAGEMENT AND COMPREHENSIVE EVERGLADES RESTORATION PLAN: UTILIZING SHELFISH RESPONSES IN SETTING WATER QUALITY TARGETS IN SW FLORIDA ESTUARIES

Ecosystem restoration and management seek to repair or improve a suite of desired environmental conditions for a specific ecosystem. Oyster responses are being used as performance measure indicators of estuaries as part of the Comprehensive Everglades Restoration Plan (CERP). This study investigated the effects of seasonal changes in water quality, including freshwater inflows and salinities on oyster responses in the Caloosahatchee River, Florida. Significant relationship exists between freshwater inflows and salinities (R² 69 - 84%) at various locations in the estuary. Prevalence and intensity of Perkinsus marinus infection varied over the sampling period and decreased with increase in freshwater inflows and lower salinities. Condition index of oysters varied with the reproductive activity of oysters. Oysters appear to spawn continuously between May - October, a period that coincides with freshwater releases. Inflows between 500 and 3500 cubic feet per second would result in optimal salinities that would support and enhance oyster reefs in the Caloosahatchee estuary. Freshwater inflows should be minimized during the spawning months to facilitate the spat recruitment of oysters onto oyster reefs. Results are being used in setting freshwater inflows as part of the CERP

Volkov, D. L., Jet Propulsion Laboratory, California Institute of Technology, Pasadena, USA, dvolkov@caltech.edu
Fu, L. C., Jet Propulsion Laboratory, California Institute of Technology, Pasadena, USA, THE ROLE OF VORTICITY FLUXES IN THE DYNAMICS OF THE ZAPIOLA ANTICYCLONE

The Argentine Basin in the South Atlantic Ocean is one of the most energetic regions in the ocean with complicated dynamics, which plays an important role in the global climate. A number of observations have discovered an intense anticyclonic gyre of barotropic circulation around the Zapiola Rise in the center of the basin. Theoretical studies have shown that the Zapiola Anticyclone represents an eddy-driven flow controlled by bottom friction. Recent advances in high-resolution global-ocean data synthesis, performed using NASA supercomputing facilities, provide realistic simulations of the circulation and variability in the Argentine Basin. Using these simulations and satellite altimeter observations we analyzed the vorticity balance of the Zapiola Anticyclone. Our results suggest the dominance of the planetary vorticity flux in determining the inter-seasonal and inter-annual variability of the gyre, whereas the planetary pressure flux also plays a role in the intra-seasonal scale.

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ON THE RELATIONSHIP BETWEEN SATELLITE-DERIVED AEROSOL OPTICAL THICKNESS AND CHLOROPHYLL IN THE MEDITERRANEAN SEA

The coupling between dust aerosols (AOT) and surface photopnthesis concentrations (MCHL) in the Mediterranean Sea, a LNRIC region, is examined at different time scales using SeaWiFS observations from 1998 to 2002. Seasonally, AOT and MCHL exhibit very different spatial patterns. AOT shows a meridional gradient with maximum values close to the dust sources and mainly during spring and summer, while MCHL exhibits a zonal gradient, with the western basin being more productive, especially during winter and spring. Weekly averages of MCHL and AOT are significantly correlated during the dusty season. However, this analysis cannot distinguish between real photopnthesis response and artifacts due to residual dust in the atmosphere or water. Daily progression of AOT and MCHL, for single dust events, and their temporal cross-correlation were examined. An increase in MCHL within two days was found after AOT events and most of the cross-correlations were significant at zero lag. Nonetheless, both positive and negative correlation was observed at lags 3-7 days indicating no compelling evidence that dust enhancement of photopnthesis growth is significant in the Mediterranean Sea.

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IS THE ATLANTIC MULTIDEcadAL VARIABILITY EXCITED BY ATMOSPHERIC NOISE? RESULTS FROM AN ENSEMBLE OF COUPLED CLIMATE MODEL SIMULATIONS

In simple ocean-only models spontaneous multidecadal variability can appear. In these models, an oscillation appears because the large-scale equilibrium flow obtained under restoring conditions is unstable under prescribed heat flux conditions and an internal mode of variability grows on the equilibrium flow. The oscillation is characterized by temperature anomalies propagating westward across the basin in combination with variations of the strength of the meridional overturning circulation. In coupled ocean-atmosphere models, the oscillation is damped, and it has been suggested, that atmospheric noise is needed to excite the oscillation to amplitudes observed in reality. In this presentation we study the mechanism of the Atlantic Multidecadal Variability in a large ensemble (17 members) of simulations with a fully coupled climate general circulation model (ECHAM5/OMI). In particular, we compare with the mechanism found in simple ocean-only models. Furthermore, we study the relation between atmospheric noise (with the spatial/temporal statistical properties of the North Atlantic Oscillation) and the Atlantic Multidecadal Variability.

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VELOCITY STRUCTURE OF PLUME EDDIES IN A ROTATING STRATIFIED ENVIRONMENT, WITH APPLICATIONS TO THE GREENLAND SEA

Turbulent plumes are found in many geophysical phenomena. They can be described by the turbulent plume model of Morton, Taylor and Turner (1956). As a negatively buoyant plume sinks, it entrains ambient water, and spreads laterally once it reaches its neutrally buoyant level. Once the effect of rotation is added to this, the lateral spreading is bounded by the Rossby deformation length and a so-called plume eddy forms. In this paper we present experiments examining quantitatively the horizontal velocity structure in such a plume eddy. The experiments undertaken follow those of Helgesson and Battisti (1991), using methods similar to those of Helgstrom and Armi (1988) to visualize the velocities. The goal of this work is to compare the experimental velocity structure to theories by Gill (1981) and Speer (1989), and to observe variations in submesoscale coherent vortices (SCVs) in the Greenland Sea. The Greenland Sea is known to be a site of deep water formation, and plumes that form under sea ice may be involved in deep convection and the formation of SCVs.

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BLACK BAND DISEASE DYNAMICS: ASSESSING NUTRIENT IMPACTS AND MICROBIAL COMMUNITY VARIATION

Black band disease (BBD) is a pathogenic microbial assemblage that infects scleractinian corals worldwide. Despite over thirty years of BBD research, the microbial community composition of this disease and the environmental conditions that promote infection remain elusive. The research presented here specifically examines the potential role of nutrient concentration in BBD occurrence. Regression analyses indicated significant positive relationships between dissolved inorganic nitrogen and BBD prevalence in both the Florida Keys (FK) and Lee Stocking Island (LSI) Bahamian studies. This study is one of few to quantitatively address the potential difference in coral disease dynamics between human-impacted (FK) and relatively pristine (LSI) reef systems. In addition to investigation of the environmental drivers that affect BBD prevalence, this study utilized length heterogeneity profiles of the BBD microbial community. Multivariate ordination and nonparametric analyses of the LH-PCR profiles revealed significantly distinct BBD microbial communities sampled from different geographic regions of the Caribbean. The results of this study, in concert with the findings of previous and ongoing molecular analyses of BBD bacterial communities, attest to the intrinsic variability and complexity of this dynamic microbial assemblage.

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A NEW TOOL TO MEASURE THE UPWELLING POLARIZED SPECTRAL RADIANCE DISTRIBUTION

We have developed a new instrument to measure the upwelling polarized spectral radiance distribution in the ocean. This instrument is based on combining 3 of our NuRADS instruments.
instruments into one package, with a linear polarizer inserted into each instrument. The images of the separate systems are obtained synchronously and can be combined to obtain the linear polarization state of the light field. The calibration/characterization procedures are more difficult than for a radiance system, but the polarization can be determined to within +0.05 in normalized Stokes vector units. This instrument has been used on several cruises, and we will present data from a clear water station off Hawaii. The measurements show that the upwelling light field is highly polarized in this clear water, with the degree of linear polarization exceeding 50% in some directions.

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NITROGEN FIXATION RATES AND HETEROZOOSPIRATORY ACTIVITY UNDER HIGH PCO2 IN FREE DRIFTING MESOSOMES IN THE BALTIC SEA

In July 2007 six free floating mesocosms with ~60m3 of volume were deployed in the southern Baltic Proper for two weeks. pcO2 levels in the mesocosms were adjusted 3 times (after exchange of water) to yield concentrations between 312 µatm (ambient) and 1600 µatm. The response of nitrogen fixing species was measured and heterotrophic activity calculated based on the uptake of radiolabeled thymidine. There was no consistent response in nitrogen fixation rates. Only in the size fraction <10 µm N fixation rate decreased with increasing pcO2. A daily cycle of N fixation rates was only visible in the fully mesocosm with ambient pcO2, and, which also had highest N-fixation rates of up to 1.4 nmol N/L/h, suggesting that seawater acidification and mixing adversely affected the diazotrophic cyanobacterial community. A sharp decrease within the first 24 hours after acidification was also occurred with regard to cell specific bacterial biomass production but, in contrast to N fixation, showed higher activity with increasing CO2 concentration during the rest of the experiment. Our results indicate a potential decoupling of primary and secondary production under increasing CO2 concentrations.

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PHYSICAL CONTROLS ON BENTHIC EXCHANGES ON THE MID-SHELF OF THE SOUTH ATLANTIC BIGHT: RIPPLE EVOLUTION AND TURBULENCE MEASUREMENTS

Data on nearbed sediment mobility, bedform evolution and water column turbulence are presented from a Benthic Observatory and Technology Testbed (BOTTOMS-UP) operating on a medium sand bed on the Mid-Shelf of the South Atlantic Bight. The project examines benthic exchanges and ripple dimensions to identify their role in the advection processes of porewater transport and particulate exchange rates. In addition to wave-induced orbital velocities, strong tides (up to 15 cm/s) and wind-driven circulation contribute to near-bed stress levels. Initial results from a 5-beam VADCP during storm events are used to evaluate the importance of tidal modulation in determining maximum near-bed velocities. The ripple geometry data is compared with recently developed time-dependent ripple evolution models and the role of turbulence due to mean flows is presented as a factor for ripple height diffusion. Full-depth Langmuir cells develop during strong wind/wave forcing, evidenced by clouds of strong backscatter, highly correlated with vertical velocity, originating from both surface and bottom boundaries. Their effect on near-bottom suspension events and benthic exchanges is also considered.

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THE IMPACT OF LARGE FRESHWATER DISCHARGE EVENTS ON THE DELAWARE ESTUARY

The Delaware Estuary, a well-mixed coastal plain basin in the mid-Atlantic region of the US, has a large watershed within Delaware, Pennsylvania, New Jersey and New York states, and primary freshwater inputs supplied by the Delaware and Schuylkill rivers. Typically, strong tidal forcing creates a well-mixed water column and a fairly predictable salinity gradient, which controls the physical and chemical properties of the estuary. During large storms, freshwater discharge overcomes the tidal forcing effect, redistributes the salinity gradient further downstream, and alters the estuarine biogeochemistry. In attempt to evaluate the watershed influence, we examine long-term databases for large discharge events, which have become more frequent since 1999. Occasional large storm discharge events may introduce large watersheds, DOM, and suspended sediment concentrations to USGS gauging stations along the Delaware Estuary's main tributaries. Large storm events indicate that the watershed can cause changes in the estuarine biogeochemistry.

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THE MOVING WATER QUANDARY

A spectral content of the internal waves is a fundamental measure that can be made from seismic images of water structure. However, this is not as robust as it may first appear. An underlying assumption in the seismic method is the reflection boundary is fixed in space. This is not true for boundaries in water. These are dynamic and the larger-amplitude lower-frequency internal waves, which are the easiest to map, are those moving with the fastest velocity; which may be on the order of a meter per second. This speed is significant when compared to the velocity of the seismic acquisition vessel. We observe asymmetry in apparent structure on data acquired as part of the EU funded G0 data. Also, deceleration velocity analysis reveals a more complex stacking velocity field than expected. We demonstrate that both these effects can be predicted using simple models and, when appropriate corrections are applied, how the correct images can be obtained.

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ANALYSIS OF MONOSACCHARIDE COMPOSITION OF CARBOHYDRATE IN SEA WATER USING METHANOLOGY METHOD

Monosaccharide composition of carbohydrates provides various clues such as origin and diagenetic state and organic matter in seawater. It is essential that we reconstruct the carbon cycle of the oceans. Methanolysis reaction was used as a standard procedure of depolymerization since several decades ago, but the hydrolysis is only applicable to neutral sugar because other carbohydrate species such as uronic acid (UR) are unstable under hydrolysis procedures. Here, we develop methodology, which can be applicable to the measurement of the concentration of UR because UR is relatively stable under methanolysis processes. Methanolysis reaction was completed using HCl/Methanol solution. The liberated monosaccharides were converted into trimethylsilyl derivatives, and were analyzed by gas chromatography-mass spectrometry. Seawaters were collected at Sato-Nada in Japan, and particulate organic matter was obtained by filtration. Total particulate carbohydrate (T-PCHOs) concentrations ranged 25-90 µg C/L, accounting for 10-17% of particulate organic carbon (170-310 µg C/L). The T-PCHO concentrations were 3.3–8.7% of T-PCHO. The vertical profile showed that the proportion of the UR in T-PCHO tends to increase with depth.

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STRUCTURAL CONTROL ON CONTINENTAL SHELF SEDIMENT DYNAMICS, NORTH ISLAND, NEW ZEALAND

Over 850km of Edgetech chirp sub-bottom profiles were analyzed in order to investigate regional structural control on stratigraphy-forming processes operating along the gently (<0.7%) sloping Waiapu continental shelf. Shelf stratigraphy is dominated by a reflection surface, identified as Miocene-age sedimentary rock, which is exposed on the seafloor in the eastern portion of the shelf and dips down towards the south. The outer shelf is heavily faulted and folded, creating a structural low on the continental shelf. Seismic interpretation indicates that sediments are thickest on the central and southern continental shelf, and more laminated in the southern continental shelf, indicating preferential deposition in these structural lows. This suggests that in the geologic past the primary direction of sediment transport and preservation was not simply offshore but was structurally steered towards the south. These observations are consistent with recent findings indicating that modern flood deposits are primarily transported and preserved on the southern Waiapu continental shelf. These data further suggest that current sediment transport models should include the effects of bathymetry on sediment dynamics even on gently sloping continental shelves.

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BATHYMETRIC INFLUENCES OF THE EMPEROR SEAMOUNTS UPON THE NORTH PACIFIC SUBARCTIC CYRE BOUNDARY CURRENT ALONG THE EASTERN SIDE OF THE EMPEROR SEAMOUNTS

To make bathymetric influences of the Emperor Seamounts upon the North Pacific subarctic gyre, numerical experiments were performed using two-layer model with an idealized eddy and ridge. Seasonally varying interior Sverdrup transport to the east of the ridge partly returns along the eastern side of the ridge as a western boundary current. A ratio of the boundary transport to the interior transport depends on a ridge height (HM) and stratification (N). For smaller HM, the ratio increases with HM, but it changes little with N. For larger HM, the ratio decreases with N but is independent of HM. Spatial distribution of geostrophic contours is a key to understanding the dependency of the ratio on HM and N. For smaller HM, the ratio almost coincides with a ratio of the number of closing geostrophic contours to one of all geostrophic contours. For larger HM at which all geostrophic contours in the eastern region cannot cross over the ridge, bottom pressure decreases with N to allow more transport across the ridge.

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of internal waves. Rhodamine WT was injected in a streak perpendicular to the axis of the dominant wind. The dye cloud was mapped daily for three days, and temperature microstructure profile were measured concurrently. Throughout the experiment, wind forcing and the internal wave field were measured by a lake station. We relate the behavior of the dye cloud to the forcing and evaluate two mechanisms for generating intrusions: bottom turbulence caused by seiche currents and mixing caused by breaking internal waves.

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THE WEST SPITSBERGEN CURRENT: STRUCTURE AND VARIABILITY
Based mainly on synoptic observations conducted by the Institute of Oceanology Polish Academy of Sciences in the area of the West Spitsbergen Current (WSC) and Fram Strait, the Atlantic Water (AW) properties, heat and salt transports and its surface heat variability are presented and analyzed. The AW northward flow structure, dynamics and warm signal propagation by the WSC are discussed. Dependence of the WSC hydrology on the upstream conditions as exchanges through the Iceland-Svalbard Ridge and Norwegian Atlantic Current fluctuations are considered. Two sources of the warm water observed since 2003 has been recognized: core of the WSC flowing along the Barrents Sea and Spitsbergen shelf-break as prolongation of the barotropic Norwegian Atlantic Slope Current and the baroclinic western branch. The WSC western branch being extension of the Norwegian Atlantic Current outer branch continues over the submarine ridges. This flow has been neglected for the long time and only recently its importance has been recognized. Role of the western branch for the WSC warming and AW northward transport is discussed.

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EFFECTS OF INFAUNA ON PERMEABLE SEDIMENT CHEMISTRY AND TRANSPORT PROCESSES: MULTIPLE SITE AND SPECIES COMPARISONS
Significant changes to permeable sediment biogeochemistry due to complex interactions among bioturbating infauna and porewater advection are increasingly evident. Dynamic physical properties and methodological limitations have inhibited in-situ studies of infauna in permeable sediments. An important research goal is to evaluate the nature, extent and species-specificity of these effects within realistic porewater advection regimes. We present findings from field studies of several different intertidal flats, inhabited by five taxonomic different infauna. We determine the solution and sedimentary properties, bulk sediment granulometry, and density of infauna within experimental plots. Different infaunal species exert significantly different effects on porewater transport and sediment biogeochemistry, which appear to be related to feeding strategies and burrow characteristics. Deep burrowing deposit feeders increased porewater advection, while effects of surface deposit feeders appeared to depend more on the burrow type. Strikingly, within site effects of infauna are independent of sediment properties, while across-site infaunal effects may be dependent on site characteristics. Although we lacked the same dominant species among sites, our results provide evidence of functionally specific effects of infauna on permeable sediments in a range of diagenetically important environments.

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NEW TOOLS FOR SATellite SURVEILLANCE OF RAPIDLY MOVING CYCLOONES ALONG THE MARGIN OF THE LOOP CURRENT: GULF OF MEXICO
This paper presents an improved method to track cyclonic mesoscale eddies along the outer margin of the Loop Current (LC). Recent research has shown the critical role that these features play in the intensification of surface currents, as trigger mechanisms for deep flows and LC eddy shedding, and for hurricane intensity changes. The rapid motion of these features (35 km/day) makes their study problematic. We discuss new advances in the integration of data from several remote sensing systems to track the motion of LC frontal eddies in real-time and in hind-cast mode. Mid-infrared (35-39 micron) measurements from GOES GVAR, available every 15 minutes over the Gulf, provide an excellent source of de-clouded night-time surface temperature information. Measurements in this atmospheric window maximize ocean information in cloudy and humid regions such as the Gulf. On the other hand, satellite altimetry measurements provide the only remote sensing technique that directly measures a dynamical variable of ocean state - the surface height. Detection of mesoscale eddies has been improved by combining multi-mission measurements from TOPEX-Poseidon, ERS-2, GFO, Jason-1 and Envisat into a gridded product, updated daily. Ocean color sensors (MODIS, OCM) provide surface pigment information that can aid in the discrimination of eddies as well as the detection of hurricane-induced upwelling and associated near surface bio-geochemical changes.
exert many harmful effects on sealife and cause severe respiratory symptoms in humans.

The toxic dinoflagellate, Karenia brevis, produces brevetoxins, potent marine toxins which

ZOOPLANKTON OF THE CANADIAN BEAUFORT SEA

Zooplankton composition and distribution were studied during two cruises in the Beaufort Sea during the summer of 2005 and 2006. Thirty three stations were sampled by means of 15mµm vertical net and 500µm Bongo net. The data were used to assess zooplankton taxonomic di-

The tropical ocean and atmosphere play key roles for climate, atmospheric chemistry and

The TROPICAL EASTERN NORTH ATLANTIC TIME-SERIES OBSERVATORY AT CAPE VERDE (TENATSO). STATUS AND INITIAL RESULTS

The tropical ocean and atmosphere play key roles for climate, atmospheric chemistry and

Sedimentation and morphology of the outer shelf and slope of the Vápaa ocean margin: an integration of geophysical and radiochemical data

Despite the present high stand in sea level, the outer shelf and slope of many continental margins are continuing to evolve. The Vápaa ocean margin in New Zealand is a tec-

Observations of coral reef lagoon/ocean exchange in a nearly tideless system

The exchange of water between coral reef lagoons and the open ocean depends on the interaction between waves, buoyancy forces, and alongshore currents. Some processes act to retain lagoon water such as onshore flows driven by surface waves, while others, e.g. the momentum jet that exits the lagoon, export lagoon water. To explore exchange dy-

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basically in the geostrophic balance, and the reversed across-shelf pressure gradient is re- 
sponsible for the reverse of the SCSWC and slope current. Such pressure gradient comes 
from the combined effect of local and remote forcing, which include the basin scale cy- 
oclonic circulation induced water piling up along the shelf break, the influence of the south- 
westward branch of the intruded Kuroshio, the winter monsoon induced water piling up 
east of the Hainan Island, and the southwestward tilting of the sea surface elevation in 
the interior of the northern SCS. Diagnostic analyses of the vorticity balance equation indi- 
cate the onshore flow is driven by the bottom pressure torque component of JEBAR. 
the onshore component of the slope current, while climbing the continental slope, is deflected 
in the anticycloonic tendency to generate compensated negative relative vorticity. With 
The geostrophic adjustment, the onshore offshore flow continuously feeds into the SCSCW 
under force of the across-shelf pressure gradient. The local onshore transport and horizontal 
tendency of momentum and vorticity balances provide mass and momentum for the SCSWC.
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LONG TERM TREND OF TEMPERATURE IN THE CHINA SEAS AND THE 
KUROSHIO REGION IN THE PAST 40 YEARS
Global warming is known as a remarkable phenomenon of the atmosphere-ocean system, 
which has been studied through global and basin scales intensively. However, long term vari-
ability of temperature in continental margins, including the Yellow Sea (YS) and the East 
China Sea (ECS), has been rarely studied and poorly understood. To fill this gap, long term 
data from 1957 to 2001, long term trend of temperature in the YS and ECS and their 
relationships with variations in the Kuroshio region are studied. Trends of warming and 
cooling are both observed in the study waters with complicated spatial patterns. In summer, 
sea surface temperature (SST) showed warming tendency in the northern YS and most part 
of the ECS including the Kuroshio and Taiwan Warm Current (TWC) regions, while cool-
tendency in the south YS and north edge of the ECS. In winter, temperature in most part 
of the YS and the ECS warmed up. The two warming centers correspond to the re-
regions of the TWC and the Yellow Sea Warm Current (YSWC), respectively. As the origin 
of the TWC and YSWC, the Kuroshio area warmed with smaller amplitude.
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TOWARD A MERCURY MASS BALANCE MODEL IN THE ARCTIC OCEAN: WHAT 
CAUSED THE MERCURY CONTAMINATION IN BEAUFORT SEA BELUGA WHALES?
One of the major findings regarding the global mercury (Hg) pollution is the highly elevat-
ed Hg levels in beluga whales from the Beaufort Sea of the Arctic Ocean. The Hg levels in 
Beaufort belugas were on average 10-fold higher than during the 15th to 17th centuries. 
Long-term concentrations of this persistent bioaccumulative Hg have further tripled from the early 
1950s to the mid-1990s. The atmospheric Hg deposition, including the tropospheric mercury depletion 
events (MDEs), alone seems insufficient to explain such high Hg burdens and large varia-
tions. As part of the ArcticNet program, extensive studies have been carried out to probe 
the causes of Hg contamination in the Beaufort Sea beluga whales, Mercury and methylmer-
cury (MeHg) concentration, speciation and flux from a variety of possible Hg sources 
and sinks were studied or estimated. These included the atmospheric deposition, rivers, 
coastal erosions, oceanic circulation, sea ice loss, and sedimentation. Further studies were 
conducted on the habitats and feeding patterns of beluga whales and the food web struc-
tures. The results allowed us to construct the first mass balance model of Hg in the Arctic 
Ocean. The Hg is found to be in a quasi-steady state in the Arctic Ocean, and only a very 
small fraction of the Hg in MeHg is accumulated in biological systems. The rapid Hg 
bioaccumulation observed in marine mammals in recent years is thus unlikely purely mass 
driven. Alternative processes such as biotic and climatic drivers are proposed.
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IMPLICATIONS OF MICROBIAL COMMUNITIES ASSOCIATED WITH ALIEN 
MARINE SPONGES FOR HAWAII REEF ECOSYSTEMS AND HUMAN HEALTH
The coral reef ecosystems of the Hawaiian Islands are sensitive to alien marine species 
because of their isolated nature. Alien sponges alone constitute nearly one-third of intro-
duced marine species in Hawaii. These alien sponges harbor microbial pathogens and 
other diverse microbes and represent a great source of bioactive natural compounds; some 
of these sponges have become invasive. Consequently, alien sponges and their micro-
bial symbionts have significant implications for the reef ecosystems and human health. 
Mycal armata and Suberites zeteki are two of the most abundant alien sponges in Hawaii.
Using cultivation-dependent and molecular approaches, we have isolated and identified hundreds of fungi and bacteria from these two sponges. Both of these species harbor microbial pathogens with the origins of human, animals, and plants. Phylogenetic analysis revealed their unique microbial signatures, which may contribute to the invisiveness of M. aramta. Bioactivity assays indicated that some microbial strains derived from these two sponges produce interesting biological activities. In this talk, we focus on phylogenetic diversity and biomolecular potential of microbes isolated from these two sponges. In addition, we will discuss the potential impact of the invasive sponge M. aramta and the implications of sponge-symbionts on the reef ecosystems and human health.

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INFLUENCE OF PHYTOPLANKTON COMMUNITY STRUCTURE ON PHOTOSYNTHETIC PHYSIOLOGY AND BIO-OPTICS IN SOUTHERN CALIFORNIA CURRENT ECOSYSTEM

Biophysics and physiology dynamics of pelagic photosynthesis were investigated during two process research cruises of California Current Ecosystem (CCE)-LTER projects in 2005 and 2006. Coastal and offshore waters of CCE have very different phytoplankton community structure and environmental forcing of photosynthetic physiology. Diatom dominate in coastal high chlorophyll area, while in oligotrophic offshore waters the community is mainly composed of much smaller phytoplankton such as Prochlorococcus, cyanobacteria Synechococcus and Phaeocystis. Results from photosynthesis-irradiance (P-E) experiments indicated that coastal waters tend to have higher light-saturation parameter (Ek), light-saturation value of chl-a specific rate of photosynthesis (Pmax), but relatively higher quantum yield (Fmax); as the contrast, offshore waters show the opposite trends. Modeling of ocean photosynthesis need to account for how community structure and acclimation to light condition by the light-saturation temperature matrix regulate the parameters of photosynthesis used in the models. Our goal as part of CCE-LTER is to be improve the knowledge of both community structure and environmental acclimation of phytoplankton to improve models of plankton ecosystems.

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A COMPARATIVE STUDY OF CHESAPEAKE BAY’S RESPONSE TO THE HURRICANE ISABEL AND FLOYD

Hurricane Floyd swept through the mouth of the Chesapeake Bay on September 16, 1999 as a category 1 storm moving northeastward along the coast of the mid-Atlantic. Hurricane Isabel, on the other hand, made landfall on September 18, 2003 near Outer Banks of North Carolina as a category 2 storm moving west-northwestward inland. The two hurricanes differed in many aspects, including their magnitudes, storm paths, and accumulated precipitation. Hurricane Floyd passed through the eastern side of the Bay generating northerly wind and created a setup the in upper Bay. In contrast, Hurricane Isabel passed through the western side of the Bay generating a persistent southerly wind that gave rise to a second component of surge in addition to the initial surge coming from the continental shelf. As a result, it induced an unexpected large setup in the upper Bay. Another difference is the amount of precipitations. A band of 12-16 inch rainfall fell directly onto the Bay proper over 24 hour period during Hurricane Floyd, whereas only 3-5 inch of rain fell directly onto the Bay during Hurricane Isabel, resulted in a significant difference of the buoyancy influx and subsequent response of the Bay. A three-dimensional unstructured grid model (FE) was used for the simulation. The model results compare favorably with observation data and elucidate the barotropic and baroclinic responses of a large estuary to hurricane forcing.

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ARCTIC OSCILLATION AND DIPOLE ANOMALY AND THEIR CONTRIBUTION TO SEA ICE EXPORT FROM THE ARCTIC IN THE 20TH CENTURY: OBSERVATION AND MODELING

The winter Arctic Oscillation (AO) and Dipole Anomaly (DA) in the Arctic atmosphere and their contribution to sea ice export are investigated by using both the NCEP reanalysis and a high-resolution coupled general circulation model. The spatial patterns of the first two leading EOF modes of winter mean sea level pressure and geopotential height at 500 hPa north of 70oN obtained by the long-term simulation (1900-2010) are highly similar in the high resolution run (H) and the coarse resolution run (L), the coastal upwelling is much stronger in H than in L and the warm biases are partially removed in H. It indicates that the coastal SST and upwelling rate are mainly determined by the coastal wave dynamics and cannot be explained by Ekm dynamics. An idealized ocean-gene circulation model (OGCM) is also used to further demonstrate that it is true for the idealized setting as well as for the fully coupled regional model of the tropical Atlantic. Since the coastal upwelling is one of the major biases in coupled GCMS, and the primary production of ecosystems is largest in coastal upwelling regions, the next generation of GCMS must either parameterize or resolve the coastal undercurrents and associated Kelvin waves.

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ASSESSING WETLANDS RESTORATION IMPACTS ON NEARSHORE SALINITIES IN BISCAYNE BAY, FLORIDA

To evaluate the impacts of planned restoration and compare alternative restoration measures, we have adapted a previously developed salinity model of Biscayne Bay to focus more explicitly on the nearshore region downstream of the coastal wetlands targeted for restoration. Historic forcing from wind, tides, and observed canal-discharges are imposed on the one-layer 2D hydrodynamic finite element model for the period 1996 to 2005 to quantify the model performance as a measure of validation. Salinity data from a number of monitoring efforts over the past 10 years are analyzed in conjunction with model hindcasts. The nearshore brackish zone is on the order of 500 m wide due to the relatively small quantities of freshwater runoff interacting with the 0.5m tides in the very shallow water less than 1 m deep. To refocus on this nearshore region, the horizontal resolution in the area is increased in two phases. Various scenarios for the spatial and temporal redistribution of freshwater flows, including those of the State of Florida’s Acceler8 program and the federal Comprehensive Everglades Restoration Plan, were used to drive the model.

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EROSIONAL AND DEPOSITIONAL CHARACTERISTICS OF REGIONAL OVERWASH DEPOSITS CAUSED BY HURRICANES IVAN AND DENNIS ALONG SANTA ROSA ISLAND, FLORIDA

Regional-scale washover deposits along the Santa Rosa Island induced by hurricane Ivan in 2004 and hurricane Dennis in 2005 were studied through coring, trenching, GPR (Ground Penetrating Radar) imaging, aerial photography, and pre- and post-storm beach profile surveys. Erosional and depositional characteristics in different barrier-island environments, including dune field, interior wetland, and back-barrier bay, are examined. Over the eroded dune fields, the washover deposits are characterized by an extensive horizontal basal erosional surface, truncating the old dune deposits, and horizontal to slightly landward dipping bed. Over the marsh wetlands in the barrier-island interior, the washover deposits are characterized by steep tabular bedding, with no erosion at the bottom. The homogeneity of sediment along the northern Florida coast makes distinguishing between washover deposits from Ivan (2004) and Dennis (2005) difficult. The aerial extents of washover deposits are controlled by both the storm intensity and the pre-storm morphological characteristics.

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AN ISOTOPIC EXCHANGE METHOD FOR MEASURING PHOTOPRODUCTION OF CO2 FROM DISSOLVED ORGANIC MATTER IN SEAWATER

Accurate measurements of CO2 photoproduction from colored dissolved organic matter (CDOM) in oceans are important for understanding carbon cycling and budgets. A new 14C exchange method could provide an independent comparison to the standard ‘pool depletion’ method. When measuring small increases of CO2, ambient dissolved inorganic carbon (DIC)
concentrations pose problems of high background. This is reduced by replacing DIC carbon with 14C by flowing a 13CO2 (600 ppm) gas mixture over the samples. The production of CO2 can be calculated by the change in the 13C/12C ratio before and after photoreactions, measured with isotope ratio mass spectrometry. Procedures that may alter the chemical properties of CDOM - adjusting sample pH and stripping of CO2 - are thus avoided. Instrument sensitivity is adequate for small (3-4 nl) samples. The isotope shifts for 13CO2 are more than 37 parts per thousand for coastal water samples irradiated for less than two days, with a precision of 5.4 pmol or better. Hence, measuring blue-water samples may be possible. Results of the two methods are compared for a coastal water sample.

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EKMAN WAVE AND THE WIND ENERGY PATHWAY INTO THE SUBSURFACE OCEAN

Motions in the Ekman layer, including the case with time-dependent wind, have been traditionally assumed to originate from the Ekman spiral. However, such motions can also be interpreted as waves because they can be cast in the standard forms of wave. The concept of Ekman wave is illustrated by using two long-term mooring observations. Ekman wave propagates vertically downward to the subsurface ocean with amplitude decreasing exponentially with depth. The characters of Ekman wave, including the dispersion relation and the group velocity, are examined in this study. Since the group velocity can represent the transfer speed of the energy, energy flux from the wind to any depth of the ocean can be estimated. Energy flux at the sea surface obtained from the framework of Ekman wave is the same as that discussed in classical literatures, i.e., it is the total production of the wind stress vector and the surface Ekman flow velocity. Applying the Ekman wave method to the global ocean and assimilating the WP wind stress dataset, the total energy flux from the wind to the Ekman layer is estimated as 2.76 TW, in which 0.21 TW is within the near inertial range. Using the Levitus monthly mean mixed layer data, the total energy flux penetrating the base of the mixed layer is estimated at 0.74 TW, in which 0.13 TW is within the near inertial range, and they are less sensitive to the choice of the eddy diffusivity.

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MODELING AND PREDICTING TIDES IN MONTEREY BAY, CALIFORNIA

During August 2006, a tide-permitting, real-time data assimilation and forecasting system configured from the Regional Ocean Modeling System (ROMS) was used to support several field experiments at Monterey Bay, California. The system is forced by atmospheric forcing fields and eight-daily wind stress fields at its open boundaries. Besides the three-dimensional temperature, salinity and current fields, the system also provided real-time tidal predictions, such as the depth-integrated baroclinic tidal energy and energy flux. The tidal predictions indicate that the northern flank of the Sur Platform south of Monterey Bay is associated with large baroclinic tidal energy and northward energy flux. The semidiurnal baroclinic tidal energy at the site changes by a factor of 3 during the semi-diurnal tidal cycle. The study summarized the experimental prediction practice for August 2006 and compares tidal prediction with high spatial survey data from SeaSoar, high resolution oceanogra

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INTERACTIONS BETWEEN LARVAL DEEPWATER SCULPIN AND THE VERNAL COASTAL WARMINING IN LAKE MICHIGAN

In Lake Michigan the deepwater sculpin, a benthic glacial relict species restricted to depths greater than about 70 m, has epipelagic larvae that emerge during the spring warm-up. Warm-up in the four deep Great Lakes proceeds in a way that initially generates a coastal thermal bar of 5°C, with colder isothermal water offshore, and warmer coastal water. During the thermal bar period we found statistically more larval deepwater sculpin shoaled offshore of the thermal bar than shoaled offshore of the thermal bar. The shoreward station bottom depths were much shallower than where the adults are found. Larval deepwater sculpin shoaled offshore of the thermal bar were also larger than those offshore. The post-barmal bar fate of these coastal larval deepwater sculpins is uncertain, but work on larval fishes that emerge later in the season suggests offshore transport. Because the larvae that are inside of the thermal bar may have originated farther offshore, it may be that the most successful larvae are those that serendipitously end up near the coast. Their success will depend on later offshore transport, however.

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ON THE HORIZONTAL AND VERTICAL STRUCTURE OF TURBULENCE

Vertical and horizontal structure of turbulence can be obtained by using micro and fine-scale sensors on a AUV. We will illustrate this from data obtained on the T-REMUS vehicle in a shallow region of Monterey Bay at nighttime on 2006 as part of the LOCO experiment. Eight hours of data are collected over a repeated cross isobath track runs of 2.5 kilometers. The vehicle was operated at a ground speed of 1.2 m/s at a 5 degree yo-yo mode. This allowed turbulent dissipation rate to be estimated on vertical scales of 30 meters and over horizontal scales of 150 meters. The most intense turbulence occurs near boundaries, surface and bottom, with characteristic horizontal scales of order 500-1000 meters. However patches of strong turbulence also occurred within the pycnocline. The two dominant larger scales features observed during the experiment were the intrusion of a warm water plume and the occurrence of internal solitary waves. We will examine the relationship of these features to the spatial structure of the turbulent field.
The monitoring of recreational waters is important to gauge potential risks to human health. In this study, water and sand samples taken from beach sites innants may be polluting beaches. In this study, water and sand samples taken from beach sites...
processes that influence residence time. The residence time is particularly sensitive to the exchange between the Hudson River and New York Harbor, a complex junction of tidal channels. Regions like this can represent a difficult challenge for structured grid models because adequate resolution in all channels would typically require a high percentage of grid points over land resulting in computational inefficiency. To create the numerical grid of this complex system we developed a novel technique called composite grids that allow multiple structured grids to be combined and solved simultaneously. We employ the technique with the ROMS model and demonstrate how this capability permits an unlimited number of grids to be connected together to allow more accurate resolution in regions with complex interconnected embayments and channels. This method provides a sound technique to more accurately model the residence time in the Hudson River Estuary.

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A NUMERICAL INVESTIGATION OF FORM DRAG INDUCED BY STRATIFIED TIDAL FLOW OVER ROUGH TOPOGRAPHY WITHIN AN ESTUARY

Form drag is a force felt by a fluid as it flows over an object and experiences an adverse pressure gradient. In a stratified estuary, form drag works to convert barotropic tidal energy to baroclinic features such as internal waves and eddies, and to directly dissipate energy. A numerical experiment was performed to investigate the form drag as stratified water flowed over idealized topography similar to that found at Three Tree Point in Puget Sound, WA, where observations of form drag have previously been conducted (Edwards et al. 2004, IPO). The flow was tidally forced through an area 5 km wide, 200 m deep channel with sloping side-walls and a Gaussian-shaped headland on one side-wall. The width and length of the channel was designed to mimic the scale of the side-walls of the tidal excursion, and the tidal excursion distance were all varied to see how they affected the total form drag. These topographic and flow features were reduced to drag coefficients that can be used in larger scale models to more accurately parameterize mixing and dissipation of fluctuating flow over topography.

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PARAMETER RANGES ENCOUNTERED IN SOUTH CHINA SEA SOLITARY WAVE PREDICTIONS

The Apel parameters that describe the presence of solitary waves are calculated in the South China Sea for the period of April and May 2001. Solutions are constructed for a range of Apel model parameters. The background for the calculations is obtained from 3D hydrostatic NCOM model predictions with tides. NCOM predicts internal bore locations that correspond to the solitary wave train locations. Predictions with the fully nonlinear nonhydrostatic 2D Lam model are undertaken along selected tracks. The predictions involve the generation of solitary waves in the Luzon Strait and their propagation towards the ASIAEX experimental site. The parameters ranges of Apel and Lam models are compared to observed solitary wave structure in the South China Sea (SAR, ASIAX, and WISE observations). The flow was tidally forced through a 5 km wide, 200 m deep channel with sloping side-walls and a Gaussian-shaped headland on one side-wall. The width and length of the channel was designed to mimic the scale of the side-walls of the tidal excursion, and the tidal excursion distance were all varied to see how they affected the total form drag. These topographic and flow features were reduced to drag coefficients that can be used in larger scale models to more accurately parameterize mixing and dissipation of fluctuating flow over topography.

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THE PROPAGATING RESPONSE OF INNER SHELF CIRCULATION TO WIND RELAXATIONS IN A COASTAL UPWELLING SYSTEM

Following relaxation of upwelling winds along the west coast of North America, coastal currents quickly shift from equatorward to poleward. Using an array of moorings, surface current observations from high frequency (HF) radar and satellite imagery, we examined the response of inner shelf circulation along central California to wind relaxations. Relaxations occur most frequently in late summer and least frequently in winter. A conspicuous response of the inner shelf circulation is the propagation of warm water poleward along the coast. Propagation speeds of the nose of warm water are linearly related to temperature differences, consistent with buoyancy forcing as described by Lentz and Helfrich (2002). As the nose propagates offshore, warm water warming leads to the formation of hyper-saline water flows offshore below. The alongshore flow after passage of the nose is weak. HF radar-derived current patterns show that the propagating events are disturbed by sub-mesoscale flow features such as small eddies. We speculate that these events are important in the settlement of some invertebrate species along the central California coast.

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PACIFIC WATER TRANSPORT IN THE ARCTIC OCEAN SIMULATED BY AN EDDY-RESOLVING COUPLED SEA ICE-OCEAN MODEL

The Pacific water transport from the Chukchi Shelf to the southern Canada Basin is investigated by using an eddy-resolving coupled sea ice-ocean model. The simulation results show that the inflow of the Pacific water into the Canada Basin depends on sea ice condition during summer. When sea ice margin is located in the basin, eddies are vigorously generated by instability of the Barrow Canyon jet and promote the Pacific water transport into the basin. On the other hand, when sea ice remains in the shelf even in late summer, the sea ice–ocean stress and the surface heat loss play a great role in braking the jet. In that case, the eddy generation and the Pacific water inflow are suppressed. In addition, these results also indicate that the sea ice growth in winter is delayed in the southern Canada Basin when the Pacific water gains enough heat in the Chukchi Shelf.

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IMPACTS OF LOWERED PH ON FLOCCULATION OF MARINE SUSPENDED DEBRIS

Sinking debris or marine snow is thought to be food source for herbivorous or omnivorous zooplankton in the ocean and the sinking flux determine the character...
istics of deep sea ecosystem. Smaller marine particles aggregate or flocculate each other and form gradually larger marine aggregate. The sinking speed of marine aggregate is influenced by the size. The change of sinking flux from upper layer will affects the food availability for the organisms inhabited in deeper layer in the ocean. And moreover marine aggregates have higher concentration of organic matter than the ambient water, they provide a suitable habitat for the microorganisms such as bacteria or heterotrophic nanoflagellates. This study investigated the flocculation ability of marine debris exposed by lowered pH controlled with elevated CO$_2$ or HCl. Marine debris, which were collected from near the sea bottom (100 m depth) in Toyama bay and from 1000 m depth in the western north Pacific, were stirred in seawater with various pH (6.0 - 8.0). The larger aggregates were formed in normal pH but lowered pH inhibited the flocculation of marine debris. As the reduction of the aggregate size is thought to change the sinking speed, the available amount of food source for planktonic organisms will affected, and the microhabitat of the microorganisms depend on the marine aggregates will decrease.

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SPATIAL STRUCTURE OF TIDAL AND RESIDUAL FLOWS AT A TIDAL INLET

Located on the northeastern coast of Florida, Ponce Inlet is a shallow, short estuary with depths between 2m in the shallows up to 10m in the thalweg. Current speeds, surface and profiling measurements of conductivity, temperature and depth were collected over a semi-diurnal tidal cycle on September 5, 2007. The mean flow in this estuary agrees with the flow structure of tidally dominated residual flow: inflow in the deeper channel and outflow through the shallower shoals. However, lateral gradients in density with values close to 0.01 kg/m$^3$ observed during ebb but become negligible during flood. The importance of the forcing caused by the ebb-tide density gradient relative to tidal influence and bathymetric effects are assessed.

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EDDY-MEAN FLOW INTERACTIONS IN WESTERN BOUNDARY CURRENT CETS

We present new results from the Kuroshio Extension System Study (KESS), a large-scale observational program of the Kuroshio Extension addressing the processes that govern the jet’s variability and the relation between the jet and its recirculation gyres, together with results from a theoretical study of eddy-mean flow interactions in an unstable, quasi-geostrophic jet. We show that in an idealized model of a boundary-forced jet in a parameter connection for the whelk Kelletia kelletii and have compared results to empirical data. Using this model we have simulated the impact of climatic changes on the genetic connectivity of this system to be extended to any local scale domain.

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ACCURATE MONITORING OF THE NORTH ATLANTIC AIR-SEA CO2 FLUX FROM A NETWORK OF VOLUNTARY OBSERVING SHIPS

Since the start of 2005 under the EU’s Carbo-Ocean project, we have participated in co-ordinated observations of sea surface pCO2 and related variables from a network of commercial vessels in the North Atlantic. Typically five vessels are operating at any one time. The observations will be used to reconstruct the sea-surface pCO2 field, and hence estimate air-sea fluxes, with unprecedented resolution and accuracy. Using the observations for the calendar year 2005, we use a variety of geostatistical methods to derive the precision with which regional fluxes can be obtained. The observations are generalized to the entire North Atlantic from 10N to 65N by exploiting relations between surface pCO2, SST and mixed layer depth. Using semi-varograms or an empirical technique of selective data deletion applied to the residuals, we obtain a 1-sigma uncertainty of 6% on the annual flux into the region as a whole. This is very much more precise than has been possible for any comparable region of the world (land or ocean) up to now.

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SOLVING THE IMPACT OF EL NINO ON THE GENE FLOW OF MARINE SPECIES IN THE SOUTHERN CALIFORNIA BIGHT

The signal of population connectivity can be seen in the genetic structure of populations, thus genetic markers are tools of choice to infer patterns of connectivity. In an effort to understand the relationship between patterns of circulation, larval dispersal and genetics we have developed a spatially-realized model of gene flow for nearshore sedentary species in the Southern California Bight. The model combines coastal circulation simulations of larval dispersal with a single demographic model, allowing us to specify life history traits (e.g. pelagic larval duration) and alter flow regimes (i.e. simulate El Nino and non El Nino conditions). The results produced by the model provide common metrics of population connectivity (e.g., isolation by distance and input for software like STRUCTURE) that can be used in direct comparison with empirical studies. Using this model we have simulated the impact of climatic changes on the genetic connections for the whelk Kelletia kelletii and have compared results to empirical data.

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STIRRING IN THE GLOBAL OCEAN

Global variations in lateral stirring in the surface ocean are examined by calculating finite-time Lyapunov exponents (FTLEs) from surface geostrophic currents derived from satellite-altimeter measurements. These show that stirring in the surface ocean is highly non-uniform, and vary on a wide range of scales. The probability distribution functions (PDFs) of the FTLEs are broad, asymmetric, and have long high-stretch tails. The mean FTLEs and widths of the PDFs vary with the level of mesoscale activity: There are large mean values and very broad distributions in regions of high strain rates and eddy kinetic energy (EKE), e.g., western boundary currents and the Antarctic circumpolar current, and weak mean values and narrower distributions in low strain and EKE regions, e.g. eastern subtropical oceans. The FTLEs also outlast these variations are related to the characteristics of coherent vortex structures. There are low FTLEs inside vortices and filaments of high FTLEs in strain-dominated regions surrounding these vortices.

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STORM SURGE FORECASTING IN LAKE PONCHARTAIN

As an extension to the NOPP project entitled Real-Time Forecasting System of Winds, Waves and Storm Surge in Lake Pontchartrain. Working with our NOPP (National Oceanographic Partnership Program) team, we extended the NOPP domain to include predictions for Lake Pontchartrain. For the Lake region, we use the SWAN wave model to calculate the wave heights and the wave forces. The wave forces are used together with the winds and pressure to force the ADCIRC circulation model. We will briefly discuss the domain, resolution, and efficiency of the Lake modeling system. Preliminary ground truthing of our forecast results indicate that the model accurately predicted the magnitude of the storm surge for the hurricanes of 2005. We present results of hindcast analysis using our model system. Hurricane Katrina is revisited, and results from our previous NOPP forecast/hindcast are compared to the current modeling approach. Results showcase our current capabilities in forecasting hurricane storm surge and the abilities of our NOPP system to be extended to any local scale domain.

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MODELING SMALL-SCALE SEDIMENT TRANSPORT AND MORPHOLOGY

Bedforms play an integral role in nearshore hydrodynamics. While some features may be small compared to typical coastal longfshcales, they are nevertheless efficient at dissipat-
ing wave energy in the bottom boundary layer. Additionally, their presence is known to alter net sediment transport in the cross-shore direction due to phase differences between fluid forcing and sediment entrainment. Such impacts are quantifiable at large scales, but specific details regarding small-scale sediment transport processes in the generation of sedimentary structures—like sand ripples—remain elusive. Of particular interest are the roles of bedload and suspended load during rippled evolution. The scarcity of information is due to the lack of advanced methods to monitor such processes directly.

**Diatom Monitoring in the Northeast Channel of the Gulf of Maine**


**Ferrybox in the Context of the European Contribution to GEOSS**


**Cultural Sensitivity, Relevance, and the Importance of Family: Working with Underrepresented Students in Coastal Margin Science**

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**CULTURAL SENSITIVITY, RELEVANCE, AND THE IMPORTANCE OF FAMILY: WORKING WITH UNDERREPRESENTED STUDENTS IN COASTAL MARGIN SCIENCE**

As a new National Science Foundation Science and Technology Center, the Center for Coastal Margin Observation and Prediction (CMOP) is dedicated to increasing the numbers of underrepresented students in ocean sciences education and careers. Although CMOP approaches diversity efforts as an integrative continuum across research, education and knowledge transfer, we focus here on specific CMOP K-12 education programs during summer 2007. Together with an education partner, Saturday Academy, CMOP recruited underrepresented students to participate in a week-long summer camp, and in a 8-week Apprenticeships in Science and Engineering (ASE) program. This presentation shares the expected and unexpected experiences both CMOP and Saturday Academy had while working to identify and engage students. Immediately apparent was the importance of family support and understanding. Forms, location, gender expectations and roles, tribal culture, and science itself are just some of the variables that served as barriers to program participation. We will present strategies we developed to respond to the needs of students and their families, and how our programs will evolve in response to these needs, while providing relevant and meaningful coastal margin education programs.

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**FERRYBOX IN THE CONTEXT OF THE EUROPEAN CONTRIBUTION TO GEOSS - GMES**

For long time, ships of opportunity are used to obtain oceanographic observations to improve the monitoring capabilities of the oceanic environment. Within the recent years a severe improvement of observation systems that are available especially using existing commercial ships such as ferries and cargos has taken place. Instrument packages onboard of these vessels are nowadays also referred to as Ferriesboxes. A network of Ferriesboxes has been established within the North Sea/Skagerakk and Norwegian Sea. Through the high frequency of repeated transects of the vessels valuable data sets are obtained, that are able to visualise the reaction of the ecosystem on changes within the physical environment. Within the presentation an overview of the obtained data from the Ferrybox network will be shown and initiatives forming the basis for the European contribution to the overall efforts of the Global Earth Observation System of Systems (GEOSS) and the Global Monitoring for Environment and Security (GMES) programs will be presented.

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**VALIDATION AND APPLICATION OF ENSEMBLE KALMAN FILTER IN THE GULF OF MAIN**

A Kalman Filter package, including Reduced Rank Kalman Filter (RRKF), Ensemble Kalman Filter (EnKF), Ensemble Square-Root Kalman Filter (EnSRKF) and Ensemble Transform Kalman Filter (EnTKF), from M.L.T. has been implemented into the unstructured-grid Finite-Volume Coastal Ocean Model (FVCOM). After the proof-of-concept applications with three idealized regimes, a twin experiment approach has been adopted mimicking the observational configuration in the Northeast Channel of the Gulf of Maine for evaluating the performance of ensemble Kalman filter method in the coastal ocean. The Northeast Channel is the major passage connecting the basins of the Gulf of Maine and the slope water of the Northwestern Atlantic Ocean. The transport crossing the channel, the geostrophic flow water on the northwestern side of the channel, water on the south-west side, play an important role in controlling the cyclonic circulation in the gulf. In this study, the EnKF is test by assimilating the temperature, salinity and current data along and cross the channel. The sensitivity of EnKF to the location of observational data, ensemble size, forcing errors has been examined.

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**NORMAL MODES OF THE SOUTH INDIAN OCEAN**

The Indian Ocean displays a large variety of bathymetric features, with ridges, oceanic plateaus and continental islands outlining a considerable number of abyssal plains. Consequently, barotropic variability in the Indian Ocean is strongly controlled by bathymetry, and is in many cases organized in spatially coherent modes. In this presentation we will present results of a few studies of barotropic modes of the Indian Ocean. These modes are determined through normal mode analysis in a barotropic shallow-water model of the South Indian Ocean, and
provide a dynamical basis for several modes of variability that have been observed in recent years. In particular the bi-monthly oscillations in the Mascarene Basin will be discussed, as well as the region of high variability in the Australia-Antarctic Basin.

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We discuss year-round bottom pressure, velocity, and temperature-salinity-transmissivity data collected from the nearshore (-10 m depth) Alaskan Beaufort shelf. Seasonality is set by the presence of ice, arctic river runoff, and the brief openwater season. When landfast ice is present, currents are along-shore polarized, weak (~5 cm/s), uncorrelated with winds, and have de-correlation length scales of ~100 km. Cross-shelf flow is negligible. During the spring freshet highly sheared, strongly stratified and turbid under-ice plumes spread offshore at ~10 cm/s. After the break-up, currents are swift (~20 cm/s), wind-driven, and coherent over length scales of ~200 km. Runoff induced stratification results in a pronounced asymmetry in the velocity profiles under upwelling and downwelling winds. Subtidal currents are coherent year-round with along-shore sea level slopes of O(10^-6). In summer the momentum balance is amongst the wind, bottom friction, and along-shore pressure, while in winter under-ice and bottom friction balance the pressure gradient. The annual sedimentation cycle involves: 1) rapid deposition of the terrigenous sediment load under the ice in spring and 2) fall re-suspension into the water column and pressure.

Weise, M. I., University of California Santa Cruz, Santa Cruz, USA, weise@biology.ucsc.edu; Costa, D. P., University of California Santa Cruz, Santa Cruz, USA, costab@biology.ucsc.edu; ZONES OF AREA RESTRICTED SEARCHING IN MALE CALIFORNIA SEA LION (ZALOPHUS CALIFORNIANUS) IN RELATION TO OCEANOGRAPHIC FEATURES IN THE CALIFORNIA CURRENT SYSTEM

California sea lions are one of the most abundant apex predators in the California current System, yet we have little understanding of what physical oceanographic features drive the spatial and temporal distribution of their foraging efforts. In this study satellite relay data loggers (SRDL) were used to investigate the spatially explicit foraging behavior of subadult and adult male California sea lions following the breeding season during 2003-04, 2004-05, and 2005-06. Zones of Area Restricted Searching (ARS) were identified using a new fractal landscape method that describes the peaks and valleys of fractal dimension along the path of sea lions. To identify environmental variables that best explain the variability in foraging behavior of sea lions in ARS zones we used the BIO-ENV approach. This is an iterative procedure that compares Bray-Curtis similarity matrices of behavioral data with Bray-Curtis similarity matrices of environmental variables and identifies individual or a subset of environmental variables that has a greater weighted Spearman rank-correlation. Cluster analysis and non-metric multidimensional scaling were used to corroborate BIO-ENV approach and visualize the relationships between ARS and environmental variables.

Weissberger, E. J., U.S. Environmental Protection Agency, Narragansett, USA, weissberge@epa.gov; Coiro, L., U.S. Environmental Protection Agency, Narragansett, USA, coiro.lauraj@epa.gov; Davey, E. W., U.S. Environmental Protection Agency, Narragansett, USA, davey.earl@epa.gov; EFFECTS OF HYPOXIA ON ANIMAL BURROW CONSTRUCTION AND CONSEQUENT EFFECTS ON SEDIMENT REDOX PROFILES

Hypoxia may affect the behavior of burrowing animals, which may in turn affect sediment chemistry. We investigated effects of hypoxia on burrowing behavior of three common marine species (the hard clam Mercenaria mercenaria the polychaete worm Nereis virens, and the amphipod Leptocheirus pluvialis) and consequent effects on sediment redox profiles. Animals were introduced at natural densities into defaunated sediment cores and allowed to burrow for four months at mildly hypoxic (2 ppm) and saturated (7 ppm) dissolved oxygen levels. Sediment redox profiles were taken at varying temporal intervals for the duration of the experiment. At the end of the experiment, cores were imaged using a computed tomography scanner and burrow volume measured. Sediment redox profiles differed between oxygen treatments, but not animal treatments. It is possible to burrow through hypoxic sediments, but not at the same rate as anoxic. Although mild hypoxia directly affected sediment redox profiles, it was not severe enough to affect the burrowing behavior of the animals in the experiment, which had no additional effect on redox profiles.

Weissman, D. E., Hofstra University, Hempstead, NY, USA, oggleow@hofstra.edu; Bourassa, M. A., Florida State University, Tallahassee, FL, USA, bourassa@oesps.fsu.edu; ESTIMATING AIR-SEA MOMENTUM FLUX WITHIN RAIN

The momentum exchange between the boundary layer and the sea surface is dependent on the short wave waves. In some ranges of wind speed and rain intensity, the impacts of rain droplets will create waves and similar disturbances that will alter momentum transfer. Ku-band scatterometer measurements are affected by the presence of rain through the precipitation and the atmosphere and estimate the change related to surface roughness. This study combines satellite based Ku-band data with high-resolution 3-D volumetric rain measurement, from simultaneous NEXRAD data. The results to be presented were acquired during a significant rain event in the Gulf of Mexico. This rain-modified surface will alter the transfer of momentum, and in effect will change the drag coefficient and stress. These changes in drag and stress is often associated with active weather and strong ocean forcing. Neglecting these changes causes systematic errors in the climatic distribution of surface forcing, and hence the ocean response.

Weitzman, J. S., Stanford University, Stanford, CA, USA, jweitzman@stanford.edu; Avera-Delorge, K., Hawaii Institute of Marine Biology, Kaneohe, HI, USA, avera@hawaii.edu; Kosinski, M. R., Stanford University, Stanford, CA, USA, kosofi@stanford.edu; Thomas, F. I., Hawaii Institute of Marine Biology, Kaneohe, HI, USA, fithomas@hawaii.edu; THE COUPLING OF HYDRODYNAMICS AND NUTRIENT EXCHANGE IN NATURAL SEAGRASS CANOPIES, PART ONE: FLOW CONDITIONS

Nutrient exchange processes in and around aquatic plant canopies are controlled by a dynamic combination of physical and biological influences. Our work in Florida Bay provides direct measurements of these components, allowing insight into their complex coupling. A field-deployed racetrack flume was used to regulate nutrient exposure and water motion in patches of submerged vegetation. The canopies, which were dominated by the Caribbean species Thalassia testudinum, were subjected to a broad range of unidirectional and oscillatory flow conditions. High-resolution ADVs captured full-depth velocity profiles for each of the thirty-three cases we investigated. A supplemental multi-instrument array was also deployed to survey natural flow in the flume’s vicinity. This collection of devices measured bulk water properties, spatial and temporal flow variability, and mixing layer dynamics. Our field results uncover the natural complexity of these exchange regimes, highlighting factors that are often forfeited in the transition to laboratory or numerical investigation.

Weller, R. A., Woods Hole Oceanographic Institution, Woods Hole, USA, rweller@whoi.edu; Farrar, J. T., Woods Hole Oceanographic Institution, Woods Hole, USA, rweller@whoi.edu; BUOY-BASED OBSERVATIONS OF THE DIURNAL CYCLE IN UPPER-OCEAN AND SURFACE METEOROLOGICAL PROPERTIES

We describe and analyze detailed buoy-based observations of surface meteorology and the evolution of temperature and velocity in the upper ocean, focusing on diurnal variability. The observations were collected at sites in the eastern Pacific having contrasting large-scale meteorological and oceanographic conditions. At a site beneath the intertropical convergence zone, strong diurnal cycles of surface temperature were observed during the season of active deep convection and weak mean winds. At a site beneath the expansive stratus decks of the southeastern Pacific, diurnal variability was observed in the upper ocean during times of relaxing trade winds. The buoy observations of surface air temperature, wind speed, wind direction, and water temperature agree with previous studies that captured surface atmospheric signals. This buoy network allows accurate estimation of the surface forcing on the ocean and examination of potential feedbacks from the ocean onto the atmosphere at diurnal timescales. Near-surface thermal evolution was observed with good vertical resolution (better than 1 m), and there are some observations of velocity within the warm layer.

Wells, A. I., DAMTP University of Cambridge, Cambridge, United Kingdom, A.I.Wells@damtp.cam.ac.uk; Cenedese, C., Woods Hole Oceanographic Institution, Woods Hole, USA, ccenedese@whoi.edu; Farrar, J. T., Woods Hole Oceanographic Institution, Woods Hole, USA, jfarrar@whoi.edu; Zappa, C., Lamont-Dobertly Earth Observatory of Columbia University, Palausades, USA, zappa@deo.columbia.edu; VARIATION IN OCEAN SURFACE TEMPERATURE DUE TO NEAR SURFACE FLOW: STRAINING THE COOL SKIN LAYER

The aqueous thermal boundary layer near to the ocean surface, or skin layer, has thickness O(1mm) and plays an important role in controlling the exchange of heat between atmosphere and ocean, and its dynamics can be modified by near surface flows. We present a quantitative experimental investigation of the dynamics of the skin layer in the presence of local upwelling. A non-dimensional formulation is presented that identifies different dynamical regimes for the skin layer with corresponding differences in surface temperature, or skin temperature. In laboratory experiments, we observe an increase in skin temperature above regions of upwelling flow, and show that previous theories accurately describe the observed difference between the skin and interior temperature for large Péclet numbers. The non-dimensional formulation allows us to predict that straining of the cool skin by internal waves is unlikely to be responsible for large changes in skin temperature. However, this formulation may prove to be important in the description of other scalars, such as the transfer of gases between the ocean and atmosphere.

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Motions in the main 500m-deep embayment of Mamala Bay, Oahu, are dominated by internal tides which induce large vertical displacements and strong baroclinic currents. Field observations are used to investigate the nearshore structure of the internal wave field and to assess its influence, in combination with surface wave and barotropic tidal forcing, 496
on nearshore currents. Kilo Nalu, the University of Hawaii cabled observatory, is located on the upper shelf which has a maximum depth of 50m. ADCP data, collected at the 10m site since 2004, provides the time series needed for separating barotropic from baroclinic motions, describing the temporal structure of baroclinically-driven currents, and evaluating the variance unexplained by barotropic tides and surface waves. Recent REMUS surveys and the deployment of cross-shore and along-shore instrument arrays help define the spatial structure of water column data is also examined. Data from a thermistor data logger installed last May show a normally well-mixed water column subject to intermittent stratification. The ADCP record shows cold bottom water events occurring regularly at the M2 frequency with coterminous intensified currents.

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THE INTRUSION DEPTH OF A DENSITY CURRENT IN A STRATIFIED WATER BODY

We present theory and laboratory experiments describing the depth at which a density current intrudes into a linearly stratified water column, as a function of the entrainment ratio E, the buoyancy flux in the dense current B, and the magnitude of the stratification, N. We show that the depth of the intrusion scales as Z ~ 4 B^1/3 N/tau from laboratory to oceanographic scales, i.e. a variation of six orders of magnitude. We anticipate that this scaling law will allow the fidelity of numerical models to be tested. As an example, the depth at which the Mediterranean plume intrudes has important implications for the stability of the present climate due its important role in the global thermohaline circulation so it is important to understand how the intrusion depth might change in a future climate. Density currents also occur in lakes and reservoirs, and here the depth at which a cold river intrudes into the thermally stratified water column can determine where pathogens are placed or the locations of biological hot spots.

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FE(III) COMPLEXING ORGANIC LIGANDS STRONGLY RESTRICT ECOSYSTEM RESPONSES TO ATOMIC IRON ENRICHMENT IN HIGH NITRATE LOW CHLOROPHYLL WATERS

Mesoscale iron enrichment studies have been performed repeatedly in the subarctic Pacific Ocean, equatorial Pacific, and on the Southern Ocean. Density-similar experiment designs describe the magnitude of the diatom growth response has varied dramatically. For example, the SEEDS and SEEDS II iron enrichment experiments were conducted at similar locations in the western subarctic Pacific yet their growth responses differed by an order of magnitude. Deckboard incubation experiments demonstrated that diatom growth during SEEDS II remained iron limited despite significantly elevated iron concentrations (0.5 nM) in the patch. The negative influence of strong Fe(III)-complexing organic ligands on iron availability to diatoms likely is the reason for this condition; a view supported by Cu enhanced phytoplankton growth. These findings bear on the inverse relationship between mixing depth and bloom size observed in artificial iron enrichments. Though this relationship has been attributed to physical forcing (temperature, light, mixing) it instead may result from low inorganic Fe ratios in the fertilized patch. If true, most atmospheric iron inputs to HNL waters may have little impact on diatom growth, in contrast to the current paradigm.

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COMPARING USE OF MANGROVES BY BOTTLENOSE DOLPHINS ON WEEKENDS AND WEEKDAYS

When boat traffic is high during the weekends in Sarasota Bay, bottlenose dolphins are difficult to find indicating they might seek shelter in the secluded water of the mangroves. This study determined whether bottlenose dolphins use the mangroves more on the weekends than weekdays to escape from boat traffic. Data for this project were collected opportunistically by kayak tour guides and during a dedicated kayak-based survey. Dolphins did appear to be using the mangroves more on the weekends than weekdays to escape from boat traffic signifying that dolphins are excluded from their preferred habitat 2/7 of the week. This is causing the bottlenose dolphins of Sarasota Bay habitat to become condensed and this could possibly decrease Sarasota’s Bay carrying capacity.

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SATELLITE MICROWAVE MEASUREMENTS OF THE HYDROLOGICAL CYCLE: WATER VAPOR, TROPOSPHERIC TEMPERATURE, PRECIPITATION, AND EVAPORATION

Satellite microwave observations show that water vapor, a natural greenhouse gas, has increased by 2.4% during the last 20 years. Satellites can also measure the temperature of the troposphere, and these measurements indicate the troposphere has warmed by 0.8°C during the last 20 years, which is in general agreement with surface thermometers. Thus, the water vapor has increased at a rate of 6% per degree of global warming. Climate models predict a similar rise with temperature. There is no serious discrepancy between the satellite observations and the climate models with regards to the increases in water vapor and temperature. Estimates of precipitation and evaporation can also be obtained from satellite microwave observations. When averaged over the globe, evaporation must equal precipitation. This equality provides us with a useful consistency check. We find that the precipitation and evaporation trends do agree; they both indicate an increase of 6% per degree of warming, the same as water vapor. This observational result disagrees with climate models, which indicate a smaller increase of 1-3%. This is a significant discrepancy that needs to be resolved.

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MAJOR DIFFERENCES OF BACTERIAL DIVERSITY AND ACTIVITY INSIDE AND OUTSIDE OF A NATURAL IRON-FERTILIZED PHYTOPLANKTON BLOOM IN THE SOUTHERN OCEAN

The response of heterotrophic bacterial activity and diversity to a phytoplankton bloom induced by natural iron fertilization in the Southern Ocean (Kerguelen plateau) was investigated in January-February 2005. In surface waters in the core of the phytoplankton bloom, heterotrophic bacteria revealed rates of production ([3H] leucine incorporation) and respiration that exceeded those in surrounding HNL waters by factors of 6 and 5, respectively. Based on 165s rDNA clone libraries, the dominant operationally taxonomic units in the bloom were the Br-2 and NAC11-7 cluster. SAR11 and a CFb cluster related to the agg58 group, whereas in HNL waters, SAR11, Roseobacter RCA and <Polaribacter> dominated. We designed specific probes and applied fluorescence in situ hybridization and microautoradiography (MICRO-FISH) to determine the relative contribution of these bacterial groups to bulk leucine incorporation. Our results revealed contrasting dynamics of these bacterial groups in terms of abundance and activity in the bloom compared to the HNL site. These results indicate that the Kerguelen bloom is associated with a specialized bacterial community that mediates the cycling of carbon and probably iron.

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ECOLOGICAL FORECASTING AND HINDCASTING IN THE INTERITIONAL ZONE: FROM WEATHER AND OCEANOGRAPHY TO BODY TEMPERATURES, MORTALITY RISKS, AND BIOGEOGRAPHY

Mechanistic heat budget models, coupled to NOAA weather forecasts (North American Model, Global Forecast System, WaveWatch III), NASA sea surface temperature (SST), and tide predictions are used on a daily basis to generate worldwide 7-day forecasts of animal body temperatures in intertidal zones. Hindcasts using the same models are based on ICOADS and NOAA Reanalysis data. Heat budget models were validated against biomimetic data loggers, and predicted intertidal body temperatures were congruent with data logger observations. Forecasts successfully predicted unusually high temperatures coincident with mass mortality of Echinocardium burrowing sea urchins in New Zealand in 2003, an abnormally hot summer in the US west coast in 2006, and Mytilus mussels on the US east coast in 2006. The hindcasts provide mechanistic understanding of geographic range shifts of species on decadal and centennial time scales. Large shifts in biogeographic limits of ecologically dominant intertidal species were associated with SST changes over the past 75 years. These tools can provide resource managers and ecologists with near-term warning of mortality risk and probable long term shifts associated with climate change.

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EVALUATING PHYTOPLANKTON RESPONSES TO HURRICANES AND TROPICAL STORMS WITH DIFFERENT CHARACTERISTICS (TRAJECTORY, RAINFALL, WINDS)

Beginning in the mid-1990s, the U.S. East and Gulf Coasts entered a period of elevated hurricane activity. Hurricanes and tropical storms can cause significant nutrient loading to estuaries that are unmanageable. We examined the ecological impact of several large storms varying in their characteristics on N.G. Neuse R. Estuary. The water column was stratified and nitrogen was limiting to phytoplankton growth prior to Tropical Storm Helene. Mesozooplankton chlorophyll a increased 2.5 fold after the storm, resulting from localized freshwater input and mixing of sediment-bound nutrients to the euphotic zone. Prior to passage of Hurricane Isabel, the water column was mixed and nutrient concentrations were high. As a result, the storm had minimal impact on phytoplankton biomass despite its significant freshwater/nutrient inputs. Hurricane Alex mixed a stratified water column and chlorophyll a nearly doubled in the mesohaline region after its passage. These results suggest that the mesohaline region is particularly sensitive to storm-induced nutrient inputs, but that the phytoplankton response depends on both the characteristics of a storm and the physical-chemical conditions of the water column prior to storm passage.
Trichodesmium and Crocosphaera. Here we will address how phosphorus compartment...

improving quantitative literacy in undergraduate marine science courses

Mathematical skills and concepts are required for interpreting oceanographic information.

The on-line Spreadsheets Across the Curriculum (SSAC) library consists of activities to reinforce or teach quantitative literacy or mathematical concepts and skills in context. Each activity (called a module in the SSAC project) consists of a PowerPoint presentation with embedded Excel spreadsheets. Each student works through a presentation, thinks about the in-context problem, figures out how to solve it mathematically, and builds spreadsheets to calculate and examine answers. SSAC modules were created by faculty from all over the country in various disciplines (e.g., marine science, chemistry, biology, geology, and geophysics) and are freely available at the on-line Science Education Resource Center (serc.carleton.edu), searchable by quantitative skill, subject area, and Excel level. We hired under-graduate students to use and evaluate select SSAC modules during the summer of 2007. Twenty-four students with diverse majors completed pre- and post-tests as well as personal interviews to gauge their familiarity with and attitudes toward using Excel and mathemat- ics. Overall student responses were positive, especially regarding gains in Excel skills.

Lateral exchange in a straight channel with fringing vegetation

Lateral exchange of momentum and suspended sediment between an open channel and fringing vegetation is important for river–floodplain interactions and tidal marsh dynam- ics. Here experimental results are described for lateral turbulent exchange at the bound- ary between a straight open channel and a region of model emergent vegetation. Evidence is given for coherent structures formed by shear instability that contribute significantly to lateral sediment transport. Based on experimental studies, a simple model is presented for lateral exchange of suspended sediment in a channel with fringing vegetation. The advection–diffusion equation with deposition and a vegetation-dependent diffusivity is used in conjunc- tion with a turbulent flux condition at the vegetation interface to predict suspended sedi- ment concentration and deposition within the vegetation. The magnitude of the lateral turbulent flux is compared with lateral advective fluxes from overbank flooding in a typical tidal marsh and incorporation into morphodynamic models is discussed.

Gigantocuticular characterization in Hawaiian archipelago fishes: toxicity identified by n2a bioassay

Ciguatera is the most common form of seafood poisoning worldwide. One difficulty in preventing ciguatera is lack of adequate screening methods, due in part to the presence of multiple ciguatoxins (CTX) congeners in fish tissue. CTX congeners are commonly under- studied to differ by region. As the Hawaiian Archipelago is the most remote island chain in the world, it is reasonable to expect that CTX in Hawaii’s fishes may be unique as well. The objectives of this project were: 1) identify ciguatoxins using a sodium-channel specific neurotoxin (N2a) bioassay; 2) determine how ciguatoxins vary among fish species throughout the archipelago; and 3) determine molecular masses of putative ciguatoxin congeners using HPLC/MS. Fishes were opportunistically collected from 14 islands, atolls, and reefs within the archipelago. Muscle tissues were extracted in dichloromethane and analyzed for toxicity using the bioassay. Results for 294 samples indicate 16% of fish exhib- ited toxicity. Chi square results indicated no significant differences in spatial distributions, or between herbivorous and carnivorous fishes. HPLC/MS analysis of extracts resulted in identification of several candidate peaks that may represent CTX congeners.

Evolution and oceanic dispersal of bonamia parasites of oysters

Bivalve oysters (Crassostrea gigas) are native to the Caribbean and Indo-Pacific. Australia (B. roughleyi), New Zealand (B. exitiosa), and North America (B. perspura). The taxonomy of recently discovered, congeneric parasites is under debate. It is argued that various austral Bonamia parasites, dispersed perhaps by oysters rafting (B. perspura). The taxonomy of recently discovered, congeneric parasites is under debate.
cies may indeed have become widespread, occurring from New Zealand to Australia and Argentina. Even more interesting, at least one additional cryptic species may exist in Chile. The uniqueness of the Chilean Bonamia sp. ITS sequence data, is discordant with an oyster genetic study that supports rafting of B. exitiosa host Ostrea chilensis from New Zealand to Chile. Also, the widely distributed austral Bonamia has recently been observed in North Carolina, USA, and Tunisia. Oceanic rafting of oysters may well contribute to the observed distribution of Bonamia species; however, other dispersal factors are clearly at work as well. White, E. M., State University of New York, College of Environmental Science and Forestry, Syracuse, USA; emwhit@oni.syr.edu; Reimers, C. E., Oregon State University, Corvallis, USA; Stecher, H. A., Oregon State University, Corvallis, USA; Alleau, Y., Oregon State University, Corvallis, USA; Howell, K., Oregon State University, Corvallis, USA; Gurguis, P. R., Harvard University, Cambridge, USA

**DEEP WATER VARIABILITY AT THE BERMUDA TIME-SERIES SITES**

The chemical composition of carbon dioxide (CO2) is an important pathway for mineralization of dissolved organic matter in seawater. A semi-automated analytical system was developed to determine photochemically produced CO2 in marine waters. To detect low levels of produced CO2, dissolved inorganic carbon (DIC) was removed before irradiation by acidification and sparging with low-CO2 air (pool depletion method). The pH was adjusted back to the original value and the resulting low-DIC seawater sample was transferred pneumatically to air-tight quartz tubes for irradiation. During analysis, irradiated samples were pneumatically transferred to a sample loop, injected, and acidified. CO2 was then stripped out, dried, and carried to a non-dispersive infrared CO2 analyzer for quantification. The method detection limit was 60 nM. Measured CO2 photoproduction rates ranged from 25 nM/h in coastal seawater to 6 nM/h in open ocean Gulf Stream water. Our results compared well to CO2 production rates determined employing a carbonate exchange method, verifying the accuracy of the pool depletion method.

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**DEEP WATER VARIABILITY AT THE BERMUDA TIME-SERIES SITES**

Deep water formation is an intrinsic component of climate regulation through mechanisms such as the Atlantic Meridional Overturning Circulation (AMOC). Hydrography profiles from Hydrostasys’ 5 (1954-2007) and the Bermuda Atlantic Time-Series Study (1989-2007) present a valuable framework for assessing variability in some of the deep water masses. Analyses of these depth averaged data reveal significant long term changes, most notable a steady decrease in temperature and salinity for both water masses over the past 20 years (LSW: ΔT = -0.27 °C, ΔS = -0.040 °C; NEADW: ΔT = -0.02 °C, ΔS = -0.007 °C). Short-term variability is particularly evident in LSW with variances in T and S an order of magnitude higher than in NEADW. Furthermore, changes in the LSW properties at Bermuda appear well correlated with source conditions at a time lag of 7-8 years, consistent with previous findings. This suggests that deep water variability observed off Bermuda is related to changes in the AMOC.
N fertilization experiment in two salt marshes in the northeastern USA. In each marsh 4 replicate plots were treated with 4 different Si:N ratios (ambient, 2x Si:N, 0.5x Si:N, and N only). Algal community composition and biomass (determined by cell counts, chlorophyll, and CN analysis) were altered by fertilization and changes to the Si:N ratio. We also report changes in the Si and N content of the periphyton following the treatments. While eco-
logically altered Si:N have received attention in open waters of estuaries, similar changes can alter the periphyton and may affect the lower food web of salt marshes.

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CONSOLIDATION AND EROSION ACROSS A MUD-SAND GRADIENT

Sand-mud transitions are a common feature of many continental shelves. Accompanying this transition is a fundamental change in bed erodibility. Here we present field and laboratory measurements of erosion rates and sediment properties across a gradient in the mud-sand content of the bed. The field measurements were made along a cross-shelf transect in the Gulf of Lions, NW Mediterranean, and included grain size of bed and suspended sediment, bed porosity, and erodibility measured using a Guc erosion chamber. Laboratory measurements are being made on clay-sand mixtures that consolidate for varying lengths of time, with a focus on clay fractions associated with the transition from cohesive to non-cohesive erosion behavior (~7.5%). The field measurements show a distinct difference in sediment mass eroded vs. shear stress relationship for predominantly muddy beds compared to higher sand-lower clay content beds, consistent with expectations for cohesive and non-cohesive beds. The laboratory measurements are used to better resolve this difference and its dependence on clay fraction. The results will be useful for sediment transport modeling and for understanding the processes associated with mud-sand transitions on the shelf.

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THE IMPACT OF SENSOR RETRIEVAL ERRORS AND DIURNAL WARMING ON THE ACCURACY OF BLENDED MULTI-SENSOR SEA SURFACE TEMPERATURE PRODUCTS

The blending of complementary retrievals from infrared and microwave sensors provides the potential for enhancing the accuracy and sampling of sea surface temperature (SST) products. To achieve these improvements in accuracy, however, differing uncertainties in the products and diurnal warming effects must be carefully accounted for. Previous research has revealed uncertainties in each individual SST product dependent on different environmental parameters. In this work, the impact of incorporating the uncertainties and diurnal warming corrections in blended-multi-sensor SST products is evaluated. The bias and variability of individual infrared and microwave SST retrievals from multiple sensors are derived from colocations with in-situ measurements from moored and drifting buoys. The accuracy of blended SST products relative to independent buoy measurements is compared with and without compensation for the individual retrieval bias and variability. Identified biases are directly subtracted from the retrievals. Differing variability in the retrievals is accounted for in the relative weighting applied to each. Compensation for the estimated amount of diurnal warming present in daytime observations is explored based on the application of simplified look-up tables derived from diurnal warming calculations. Interannual variability is greater than 5Sv and a large component of the interannual variability of the Pacific to Indian interocean exchange. Geostrophic (relative to 700m) plus Ekman transports are examined across 3 independent XBT lines. Interannual variability is greater than 55% and a large component is strongly correlated to remote wind forcing in the equatorial Indian and Pacific Ocean. The velocity response to Indian wind changes is very different compared to that for Pacific wind changes. Transports shall also be compared to those derived from the 3 years of direct velocity measurement attained through the INSTANT project.

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NUTRIENT SUPPLY TO THE WESTERN AUSTRALIAN SHELF

Recent estimates of nutrient supply to the continental shelf off Western Australia indicate that terrestrially derived inputs are small (~1%) compared to primary estimates of nitrogen derived from Leeuwin Current advection and eddy activity (8%) and seasonal upwelling along the shelf (7%). By closure the budget suggested that 84% of primary production was recycled on the shelf, thus, even considering the uncertainties in the offshore input estimates, the continental shelf off the west coast is primarily a recycling system. Elsewhere in the world similarly narrow shelves are typically export systems, however our preliminary budget suggests that just 7% of the shelf productivity is transported offshore and 5% exported to the deep ocean. Ongoing fieldwork is focusing on the benthic pelagic coupling of the shelf to help constrain a 3D biogeochemical model of the system. Model output is assessed against field and in-situ observations and the model is used to quantify the spatial and temporal dynamics of the continental shelf carbon and nitrogen biogeochemistry.

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WETLAND PROXIMITY AFFECTS METHYLMERCURY IN THE AQUATIC FOOD WEB OF CHEQUAMEGON BAY (LAKE SUPERIOR)

We examined the influence of wetlands and tributaries on concentrations of methylmercury (MeHg) in the food web of Chequamegon Bay, a 167 km² embayment on the south shore of Lake Superior. Concentrations of MeHg in seston (1.8-11.4 ng/g), benthic macrophytes (15-109 ng/g), and fish muscle (22-66 ng/g) were generally greater than those typically observed in open water sites of Lake Superior, but less than those in inland lakes of the region—a pattern also observed in small planktivorous (yellow perch) and benthivorous fish (Eurasion ruffle and johnny darter). Within the Bay, concentrations of MeHg in surficial sediment, zooplankton, and fish were highest in tributary- and wetland-influenced sites. Spatially, the concentration of MeHg in benthic macroinvertebrates increased concomitantly with increased exposure to organic matter from allochthonous (wetland and riverine) sources, as inferred from isotopic analysis of carbon. These results indicate that Chequamegon Bay is a transitional zone, where the entry of MeHg into the aquatic food web is strongly influenced by proximity to terrestrial landscape features, particularly wetland environments.

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SEASONAL VARIABILITY OF BIOGEOCHEMICAL PROPERTIES AND WATER QUALITY WITHIN A COUPLED MODEL OF CHESAPEAKE BAY

Seasonal variability of biological and chemical properties of Chesapeake Bay is studied through application of a numerical ocean general circulation model with a fully coupled ecosystem. The physical model is the Princeton Ocean Model System (ROMS). The ecosystem model has been modified from the standard Fasham-type formulation packaged as part of the ROMS distribution to include components that explicitly simulate the impact of river borne sediments, inorganic nutrients and dissolved organic matter. Wet and dry deposition of atmospheric nitrogen, spatio-temporal variation in phosphate limitation and sediment resuspension have been incorporated. For the Chesapeake Bay Program. A series of sensitivity studies, the relative contributions made by each of the included leading order processes toward successfully realizing the Bay’s seasonal biogeochemical evolution are assessed.

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ASLO/AGU/TOS/ERF 2008 Ocean Sciences Meeting
MEASURING TURBULENCE IN LOW ENERGY BOTTOM BOUNDARY LAYERS
Recent developments in using acoustic Doppler current profiler techniques for measuring turbulence are opening up new opportunities for the direct measurement of long time series of turbulent mixing processes. In this contribution we use data from lake environments to investigate the ability of a structure function method to resolve the low levels of turbulent dissipation in the water column. The results are compared with a more conventional approach through spectral fitting to the Kolmogorov -5/3 law. In the two lakes considered forcing is by internal seiche motions (~ 2cm/s) induced by the wind. Velocity profiles from Llyn Tegid (North Wales) clearly show the modal structure of these motions, with the observed decay rate indicating a useful way of valuating measurements of dissipation within the boundary layer. An alternative validation, employed in studies in Lake Alpachr (Switzerland), is by comparing structure function dissipation estimates with estimates based on temperature microstructure. The measurements from both lakes demonstrate the potential of ADCPs to estimate low levels of turbulent dissipation (~ 10-6 Wm-3).

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IMPACT OF IRON AVAILABILITY ON DIATOM VALVE STRUCTURE AND GRAZING PROTECTION
Iron limitation has been shown to increase the silica content of diatoms. To date, however, it remains unknown, if this results in an increased valve thickness and stability which might lead to a better grazing protection. In the current study we investigated the effect of iron availability on the valve structure of the cosmopolitan diatom Coscinodiscus wailesii and the Southern Ocean species Fragilariopsis kerguelensis using scanning electron microscopy, confocal laser scanning microscopy and atomic force microscopy. We further analyzed the stability of the frustules for these two and the four additional species C. granii, Thalassiosira rotula, T. tumida and Porsoria pseudodenticulata using micromanipulator techniques. While the valve thickness seemed to be unaffected by iron availability, a modified valve morphology with significantly thicker interstriae was observed under iron limitation. These changes in valve structure resulted in an increased stability under iron limitation for all species investigated. Our results suggest a better grazing protection of diatoms growing under iron limitation. Therefore anthropogenic iron fertilization or changing iron availability over geological time scales might have a strong impact on the food web structure.

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COMPARISON OF NEKTON UTILIZATION OF THREE INTERTIDAL HABITATS IN THE HAMPTON RIVER (CHESAPEAKE BAY, VA)
This study was conducted in the Hampton River, specifically along the campus of Hampton University, in order to better understand how fish utilize different shoreline types that have been selected. In the summer 2007, we compared the selected habitats in terms of urban influence and nekton utilization. Three nets were used at each of the three selected sites with a total of nine nets that were deployed all at once. They were suspended over the habitat prior to sampling with the use of a wooden frame. The length of shoreline sampled was a 10m section with the net extending toward the high water level depending on the slope of the habitat. Nekton were identified, counted and measured to determine utilization of the selected habitats. The results contributed to the evaluation of the effects of shoreline modification in terms of fish utilization in urbanized tributary in the Chesapeake Bay.

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INFLUENCE OF THE SAN FRANCISCO OUTFLOW ON THE PRODUCTIVITY OF THE GULF OF THE FARALLONES
The San Francisco Estuary drains about 50% of the California watershed and is highly urbanized with roughly 70 tons of N produced daily as effluent from wastewater treatment plants that employ secondary treatment, discharging primarily ammonium. There are considerable riverine inputs of nitrate and silicate. However, because of severe light limitation of productivity and the inhibition of phytoplankton nitrate uptake by ammonium in the estuary, most N is exported out to the ocean. A portion of the estuarine outflow turns seaward forming a buoyancy plume along the Marin coast, carrying high ammonium concentrations that will likely extend the zone of inhibition and result in low N and C production. We report here preliminary results of a series of cruises to the Marin coast to investigate the effect of the San Francisco outflow on the pattern of primary production in the adjoining Gulf of the Farallones.

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PREDICTIBILITY OF MESOSCALE VARIABILITY IN THE EAST AUSTRALIA CURRENT SYSTEM GIVEN STRONG CONSTRAINT DATA ASSIMILATION
Incremental, Strong constraint, 4-Dimensional Variational (IS4DVAR) data assimilation with ROMS (Regional Ocean Modeling System) is used to initialize an operational forecast model of mesoscale variability in the East Australia Current. Observations assimilated are daily satellite SST, 7-day multi-satellite altimeter sea level anomalies, and XBT profiles from Volunteer Observing Ship transects of the Tasman Sea. The model uses open boundary data from NCOM and NOGAPS meteorological forcing. Control variables are initial conditions of a sequence of 1-week assimilation windows, and the model trajectory through each interval is deemed the best-estimate analysis for initializing the subsequent forecast. Using 2 years of analysis we generate a large set of multi-week forecasts, from different initial mesoscale states, with which to evaluate the system skill. To quantify forecast uncertainty, ensembles are produced using optimal perturbations computed from singular vectors of the ROMS Tangent Linear model. The data assimilation system has significant skill for forecasts up to 3 weeks. Forecast skill is enhanced, and uncertainty reduced, when empirical statistical subseaurface pseudo-observations and/or so-called balance constraints are used to augment surface satellite data.

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EFFECT OF ZINC AVAILABILITY ON GROWTH RATE, CELL SIZE AND ELEMENTAL COMPOSITION IN A COASTAL AND AN OCEANIC DIATOM
Low dissolved Zn concentrations in marine waters can limit growth and productivity of phytoplankton as Zn is a required component of critical enzymes. We investigated the effect of Zn availability on growth rate, cell size, and macronutrient uptake and composition in the coastal diatom Skeletonema sp. and the oceanic diatom Thalassiosira oceanica. Under Zn limitation (pZn 11.46), Skeletonema sp. exhibited a decrease in maximum growth rate (~80%), chlorophyll content (~90%), and silicon content (~70%). Thalassiosira oceanica increased the surface to volume (S/V) ratio (80%). In T. oceanica, Zn limitation (pZn 12.58) was also responsible for a decrease in maximum growth rate (~60%) and chlorophyll content (20%), but did not affect biogenic silica content or the S/V ratio. The elemental stoichiometry in Skeletonema sp. was 82:4.5:8:1:N:P under Zn-limiting conditions compare to 84:13:12:6:1 under Zn-replete conditions. Elemental quotas for T. oceanica were 51C:25Si:6N:1P under Zn-limitation and 71C:25Si:6N:1P under Zn-replete conditions. These laboratory experiments suggest that Zn availability in the oceans may affect the stoichiometry of nutrient uptake and the structure of phytoplankton assemblages.

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MICROBIAL ACTIVITY ASSOCIATED WITH SHALLOW POCKMARK GAS VENTS ON THE BEAUFORT SEA SHELF
A significant pockmark submarine feature on the Beaufort Shelf has been mapped. An assessment of the microbial community composition was ascertained by analyzing the fatty acid methyl ester (FAIME) profiles of the phospholipids fatty acids (PLFA) extracted from the sediments. The total amount of FAME in the sediment cores was typical of marine ecosystems. In reference cores total FAME decreased with core depth. In contrast the maximum total FAME occurred at intermediate depths in cores from the pockmark feature. Principle component analysis revealed that the FAME distinguished the samples by site of origin. Each of the sites in the present study had different profiles then previously reported from other cold methane seep sites. In spite of the absence of the sulfide-oxidizer mats observed at other seep sites, biomarker analysis suggested the presence of a more active sulfur cycle at the Beaufort pockmark site.

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SPATIOTEMPORAL PATTERNS IN MICROCIAL FATTY ACID COMPOSITION AND CARBON CYCLING IN A SEAGRASS ESTUARY
Seagrass estuaries are highly productive ecosystems that support diverse microbial communities and complex carbon cycles. Generally, organic matter production in these estuaries is dominated by seagrass. Macroalgae, phytoplankton, and allochthonous terrestrial imports, however, also contribute to the organic matter pool, creating a mixed carbon source. Seasonal production, nutrient, and climatic processes influence carbon source availability and in part regulate microbial carbon cycling in seagrass estuaries.
determine environmental regulations on carbon use and cycling in a seagrass estuary (Florida Bay, USA). fast characterization of detrital components associated with specific stable isotopic biomarker methodologies were used. Fatty acid profiles and heterotrophic bacterial carbon sources were determined for pelagic, seagrass epibiotic, and sediment microbial communities over an annual seagrass production cycle. We hypothesize that these results will support the importance of seagrass production to microbial carbon cycling in Florida Bay.

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INTERESTING MOVEMENTS OF COSTA RICAN LEATHERBACK TURTLES

We deployed satellite tags to track the movements of 14 leatherback turtles at Parque Nacional Marino Las Baulas in Costa Rica during nesting intervals (eight to ten days before nesting sets). Our goals were to determine (1) whether leatherbacks stay within the Las Baulas marine reserve during nesting intervals; (2) if there are any specific areas outside the marine reserve where leatherbacks aggregate; and, (3) if movement patterns change as the interesting interval progresses. No leatherbacks remained entirely within the marine reserve during the interesting interval. At the beginning of the interval, most turtles moved outside the marine reserve and many headed to the Gulf of Papagayo. Throughout the last three days of interesting, most turtles were within the marine reserve. Half of the turtles were in or near the Gulf of Papagayo during at least part of the interesting interval. Our results suggest the current marine reserve should be expanded to further protect interesting leatherbacks.

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WIN-WIN INFORMAL AND FORMAL EDUCATION OPPORTUNITIES AS PART OF A COMMERCIAL CRUISE LINE AND ACADMIC PARTNERSHIP

In 2000, a cooperative agreement between Royal Caribbean Cruises, Ltd. and the University of Miami established two staffed laboratories aboard the 3400 passenger cruise liner, Explorer of the Seas, with comprehensive meteorological and oceanographic instrumentation. Coincident with the laboratory operations, an informal public outreach component was incorporated into the onboard facilities, which consists of a evidence of our onboard visiting scientist lecturer or researcher and interactive educational galleries. This unique combination research and education facility has the potential to reach 180,000 family vacationers annually and to provide training and education extension programs throughout the Caribbean region. In addition to the ongoing public outreach, the program has provided a win-win combination with the nearly 300 past visiting research scientists gaining valuable experience in public outreach and presentations. Since the program inception, under-graduate education and K-12 teacher mentoring programs have been added as extensions to the original outreach component of the program at very low cost. The program continues to introduce innovation and quality educational opportunities through this partnership. This presentation will attempt to evaluate and quantify the impact of five years of operation.

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IMPACTS OF LAND COVER AND USAGE ON WATER QUALITY IN WESTERN LAKE ERIE WATERSHEDS

Land cover and usage classification were conducted on the Maumee and Sandusky watersheds for 2006 using ERDAS Imagine 9.1. Rock Creek and Honey Creek sub-watersheds classifications were extracted from the Sandusky watershed. Two accuracy assessment tests were performed overall accuracy and Kappa analysis. Water quality data was provided by the Water Quality Lab at Heidelberg College; concentrations of SS, TP, SRP, NO3, and TN were analyzed over the 2006 growing season. Land cover accuracy tests were fair assessments for both watersheds; land usage accuracy tests were strong assessment for both watersheds, except for Sandusky's cloud cover imagery which was fair assessment. The water quality data shows that flow has no correlation on concentrations of non-point source pollutants. Traditional Tillage has a higher impact on water quality degradation than Mulch and No Tillage. Soybeans have the highest impact on water quality degradation and corn has the lowest impact. Sub-watersheds had higher fluctuations of non-point source pollutants than the watersheds. Honey Creek sub-watershed and Sandusky watershed have a higher impact on water quality degradation than Rock Creek sub-watershed and Maumee watershed.

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FINGERPRINTING DEPOTED SEDIMENTS IN A TROPICAL ESTUARY: A GEOCHEMICAL APPROACH

Accelerated soil erosion is a major environmental issue world-wide. Land use practices such as agriculture, urbanization and poor cultivation practices have contributed to the rapid loss of topsoil in the landscape. Increased sediment inputs to coastal environments have the potential to not only alter natural ecosystem functions, but also facilitate the transport and deposition of pollutants in these systems. A step towards addressing issues associated with enhanced sedimentation rates in estuaries is to identify the potential source areas within associated watersheds. In this study, sediment fingerprinting, a technique commonly used to identify sediment provenance was used to determine the origins of material in a tropical estuary. Grain-size analyses, X-ray diffraction as well as gamma spectrometry provided signatures for the determination of sediments deposited in the estuary. Results of this study will contribute to a larger project, examining the relationship between soil erosion in watersheds and sedimentation rates in the tropical estuaries in the island of Puerto Rico. Additionally, insights provided may potentially lead to better management practices.

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COMPARISON OF IN SITU SURFACE MEASUREMENTS OF NONLINEAR INTERNAL WAVES WITH THOSE OBTAINED FROM REMOTE SENSING

During the summer of 2006, a vast array of instruments was deployed east of the New Jersey coast in shallow water near the shelf break. The Nonlinear Internal Waves Initiative (NLWII) was one component of an intensive set of measurements that included surface vessels, surface platforms, satellite and ship-based radar, and a variety of sub-surface moorings in an unprecedented attempt to characterize the internal wave field while simultaneously measuring acoustic propagation at a number of frequencies and using a number of signals. Among the surface measurements were those from Air Sea Interaction Spur (ASIS) buoys, which measured current, temperature, wave directional spectrum, wind speed and direction, and a number of other parameters within 15 meters of the surface, at two locations, 1 km apart. Measurements from these platforms will be discussed and contrasted with simultaneous data from measurements including ship and satellite-based remote sensors.

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THE ROLE OF ORGANIC NUTRIENTS IN SUSTAINING EXPORT PRODUCTION AND CLOSING NUTRIENT BUDGETS OVER THE SUBTROPICAL NORTH ATLANTIC

Over the subtropical North Atlantic, there are two long standing questions as to how export production is sustained and how nutrient budgets are closed? These questions are addressed through a combination of field cruises in 2004 and 2005, and application of coupled circulation-nutrient and inverse models. The surveys found elevated dissolved organic nitrogen (DON) and phosphorus (DOP) in the surface waters in the tropics, associated with upwelling zones. The modelling study suggests that the transport and recycling of DOP is important in sustaining export production, particularly over the eastern side of the basin, accounting for up to 70% of the necessary phosphorus supply. DOP is less important due to its refractory content. The inverse model is applied to sections along 26N and 36N, which reveals an overall southwards transport of inorganic nutrients linked to the overturning. Between the sections, the transports imply a net loss of nitrate and phosphate. This loss is partially offset by the northwards transport of DON and DOP from the tropics, as well as augmented by smaller atmospheric inputs of nitrogen and phosphorus.

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ADVANCES IN AUTONOMOUS BENTHIC SURVEYING AND CHARACTERIZATION OF BENTHIC HABITATS

Our research is focused on delivering advanced tools for marine scientists mapping and characterizing benthic habitats. Autonomous Underwater Vehicles (AUVs) can provide high-resolution, geo-referenced imagery of the benthos. While the imagery itself is useful for qualitatively characterising habitat composition, the volume of data can become unwieldy when trying to extract summary statistics. For AUVs to become truly relevant for qualitatively characterising habitat composition, the volume of data can become unwieldy when trying to extract summary statistics. For AUVs to become truly relevant for qualitatively characterising habitat composition, the volume of data can become unwieldy when trying to extract summary statistics. For AUVs to become truly relevant for qualitatively characterising habitat composition, the volume of data can become unwieldy when trying to extract summary statistics.
that can be related to underlying processes of interest. We are pursuing three areas of research to make autonomous marine systems useful in this context: 1) Terrain-aided and self-consistent mapping and navigation using stereo imagery and acoustic multibeam data. 2) Automated and semi-automated interpretation and classification of visual, acoustic and chemical data to produce estimates of distribution and abundance. 3) Repeatable and adaptive surveys based on 1) and 2) to enable change detection and efficient and/or exploratory surveys respectively. We present details of these research areas and results from surveys on the Great Barrier Reef and Ningaloo Reef in Australia.

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DO ULTRAVIOLET (UV) TOLERANCE AND PHOTOTOENZYMATIC REPAIR VARY ACROSS TROPHIC LEVELS FROM BACTERIA AND PHYTOPLANKTON TO ZOOPLANKTON AND FISH?

The size, mobility, and trophic position of an organism may influence the extent to which it can utilize different defenses against changes in potentially damaging UV radiation. We used a specialized photostat that separates out photoresponse wavelengths from shorter- and longer-damaging UV-B wavelengths to examine overall UV tolerance as well as the relative contribution of photoenzymatic repair (PER) to UV tolerance in a range of aquatic organisms. UV tolerance varied among species with LED values ranging from less than 20 to over 350 J m-2. The contribution of PER to UV tolerance ranged from less than 10% in two benthic invertebrates to over 90% in a bacterium and a protozoan. Neither UV tolerance nor the prevalence of PER showed any consistent relationship to organism body size. In most taxa the overall level of UV tolerance was less than the equivalent of a single day of exposure during summer solstice, suggesting that either acclimation or a daytime refugia of shaded waters is necessary to avoid high levels of mortality in low DOC systems even under current UV exposure conditions.

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MONITORING THE ATLANTIC MERIDIONAL OVERTURNING CIRCULATION USING A COMBINATION OF ALTIMETER AND ARGO DATA

In the far North Atlantic, at latitudes north of the boundary current separation, much of the meridional overturning circulation is confined to the ocean interior. Away from the steep ocean boundaries, the Argo array of profiling floats provides absolute velocity at depth and hydrographic data from the surface to 2000 m. By combining float data with altimeter data, spurious warming and cooling error can be reduced and accurate estimates of time-averaged, three-dimensional geostrophic velocity can be determined. In the far North Atlantic, such velocity estimates provide a de facto estimate of the upper, northward flowing limb of the overturning circulation. Results from an estimate of the three-dimensional velocity field in the far North Atlantic will be presented, along with inferred estimates of the overturning and net northward heat transport for the period from 2003 to 2007.

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NOAA AND IOOS

The Integrated Ocean Observing System (IOOS) is a nationally important infrastructure that will enable many different users to characterize, understand, predict and monitor changes in coastal and ocean environments and ecosystems. This infrastructure is critical to understanding, responding and adapting to the effects of severe weather, global- to regional climate variability, and natural hazards. NOAA owns and operates much of the coastal and ocean observing and data distribution infrastructure. In late 2006, NOAA decided to standup an IOOS Program Office that will provide a central focal point for IOOS activities within NOAA and with our regional and other federal partners. In the near-term NOAA will concentrate on developing a data integration framework. A fully operational data integration framework will take significant time to develop. Education is a cross cutting thread throughout IOOS. The value of ocean education cannot be overstated. IOOS can bring ocean observing into the classroom, which will allow a better understanding of importance of the ocean and make the ocean more than just a deep blue mystery.

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TURBULENT BORE WAVE EVOLUTION: COMPARATIVE RESULTS FOR A NON-BARRED AND BARRLED BEACH

Turbulent bore waves formed after wave breaking on beaches have been studied in the field with natural incident waves and in laboratory wave tanks for monochromatic and realistic wave spectra. We extend our previous research on the subject of turbulent bore evolution by adding a bar to the 1:25 sloped linear beach previously in use in the Max Hammond Wavetank at SRI, and performing detailed spectral investigations into the phase evolution and energy transfer for differing wave initial conditions. We study turbulent bore evolution to examine a simplified example for non uniform beaches, a beach with a bar. We study the evolution of differing initial wave spectra in detail, to determine the effects of the bar on the overall behavior of the incident wave field, focusing on the resulting turbulent bores. We test scalings derived from our uniform slope bottom results to determine their applicability to non uniform bottom profiles, and develop new scalings based on our current results. We investigate breaking wave harmonic structure for uniformly sloped and simply barred bottom profiles. We investigate the differing evolutionary pathways to breaking of spilling and plunging waves in the spectral domain using a beampath approach, wherein we estimate the beampaths for the evolving waves and from that extract energy transfer estimates, which are compared for the differing breaker types to determine if any underlying differences exist.

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ESTIMATING THE PERMEABILITY OF COASTAL AND SEAFLOOR SANDS

Knowledge of the permeability of coastal sediments is required for understanding submarine groundwater discharge (SGD) and porewater transport, but studies of marine sediments typically report grain size analyses and porosity rather than permeability. Here data from 39 case studies were used to assess any consistent relationship of empirical expression linking permeability to grain size for clean sands from coastal environments. All samples fell between 2x10-1 and 4x10-3 m2, and the empirical expressions estimated sediment permeability to within an order of magnitude or less, depending on the sedimentary environment (inter-tidal, near-shore, continental shelf). Core-scale permeameter tests produce permeabilities up to 1.5 orders of magnitude lower than field-scale hydraulic tests. In situ probe tests agreed well with permeameter tests, suggesting that coring does not alter permeability significantly. Empirical estimates of permeability based on grain size are not appropriate for heterogeneous sediments, for example settings that include clay lenses or other layers
of different permeabilities. Because layering is very common in coastal and shelf environ-
ments, it is recommended that permeability measurements be routinely included on
undisturbed samples when characterizing sedimentological properties of these deposits.

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TRICOSAN LONG-TERM TRACER FOR SEWAGE EFFLUENT IN ESTUARINE SYSTEMS
Pharmaceutical and personal-care products (PPCPs) and their degradation products are
introduced into the environment through sewage effluent. Once such PPCPs, Triclosan,
undergoes photodegradation and has an affinity for adsorbing onto organic rich particles
in aquatic systems. We can show Triclosan at a mean concentration of 30-35ng/g by
site (total range 3-70ng/g) from the George Washington Bridge to the open harbor. This
includes a) monthly deposition (determine by Jodine-131 in surface sediments) b) short-
term deposition (determined by Beryllium-7) of over the last 10 months at depths up to
10cm, and c) yearly retention times with deeper cores up to 40cm in depth. We can also
show that the variance within cores is not due to degradation processes, but rather can
be explained by the physical dynamics of the system. Triclosan may prove to be a modern
tracer for sewage effluent and a suit of anthropogenic compounds released annually.

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NITROGEN FIXATION HOTSPOTS? AREAS OF PERSISTENT SUMMER CHLOROPHYLL BLOOMS IN THE Oligotrophic Gyres
Chlorophyll blooms constantly develop in the oligotrophic NE Pacific in late sum-
mer, isolated from both land masses and any sources of higher chlorophyll waters. The
environment and timing of the blooms are conducive to nitrogen fixers, which require
a relatively stable water column. A better understanding of the ubiquity of summer chlo-
rophyll blooms could improve our estimate of the global nitrogen fixation rate. Here,
global SeaWiFS chlorophyll data from 1997-2007 are examined, and similar blooms are
found to occur in five other areas within the oligotrophic gyres. Two of these are regions
where blooms have been previously identified: the SW Pacific and off the southern tip
of Madagascar. Previously unreported summer blooms are also identified: the NE and SW
Atlantic and in a band along 10°S in the Indian Ocean. There is considerable variation in
the intensity and frequency of blooms in the different regions. Similarities and differences
between the location of the summer chlorophyll blooms and estimates of the global distri-
bution of nitrogen fixation will be made.

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PHYSICAL AND ECOLOGICAL INTERACTIONS IN CREEK HEADWARD EROSION.
The Santfe River Delta in South California is the largest deltaic complex on the east coast
of the United States and is characterized by extensive tidal wetland. Measurements from
geo-rectified aerial photographs indicate that Santfe saltmarshes contain numerous,
relatively short tidal creeks that are eroding headward at a rate of 2 m/yr. These creeks,
which average 100 m in length and 1-2 m in width, terminate in a dendritic structure on
the marsh platform. Current velocity measurements, geotechnical sediment analyses, and
field observations of vegetation density and crab activity suggest that creeks organize
themselves primarily as a function of marsh topography and that creeks are initiated at marsh edges and
gradually erode toward the interior of the marsh. We hypothesize a positive feedback ex-
ists between crab burrowing and Spartina alterniflora dieback. Tidal flow excess 15 cm/s
across the marsh platform and 40 cm/s in tidal creeks. Unvegetated, bioturbated sediment at
creek heads is susceptible to erosion by tidal currents. We are exploring the impact of
accelerated sea-level rise and attendant increasing flooding and draining of the marsh
platform on the dissection of the marsh.

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MODEL VALIDATION FOR 2D SURF-ZONE CIRCULATION
In this study we investigate the ability of a depth- and phase-averaged (2DHz) numerical cir-
culation model (ShoreCirc), forced with a spectral wave model (SWAN), to predict measured
alongshore currents during the SandyDuck 1997 experiment. The SandyDuck experiment
provided a long (~months) continuous and spatially-extensive time series of observations,
allowing for a comprehensive model-data comparison over a variety of field conditions.
We will assess model skill through the duration of the experiment, including several days where
the observed circulation was significantly alongshore-nonuniform. During these nonlinear
cases the 2DHz equations of motion are often assumed to be accurate, but the literature is
relatively lacking in field comparisons. Indeed, preliminary results show that these more
complicated flows tend to be poorly predicted. We address specific causes for model error,
and attempt to justify the use of 2DHz models for surf-zone forecasting.

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MONITORING GLOBAL SEA LEVEL RISE AND ITS CAUSES
Improving our understanding of sea-level rise and variability, as well as reducing associated
uncertainties, depends on the availability of adequate observations – an issue addressed at a
recent WCRP Workshop (http://wcrp.wcrp-jasmin.fr/Workshops/SeaLevel/). While recog-
nizing the need for new systems and renewed focus on conventional methods, we at the Workshop for existing systems to collect sustained, systematic observations. These in-
clude those directly observing sea level - the Jason satellite altimeters and GLOSS network of
~300 tide gauges. To estimate the change in sea level due to an increase in ocean volume (e.g.,
thal expansion), the Argo array of profiling floats observes the upper-ocean in ice-
free areas. To estimate that due to an increase in ocean mass (e.g., melting ice caps
and glaciers), GRACE observes the time-variating gravity field. Additional systems observe
changes in ice sheet & glacier topography and thickness - satellites utilizing radar and laser
altimeters, complemented by aircraft and in situ observations. All of these measurements
require a robust and stable International Terrestrial Reference Frame. Once launched,
G.OCE will observe the time-invariant gravity field to determine the precise geoid.

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CHARACTERIZATION OF ZOOPLANKTON DIET AND PARTICLE FEEDING IN THE MESOPLAGIC ZONE USING FATTY ACID LIPID BIOMARKERS
Mesopelagic food webs are poorly understood, although it is hypothesized that consum-
ption of sinking particles and carnivory are essential feeding modes. We used fatty acid (FA)
biomarkers to characterize zooplankton diet and large particle composition in the meso-
pelagic zone (150-1000 m) at two contrasting time-series sites in the subarctic (K2) and
subtropical (ALOHA) Pacific ocean. Total fatty acid concentration was 14 times higher in
zooplankton tissue in K2, largely due to FA storage by seasonal vertical migrants. Fatty acids specific to diatoms, dinoflagellates, and bacteria measured in zooplankton implied more diatom-derived food sources at K2 vs. more dinoflagellate- and bacteria-derived
food sources at ALOHA. These FAs were also found in similar proportions in particles at
all measured depths, evidence that mesopelagic zooplankton consume sinking particles.
Carnivory indices increased significantly with depth at ALOHA, and exhibited distinct peaks at K2, representing an increase in dependence on other zooplankton for food. This comparison of zooplankton and particle FA biomarkers between contrasting environ-
ments will help our understanding of how variations in particle repackaging and carnivory
can affect the biological pump.

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VALIDATION OF AATS RUSING THE ISAR RADIO METER - RESULTS SINCE 2004 AND A NEW APPROACH FOR A MATCH-UP QUALITY INDICATOR
The Infrared Sea surface temperature Autonomous Radiometer (ISAR) was specifically
developed for the validation of satellite SSTskin temperature data products, in particular
for the Advanced Along Track Scanning Radiometer (AATSR). Two ISAR instruments
have, since March 2004, been deployed on a continuous (one on, one off) basis on the
P&O ferry M/V Pride of Bibao, which sails between Portsmouth (UK) and Bilbao (Spain)
on a 3 day repeat cycle. A number of ancillary measurements, such as wind speed, short
wave radiation, long wave radiation, air temperature and humidity are recorded. In

presenting the validation results since 2004, we shall discuss the error budget associated with
match-ups. A novel quality indicator will be specified, using both ancillary and satellite data. This
is proposed as a robust and objective way for specifying the quality of each match-up, which is necessary in order to refine the quality assessment of the data products for AATSR.

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TIDAL CIRCULATION IN A STARTTED ESTUARY
The three-dimensional tidal circulation in an elongated two-layer basin is described with a
linear model in the p-plane. Rotation alters the flow by introducing a lateral circulation of
comparable magnitude to the axial flow. In a two layer system, fluctuations at the interface
are driven by convergences of the lateral flow noted above, with the result that in certain
cases the interfacial amplitude can be much larger than the amplitude of the free surface,
and the resulting current field can be quite different from the case without stratification
OBSERVATIONS OF WAVE- AND WIND-INDUCED REYNOLDS STRESSES IN A WINDY BAY

Observations of current velocities and pressure were obtained at fixed locations in a windy bay in order to determine the spatial distribution of Reynolds stress in the water column and its temporal variability. Measurements were obtained over a fortnight in Bahia Concepcion, Mexico in January 2005. The observation period was characterized by sea-breeze peaks around 1000 m/s and wave periods typically less than 5 seconds. The maximum Reynolds stresses were restricted to the upper 2-3 meters near the surface. The variability of the Reynolds stresses associated with these observations is described in the context of theoretical results of wave-induced and wind-driven flows. The theory shows that high-frequency wave fields produce shear stresses due to the earth’s rotation of the same order of magnitude as the wind stress, and should be included in the total stress.

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TRACE ELEMENT BEHAVIOR IN A FRESHWATER-SEA WATER MIXING ZONE WITHIN PERMEABLE SEDIMENTS

Sandy barriers developed during the Holocene transgressing sea are common features of many coastal regions throughout the world and often restrict the flow of continental runoff to the ocean. One such area is along the Southern coast of Brazil where an ca. 600 km barrier has created the Mirim-Patos Lagoon system, the largest in South America. Because of the limited surface connection of the lagoon system to the ocean, a substantial fraction of the regional freshwater runoff is transported through the permeable sands of the barrier within which freshwater and seawater mix. Groundwater samples collected from well points along an approximately 300 km length of the barrier indicates that freshwater and sea water mix within a narrow band beneath the ocean beach. Concentrations of Ba, Cd, Co, Cu, Fe, Mn, Mo, U and V, relative to salinity within the sediments pores water, exhibit considerably different behaviors from similar relationships observed for surface water. Results suggest that a combination of redox conditions and residence time are the controlling factors in producing this different behavior.

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WRINKLES IN SPACE AND TIME: PATTERNS OF PLANKTONIC THIN LAYERS AND VELOCITY SHEAR IN COASTAL SYSTEMS

High-resolution vertical profiles of hydrographic and bio-optical properties permit the detection of planktonic thin layers in relation to local velocity gradients. The spatial extent and persistence of such layers can have considerable impact on local ecosystem dynamics. We use our extensive dataset of over 2000 such profiles from Monterey Bay, CA, the Oregon continental shelf and the Florida Keys, WA, from 5 different summers (1997, 1998, 2004, 2005, 2006), to characterize the spatial and temporal patterns of planktonic thin layer occurrence and persistence in relation to local velocity gradients. We have found that planktonic thin layers in these coastal regions occur over a range of temporal scales (minutes to hours) and spatial scales (kilometers to 10s of kilometers). We present these results in the context of the wind and tidal forcing of localized vertical mixing, which defines the threshold conditions for thin layer persistence in these coastal areas.

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APPLICATION OF PALEOEOLOGY TO THE 50-YEAR EVERGLADES RESTORATION PLAN AND BEYOND

Paleoecologic data from sediment cores in Biscayne Bay, Florida Bay and southwestern coastal Florida are being compiled to examine anthropogenic and natural change in the south Florida estuarine ecosystem. These data provide restoration planners with information needed to set targets and performance measures for the estuaries. The Comprehensive Everglades Restoration Plan, however, does not factor sea-level rise into the 50-year planning cycle. Analyses of faunal remains in cores from the three estuarine regions of south Florida indicate that relative sea level has been rising over the last 1000 years or more, confirming earlier studies. Additional dating is required to determine the exact timing of this change and whether it was due to sea-level rise, decreases in freshwater supplied to the estuaries, or a combination of the two. Nevertheless, the highest elevation in south Florida today is ~2.5 meters above sea level, and even conservative estimates project a rise of 40 cm over the next century. Thus, it is critical to establish the patterns, causes and impacts of rising sea level and factor them into restoration planning.

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VERTICAL ZONATION AND DISTRIBUTIONS OF CALANOID COPEPODS THROUGH THE LOWER OXYCLINE OF THE ARABIAN SEA OXYGEN MINIMUM ZONE

We provide the first comprehensive analysis of calanoid copepod vertical zonation and community structure at midwater depths (300-1000 m) through the lower oxygen gradient (oxycline) (0.02 to ~0.3 ml/L) of an Oxygen Minimum Zone (OMZ). Zooplankton were collected in day and night vertically-stratified MOCNESS tows during the JGOFS Arabian Sea study. Based on calanoid species zonation, three unique subzones with specialized community interactions occurred through the lower oxycline. These subzones were termed the OMZ Core, the Lower Oxycline, and the Sub-Oxycline. The calanoid community was most diverse in higher oxygen, but species rank order of abundance was similar in the Lower Oxycline and Sub-Oxycline. No diel vertical migration at these midwater depths was observed. A common oxycline species was detritivorous. Vertical zonation of copepods through the lower OMZ oxycline is a complex interplay between physiological limitation by low oxygen, potential predator control, and potential food resources. Pelagic OMZ and oxycline communities, and their ecological interactions in the water column and with the benthos, may become more widespread in the future ocean, if global warming increases OMZ extent.

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ABUNDANCE AND DISTRIBUTION OF TWO IMPORTANT DECAPOD LARVAL SPECIES, CALLINECTES SAPIIDUS AND MENIPPE MERCENARIA, IN THE GULF STREAM OFF SOUTHEAST FLORIDA, USA

Knowledge of the abundance and distribution of the larval of commercially important crustaceans of the nearshore and offshore waters of Florida’s eastern coast is minimal, yet...
crucial, for future fisheries management implications. Analysis of the larval abundance of two commercially important crab species, blue crab, Callinectes sapidus, and stone crab, Menippe mercenaria, was conducted following bimonthly cruises in 2007 at 3 stations along an East-West transect in the Gulf Stream east of Port Everglades, Ft. Lauderdale, Florida. Preliminary analysis of abundance of total pleocytema larva revealed a fourfold increase in abundances from February and March to May and July. The combination of the species’ distributions and abundances, along with recorded seasonal changes in temperature and salinity, are expected to be indicators of the species’ peak spawning periods. Additionally, vertical distribution of the larva in the water column is expected to reveal the use of currents to disperse into and out of parent populations as recorded by acoustic Doppler current profilers.

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CONNECTING THE CAPE BASIN WITH THE SOUTH ATLANTIC SUBTROPICAL GYRE USING FOURTEEN YEARS OF SATELLITE ALTIMETRY: ASTTEx IN THE BROADER CONTEXT

As part of the Agulhas-South Atlantic Thermohaline Transport Experiment (ASTTEx), sea level observations from the TOPEX/POSEIDON (T/P) and Jason-1 satellite altimeters are combined to obtain a 14-year record of mesoscale and large-scale ocean variability within the South Atlantic basin. Modes of non-seasonal sea level variability are evaluated in non-overlapping subregions of the South Atlantic, with the goal of understanding the relationship between variability at interannual time scales in different parts of the basin. Of particular interest are relationships between variability in the vicinity of the ASTTEx mooring array, which spanned the Agulhas eddy corridor in the eastern Cape Basin between January 2003 and April 2006, and variability in regions to the east and west. The primary mode of gyre-scale variability, representing interannual variations of sea level within a broad region of the center of the subtropical gyre, is weakly correlated with variability in the Cape Basin. Time-dependent variations associated with the second mode of gyre-scale variability closely track interannual variations in sea level in both the western and eastern part of the Cape Basin, with the relationship being particularly strong beyond the region of the most intense eddy mixing. Variations in sea level at the Agulhas Retracement region occur primarily at the high frequencies characteristic of eddy shedding and contain relatively little interannual time scales.

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IN-SITU MEASUREMENTS OF WAVES, TIDES, BEDFORMS AND SEDIMENT TRANSPORT IN THE NEARSHORE ZONE

The LEACOAST2 project (http://pcwww.liv.ac.uk/civil/CRG/leacoast2/) is studying the effect of a shore-parallel breakwater system on the evolution of coastal morphology at Sea Palling on the east coast of England, facing the southern North Sea. Here there are strong tidal currents, and occasional storm wave conditions where the mixed sediment, ranging from coarse sand to silt, supplied from the soft boulder clay cliffs to the north, is quite mobile under tide and wave stirring. The breakwaters have trapped sand in embayments with tombolos and salients behind the breakwaters. As part of this project data were collected from 3 instrumented tripods deployed near the breakwaters, during 2 field campaigns (March-May 2006 and October 2006 - January 2007). The instrumentation includes acoustic and optical instrumentation (ADCP, ADV, LISST and bedform scanners). One tripod was deployed in the intertidal zone. The others were deployed in water depths of 6-8 m (tidal range is about 2m). A large dataset has been successfully obtained. Here we present a description of the hydrodynamic conditions, suspended sediments and bedforms, with first results for the suspended sediment flux and bedload transport.

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OVERTURNING CIRCULATION IN AN EDDY-RESOLVING MODEL: THE EFFECT OF THE POLE-TO-POLE TEMPERATURE GRADIENT

The effect of the pole-to-pole surface temperature difference on the deep stratification and the strength of the global meridional overturning circulation (MOC) is examined in an eddy-resolving ocean model configured in an idealized domain representing the Atlantic sector. The strength of the global meridional overturning circulation (MOC) is examined in an eddy-resolving ocean model configured in an idealized domain representing the Atlantic sector. The effect of the pole-to-pole surface temperature difference on the deep stratification and the MOC compared to laminar models. For and April, opening of the models representing the pole-to-pole temperature gradient. The model resolves the Northern Hemisphere sinking site must lie in the range of surface densities found in the ACC for efficient formation of deep water and a vigorous northern hemisphere overturning circulation. In contrast to the laminar theory, realistically strong deep stratification is formed even if the temperature at the northern sinking site is warmer than any temperature found in the channel.

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INFLUENCE OF FLUVIAL AND MARINE ENERGY ON LAND-SEA SEGMENTATION: INSIGHTS FROM THE WAIPOA SEDIMENTARY SYSTEM, NEW ZEALAND

Marine environments are typically non depositional in high supply river-fed dispersal systems under Holocene highstand conditions. Over the last Holocene the shoreline of the high-supply Waiapoa sedimentary system (WSS) has filled in Poverty Bay, prograding over 12 km in the last 7 ka. Sand and gravel are largely retained in the alluvial plain and shoreface, but the majority of the mud-dominated total load reaches the sea. However the nearshore is predominantly sand, and the outer bay and shelf appear to largely bypass this mud, with minor accumulation driven by tectonic subsidence on the shelf. In contrast, other high supply systems (FLGanges) commonly show significant mud accumulation in shelf chlinoforms. Sedimentary process modeling suggests that mud bypass is due to relatively high marine energy, such that the WSS shelf is effectively a chlinoform topset. Furthermore, relative absence of mud in the nearshore suggests that shoreline progradation in the WSS may be largely dominated by fluvial processes, despite the high marine energy, demonstrating the complexity in fluvial-marine influences on shoreline migration.

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ANOMALOUS T-S STEPS AND SUBTROPICAL FRONT MEANDERS IN THE UPPER SOUTHEAST INDIAN OCEAN

During the CLIVAR/CO2 repeat hydrographic survey along the 185 line in February and March 2007, anomalous T-S steps were observed in the Subtropical Front of the Southeast Indian Ocean, north of the Kerguelen Plateau. These steps are isothermal and isolineal layers of warm, salty intrusions, observed at depths of 200-400 dbar. The biggest step is 100 m thick, spans 0.1 (PS-78) in salinity and 0.4°C in temperature. Water data from nearby Argo float data that T-S properties of these steps are found at the base of winter mixed layers and equatorward of the Subtropical Front. It is hypothesized that meandering of the Subtropical Front during the 2006 Austral winter transported subtropical winter mixed layer water poleward into the Subantarctic Zone. The subsequent lack of mixing below the summer mixed layer allowed the subtropical water to survive as isolated homogeneous layers through the summer months. The presence of these anomalous T-S steps represents increase in upper ocean stratification, which could hinder formation of deep winter mixed layers in the Subantarctic Zone, thus indirectly affects local formation of Subantarctic Mode Water.

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OASES IN AN OCEAN DESSERT

The western subtropical north Pacific Gyre is highly oligotrophic. Throughout the year, its chlorophyll-a concentration is mostly <0.05 mg/m³ and the top of its nutricline is as deep as 200 m. It is intriguing to ask whether this oligotrophic ocean desert can ever get ‘greener’, i.e. is there any possibility for phytoplankton blooms to occur? Using the synergy of 5 types of remote sensing data, including (a) ocean colour data (chlorophyll-a concentration and ocean colour spectra) from the NASA SeaWIFS (Sea-viewing Wide-Field-of-view Sensor) satellite, (b) aerosol data from the NASA MODIS (Moderate Resolution Imaging Spectroradiometer) satellite, (c) cloud-penetrating SST data from the TRMM (Tropical Rainfall Measuring Mission) satellite, (d) Sea Surface Height Anomaly (SSHA) data from the TOPEX/POSEIDON and JASON-1 satellites, and (e) ocean surface wind vectors from the NASA QuikSCAT satellite, here we analyze one complete year of data from 2003. We found that indeed blooms occurred in this ocean desert and the nutrients fueling the blooms might have originated from atmospheric depositions and from vertical mixing induced by super-typhoons.

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INITIAL IchthyoplankTON ANALYSIS OF THE MACKENZIE PLUME FRONT

Annually the Mackenzie River transports approximately 300 km³ of freshwater to the Beaufort Sea. In summer this discharge creates a 60,000 km² plume over the Canadian Beaufort Shelf that can exceed 6 m in depth. In the present study ichthyoplankton assemblages associated with the plume front were sampled during July and August. The ichthyoplankton was comprised of six taxonomic families of marine fish. Arctic cod (Boreogadus saida), Pacific herring (Clupea pallasi pallasi) and sandlance (Gadus liparideus) were the most abundant larval fish. Analysis revealed significant size differences among Arctic cod were associated with different generations across the plume. A preliminary analysis suggests that the plume plays an important role in the ecology of marine larval fish on the Canadian Beaufort Shelf.

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CLIMATE DRIVEN HABITAT BOUNDARIES: TRANSLATING COUPLED PHYSICAL-ECOSYSTEM DYNAMICS TO THE MID-ATLANTIC FISHERIES COMPLEX
Understanding the effects of climate variability and change on ecosystem dynamics is one of the most important and complex problems facing modern ecology. Analysis of climate effects on habitat boundaries and conditions is a powerful approach to this problem. Zooplankton can serve as holistic integrators of habitat conditions and provide a critical linkage between primary production and higher trophic levels. We used spatial techniques coupled with zooplankton community composition analysis to depict changes in fisheries habitat resulting from differing interannual hydroclimatic conditions in Chesapeake Bay, one of the most important fishery habitat areas in the Northeast US Shelf Large Marine Ecosystem. The dominant signal revealed in the analysis suggests that the timing and nature of the winter-spring transition determines the quality, quantity, and nature of fish nursery habitat as evident in the hydrographic, zooplankton community, and fishery recruitment profiles over the last two decades. These results illustrate the important linkages between physical processes and ecosystem dynamics that occur through variations in habitat conditions and boundaries and eventually affect upper trophic levels.

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PERCEPTION OF PRESSURE PULSES: PATCHES, POROSITY AND PEREGRINATION

Hydraulic activities of infauna often result in transient pressure pulses in the porewater which can be measured with pressure sensors. The resulting measurements taken across a gradient of densities allow calculation of biogenic advective forces and resulting porewater flux. We have measured such pressure transients for a variety of species including arenicolous and neild polychaetes and tellinid bivalves and have been able to associate wave forms of those most active with particular animal behaviors. However, in other cases animal behaviors have resulted in no detectable pressure pulses. This absence appears to be the result of the following: (1) uninterrupted connections between the animal and the overlying water column, (2) high permeability of the sediment column, or (3) highly forced burrows. If pressure transients are detectable at distances due to animal activities, then advective forces may be significant. How often does this occur and how common are the organisms and are these the elements that drive the assemblage?

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RECONSTRUCTING RELATIVE WAVE HEIGHTS RESPONSIBLE FOR HURRICANE-INDUCED DEPOSITS

Inverse modeling techniques are used to reconstruct flooding conditions for hurricane-induced overwash deposits from Laguna Playa Grande, a back-barrier lagoon located on the island of Vieques, Puerto Rico. Grain-size distributions for siliclastic sediment collected from these overwash deposits fine landward (away from the barrier and towards the mainland). A simple advective/settling model can explain this pattern of lateral sorting and is used to constrain the relative magnitude of probable flooding events. The deposit attributed to the 1928 AD San-Felipe hurricane is used as a modern analogue to test the technique, which produces reasonable estimates for wave heights that exceed the barrier during the event. A 5000 yr reconstruction for local flooding intensity is developed. This reconstruction shows that although the Vieques overwash record indicates periods in which hurricane strikes have occurred more frequently, no event appears to have carried coarse-grained sediment any farther than storms occurring during the historic period. Thus none of the 29 overwash deposits analyzed in this study appear to be associated with an anomalously large hurricane or tsunami event, with a sediment transport competence significantly greater than that of historical hurricanes.

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RECRUITMENT IN UPWELLING-DOMINATED REGIONS DRIVEN BY THE MOVEMENT OF NEARSHORE FRONTS

A field study was conducted during the upwelling season in northern Monterey Bay to assess the influence of nearshore fronts on the recruitment of barnacles and nearshore fish species. During the upwelling season, the northern Monterey Bay is characterized by a distinct upwelling shadow. This water body creates strong fronts with cold, recently upwelled waters of the outer coast. Juvenile fish and barnacle recruitment were sampled at four sites (two within the upwelling shadow, two within the outer coast upwelling plume concurrently with physical oceanographic variables. Sites located within the upwelling shadow showed consistently low recruitment levels, while sites located within the upwelling plume showed distinct pulses of recruitment associated with the nearshore front. Northward movement of the upwelling shadow Front during relaxation events did lead to recruitment pulses. However, the location of the upwelling front could move also in response to local forcing leading to interannual recruitment pulses at outer coast sites. These results highlight the importance of nearshore oceanographic features in defining larval dispersal and observed recruitment patterns.

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AMMONIA CONCENTRATIONS AND PROCESSES IN OLIGOTROPHIC WATERS

In wide areas of the world’s oceans phytoplankton productivity is limited by the availability of nitrogen. Surface waters in the Atlantic Ocean and Tasman Sea, are typically depleted of dissolved inorganic nitrogen species. Quantification of biogeochemical processes would not be practicable for these waters in the absence of reliable nutrient concentrations. An ammonium analysis technique is used based on ammonia gas diffusion across a Teflon membrane, followed by o-phthalaldehyde derivatization, and then fluorometric detection. Results from water column samples are presented from a research transect cruise from the UK, through both the oligotrophic north and south Atlantic gyres, to South Africa. Further results from a cruise in the Tasman Sea show fine scale near-surface profiles. Ambient concentrations of ammonia, often less than 5 nanomoles per litre, are reported showing a biologically derived maximum, over 100 nanomoles per litre, found at the top of the deep chlorophyll/nitrate maximum zone, which is characteristic of oceanic waters. Fine scale sampling in the upper 10 metres of the Tasman Sea are discussed in the context of previous experiments investigating ammonium photo-production.

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EVALUATION OF AN AUTOMATED OBSERVATION QUALITY CONTROL SYSTEM TO SUPPORT DYNAMIC OCEAN MODELS IN AN OPERATIONAL ENVIRONMENT

The Naval Oceanographic Office (NAVOCEANO) operates a suite of ocean models that assimilate large amounts of satellite and in-situ observations using the Navy Research Laboratory (NRL) developed Naval Coupled Ocean Data Assimilation (NCODA) system. The performance of these ocean models is sensitive to the quality of the observations they assimilate. This presentation will evaluate the implementation of NCODA’s automated Ocean Quality Control (OcnQC) system at NAVOCEANO, with emphasis on the QC of ocean temperature and salinity profiles. We will compare datasets that have been processed through OcnQC to the same profiles run through the present manual process. These data sets will include known error types such as gaps, surface spikes and depth offsets. The evaluation will also include the effects of various QC tuning options, such as buddy checks, comparisons with climatology and/or model analysis fields.

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A DECADE OF ACOUSTIC THERMOMETRY IN THE NORTH PACIFIC (A): USING LONG-RANGE TRAVEL TIMES TO TEST GYRE-SCALE TEMPERATURE VARIABILITY DERIVED FROM OCEAN MODELS

Large-scale temperatures in the North Pacific were measured by long-range acoustic transmissions from 1996–2006. Acoustic travel-time data are inherently integrating, suppressing mesoscale variability and providing accurate measures of large-scale temperature variability with high temporal resolution, subject to the limitations of the ray path sampling. Even at gyre scales, the ocean is found to be highly variable, with significant changes occurring on time scales as short as a few weeks. The interannual variability is large compared to trends in the data. Travel times equivalent to the measured travel times have been calculated using objectively mapped 0.75 m temperature fields for the global ocean derived from satellite altimetry and profile data. Similar comparisons have also been made using travel times derived from the Estimating the Circulation and Climate of the Ocean (ECCO) model, constrained by satellite altimetry and profile data using data assimilation methods. In both cases the measured and calculated travel times are similar, but they also show significant differences. These results suggest that the acoustic travel times can be used to provide meaningful additional constraints on model behavior.
As part of the Lagrangian Transport and Transformation Experiment (LaTTE), concentration and acoustic backscatter profiles, respectively. Model calculated velocities calculated from the bottom boundary layer model ranged from approximately 6 - 8 cm s⁻¹ over the course of the sediment transport event. In order to quantify the magnitude, direction, and duration of sediment transport at the inner-shelf site during the hurricane passage, critical bed shear stresses were calculated using the Grant-Madsen-Glen model (Stiles and Glen, 2000) and compared with bed stresses calculated from measured waves and currents. Shear velocities calculated from the boundary layer model ranged from approximately 6 - 8 cm s⁻¹ over the course of the sediment transport event. Large amounts of suspended sediment transport occurred in the along-shelf direction towards the southwest. Model calculated cm s⁻¹ over the course of the sediment transport event. Large amounts of suspended sediments in plume sampled in the Hudson River buoyant plume during contrasting discharge regimes in April 2005, sampling was carried out immediately following a period of record high discharge which resulted in the formation of a large recirculation zone that occupied the entire New York Bight. In contrast, sampling in May 2006 was carried out under moderate discharge conditions that resulted in a characteristic southward flowing coastal current. Metals in both phytoplankton and zooplankton were generally enriched closer to the Hudson River, where dissolved metal concentrations were also highest. In contrast, however, silver and inorganic mercury in zooplankton were highest, further south in the plume, particularly near large sewage outfalls along coastal NJ. For some metals, concentrations in zooplankton were correlated with those in phytoplankton and model calculations indicate that trophic transfer was an important pathway of metal accumulation in plume zooplankton.

A NEW PARADIGM FOR STUDYING LARGE-SCALE COASTAL MORPHODYNAMICS: THE DISTRIBUTED COASTAL LABORATORY

A new frontier in coastal morphology involves study of interdependent suites of hydrodynamic processes, coastal and shelf morphologies, and temporal sequences of change on scales of hundreds to thousands of kilometers. The complex process suites that dominate large deltaic and coastal margin systems require a new approach to experimental investigations. Experiments conducted in coastal margins were conducted within field laboratories having horizontal dimensions of order 1-10 km. The next morphodynamic paradigm shift can be facilitated by Distributed Coastal Laboratories (DCLs) spanning the entire U.S. Atlantic and Gulf coast and shelf or the entire region of the American Pacific Coast (NOAA’s Integrated Ocean Observing System (IOOS)), the NSF Ocean Observing Initiative (OOI), NASA satellites and numerous regional observatories. The envisioned DCL will be enabled by a robust information technology (IT) infrastructure that links the existing resources owned and operated by a diverse community. The DCL Service Oriented Architecture will integrate information and disseminate data and model results to scientists in standardized formats including GIS-compatible maps of key variables. Results from the existing prototype can be seen at www.openoios.org and www.oosthys.org.

NON-HYDROSTATIC MODELING OF VEGETATION EFFECTS ON FLOW MOTIONS

A three-dimensional non-hydrostatic model is developed to study the effects of aquatic vegetation on flow motions. Vegetation is modeled as resistance that is introduced as drag in the momentum equation and drag-induced turbulence production in the turbulence closure. The model incorporates a generic vegetation boundary layer model that is first validated against open-channel flow experiments. The model is then applied to examine flows through submerged and emergent vegetation. In the case of 1-D flow over submerged vegetation, model results show that flows are retarded inside the vegetation layer and a maximum turbulent intensity occurs at the top of vegetation, consistent with model calculations. Suspended sediment concentrations were measured well with the measured current and acoustic backscatter profiles, respectively.

As an ADCP was deployed on the inner-shelf of Long Bay, South Carolina as Hurricane Ernesto traveled up the South Carolina coast in August 2006. As the storm approached the area and passed through Long Bay, simultaneous measurements of wind velocity, atmospheric pressure, current velocity profiles, wave characteristics, and water levels were collected. Sustained winds on the inner-shelf were over 35 m s⁻¹, while current velocity ranges from 40 to 50 cm s⁻¹ towards the south and west, respectively. Measured wave heights were approximately 2 meters at the relatively low energy inner-shelf site, although wave heights were reported to reach over 6 meters on the mid-shelf. In order to quantify the magnitude, direction, and duration of sediment transport at the inner-shelf site during the hurricane passage, critical bed shear stresses were calculated using the Grant-Madsen-Glen model (Stiles and Glen, 2000) and compared with bed stresses calculated from measured waves and currents. Shear velocities calculated from the boundary layer model ranged from approximately 6 - 8 cm s⁻¹ over the course of the sediment transport event. Large amounts of suspended sediment transport occurred in the along-shelf direction towards the southwest. Model calculated current and suspended sediment concentration profiles compared well with the measured current and acoustic backscatter profiles, respectively.

Sediment transport processes on the inner-shelf of South Carolina during Hurricane Ernesto

An ADCP was deployed on the inner-shelf of Long Bay, South Carolina as Hurricane Ernesto traveled up the South Carolina coast in August 2006. As the storm approached the area and passed through Long Bay, simultaneous measurements of wind velocity, atmospheric pressure, current velocity profiles, wave characteristics, and water levels were collected. Sustained winds on the inner-shelf were over 35 m s⁻¹, while current velocity ranged from 40 to 50 cm s⁻¹ towards the south and west, respectively. Measured wave heights were approximately 2 meters at the relatively low energy inner-shelf site, although wave heights were reported to reach over 6 meters on the mid-shelf. In order to quantify the magnitude, direction, and duration of sediment transport at the inner-shelf site during the hurricane passage, critical bed shear stresses were calculated using the Grant-Madsen-Glen model (Stiles and Glen, 2000) and compared with bed stresses calculated from measured waves and currents. Shear velocities calculated from the boundary layer model ranged from approximately 6 - 8 cm s⁻¹ over the course of the sediment transport event. Large amounts of suspended sediment transport occurred in the along-shelf direction towards the southwest. Model calculated current and suspended sediment concentration profiles compared well with the measured current and acoustic backscatter profiles, respectively.

Aggregated Transport and Transformation Experiment (LaTTE), concentrations of several trace metals (Hg, MeHg, Cu, Ag, Pb, Fe, and Ca) were measured in phytoplankton and zooplankton sampled in the Hudson River buoyant plume during contrasting discharge regimes. In April 2005, sampling was carried out immediately following a period of record high discharge which resulted in the formation of a large recirculation zone that occupied the entire New York Bight. In contrast, sampling in May 2006 was carried out under moderate discharge conditions that resulted in a characteristic southward flowing coastal current. Metals in both phytoplankton and zooplankton were generally enriched closer to the Hudson River, where dissolved metal concentrations were also highest. In contrast, however, silver and inorganic mercury in zooplankton were highest, further south in the plume, particularly near large sewage outfalls along coastal NJ. For some metals, concentrations in zooplankton were correlated with those in phytoplankton and model calculations indicate that trophic transfer was an important pathway of metal accumulation in plume zooplankton.
but mainly in the north and northwest of the subpolar North Atlantic. A sustained 30 to 40°Ftening trend of the late half of the 20th century in the subpolar North Atlantic and the recent trends in hydrographic properties. We demonstrate the possible impact of the one-big-loop circulation regime and a detached two-small-loop regime resulting in heat and salt transport. 

This paper presents a mechanism for interconnection and variability between the Arctic/Pacific through the wind-evaporation-SST (WES) feedback. The global response to a shutdown of the Atlantic meridional overturning circulation (AMOC) is investigated by conducting a water-hosing experiment with a coupled model. Our results show that in both shelf (DFe 3.5 nM) and deep basin (DFe 2 nM) waters, Fe-organic ligands in seawater samples collected during the Spring 2007 BEST cruise. Our measurements suggest that Fe-organic ligands are in excess of total dissolved Fe by 1-2 nM, suggesting that the organic ligands may help maintain the high concentrations of DFe in the water. Our error correction using the iteration procedure makes a substantial difference in the modeled ligand concentrations and stability constants.

The continuing thinning of the Antarctic ozone layer deems it necessary to study the effects of UV-B radiation on the marine microphytobenthos, a previously neglected group. The results of these studies offer new insight into timing and discriminating paleo-tsunami events in geological records and differentiating these from storm deposits, tsunami are one of the major natural hazards in the Caribbean; recent studies reveal that they strongly affect the coastal environment of even remote sites like the Islands of Curacao, Aruba and Bonaire (Lesser Antilles, Caribbean). Identifying paleo-tsunami events in geological records and differentiating these from storm deposits, however, remains a challenge. Here, we use sediment cores from distal coastal-marine and lacustrine sites to place better constraints on a known submarine slide that likely generated a ~15-m tsunami along the southwest coast of the Island of Curacao ca 14,000 years ago. A detailed core description, magnetic susceptibility and grain size measurements revealed a succession of storm deposits in marine sediments in the partial open bay areas, and tsunami deposits in lacustrine sediments in the rather storm protected Lagoon. The results of these studies offer new insight into timing and discriminating between distal paleo-tsunami and storm deposits in a paleoclimatic context.
group of primary producers. In the intertidal, recruitment of benthic marine diatoms was observed to increase at 0.6µm UV-B and PAR+UV-B (PAR=UV-A+PAR; PAR+UV-B=UV-A+UV-B) for 14 months. No UV effects were observed. In the laboratory, mechanistic effects of enhanced UV-B were studied. Diatoms were exposed to different time treatments of PAR and PAR+UV-A. PAR+UV-B was not compared due to the effect of changes in pH on the concentration and dynamics of PAR. PAR, we conducted a series of experimental studies in the Baltic Sea in summer 2007 within the frame of the SOPRAN (Surface Ocean PRocesses in the ANthropocene) project. At this time diazotrophs were the main primary producers. Thus, the relation between autotrophic N2-fixation and heterotrophic activity (uptake of radiolabeled Leucine) was determined and compared with PAR+UV-B concentration measurements to elucidate how production and fate of PAR may be altered due to short term responses to acidification. We observed that the amount of PAR as well as PAR+microbial activities were sensitive to changes in pH. Our results indicate a decrease of PAR concentration with increasing pCO2 under net heterotrophic conditions. Furthermore, significant correlations between PAR concentration and bacterial abundance suggest a tight coupling between the dynamics of acidic carbohydrates and bacteria dynamics. This study shows that manipulations of pH can affect microbial carbon turn-over and, hence, organic matter cycling.

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THE INFLUENCE OF ANTHROPOGENIC MARINE SUBSIDIES ON TROPHIC DYNAMICS IN A LOW-PRODUCTIVE TERRESTRIAL ENVIRONMENT

Ecological perturbations can have strong influences on food web dynamics by altering the source, abundance, and temporal availability of resources. This in turn may disrupt nutrient pathways by varying controls for top-down and bottom-up interactions. The beaches of Isla Magdalena (Baja California, Mexico) are littered with discarded catch (bycatch) of local artisanal fisherman every summer. This marine nutrient input could be supporting excess densities of apex predators (coyotes, Canis latrans). Our objectives are to understand the effects of marine nutrient inputs on the island's coyote population and identify any cascading effects on lower trophic levels. To do so we are using a combination of mark-recapture techniques and stable isotope (13C, 14N, D) analysis of coyote tissue, their prey, and primary producers. Abundance indices suggest spatial differences in coyote and prey density that likely correspond to variations in bycatch biomass across the island. Isotopic results show that a high proportion (>50%) of most coyotes' diets consist of bycatch during the summer. This interdisciplinary study will illustrate how anthropogenic activities in marine ecosystems can have dramatic affects on adjacent terrestrial environments.

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LIGHT-INDUCED FORMATION OF CARBON MONOXIDE FROM PARTICLES IN SEAWATER: PRELIMINARY RESULTS

Carbon monoxide (CO) formation from particle photoprocesses was determined on seawater samples collected from one open-ocean (BATS) and two coastal (Vineyard Sound and St. Lawrence estuary) sites. Particles were concentrated using cross-flow filtration with 0.2-micron filter pore size. Samples containing varying levels of particles were irradiated under solar or solar-simulated radiation. CO formation rate increased linearly with particle concentration. Particles contributed to 20-40% of the CO formation in the original samples. Although this increase in CO formation was in part due to light scattering by particles, our results demonstrate that CO formation by particle-involved photoprocesses could be significant compared to CO production from dissolved organic matter photochemistry.

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MIXING INDUCED BY EDDY IN NORTHERN PART OF SOUTH CHINA SEA

An intensive and comprehensive experiment was newly performed in northern part of South China Sea (SCS) in June/August, 2007. Conductivity-Temperature-Depth (CTD), Lower Acoustic Doppler Current Profile (LADCP) and TurboMAP-II were used in observation. The geostrophic calculation shows that a subsurface cyclonic circulation exists in a depth range from 50m to 200m with maximum scales of 18°-20°N and 115°-118°E at about 100m, and a deeper anticyclonic eddy becomes evident at 17.5°-19.5°N, 114°-116°E below 50m down to 2000m. The dissipation rate and eddy diffusivity in the eddies are investigated from microstructure observation. Vertical velocities in the eddies are also calculated from ω-equation and microstructure observation, respectively.

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NORTH ATLANTIC INFLUENCES ON TROPICAL AMERICAS: RAINFALL AND CROSS-CENTRAL AMERICAN MOISTURE TRANSPORT

Palaeoclimatic observations suggest that during Heinrich events, precipitation decreases on both sides of the Central American Isthmus. A high resolution coupled ocean-atmospheric model simulates this suppression of tropical American rainfall in response to a cooling over the tropical North Atlantic, the latter being typical of Heinrich events. The simulation reveals a surprising analogy to the so-called mid-summer drought of Central America. With increasing solar radiation, wet precipitation over Central America and southern Mexico increases from April to June but then mysteriously decreases in the mid-summer during July-August. The simulation suggests that suppressed convection over the tropical Atlantic warm pool is a cause of the mid-summer drought over Central America and the far eastern tropical North Pacific by exciting subsidence Rossby waves that propagate through the Isthmus. The moisture transport from the Atlantic to Pacific across Central America favors the North Atlantic for the sinking branch of the global meridional overturning circulation (MOC). The mid-summer drought is associated with the development of northeasterly winds across Central America, which are responsible for much of the Atlantic-to-Pacific moisture transport. In response to a North Atlantic cooling as during Heinrich events, the intensified northeast trade winds increase the moisture transport from the Atlantic to Pacific, suggesting a negative feedback to MOC variability.

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TSUNAMI INCISIONS PRODUCED BY THE DECEMBER 2004 EARTHQUAKE ALONG THE COASTS OF THAILAND, INDONESIA, AND STRAITS

Field observations and satellite images indicate that tsunami waves select specific patterns of incision in the coastal landscape. To study these incisions we analyze high resolution remote sensing images of the coastline of Indonesia, Thailand, and Sri Lanka impacted by the tsunami of December 26, 2004. The analysis sheds light on the different mechanisms by which currents scour incisions during the flooding and receding phase of a tsunami. During flooding the high velocity flow indents the levels of existing tidal channels and bays, leaving short flood scours. During the receding flood water dissects the coastline with equally spaced return channels widening toward the coast.

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ASLO/AGU/TOS/ERF

The Advanced Circulation (ADCIRC) model is employed to simulate barotropic tides and wave conditions over a tidal cycle in the Gulf of Mexico, southwest of the Mississippi River mouth. The two-dimensional version of ADCIRC has been used to simulate the mean and residual currents, and the associated transport of suspended sediments, nutrients, and dissolved oxygen in the area of the Mississippi River Delta. The model results indicate that the Mississippi River discharge plays a significant role in the development of estuarine circulation and sediment transport in the area. The model results are in good agreement with observational data from the Mississippi River Delta.

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NUMERICAL STUDY OF LAGRANGIAN TRANSPORT PROCESS IN A MARGOCITAL BASIN

Mixing and transport in a tidal basin or estuary is not only an interesting scientific problem but also an important processes which control the fate and distribution of nutrients, suspended sediment, pollutants and other planktonic waterborne biota in coastal oceans. Two basic mechanisms of horizontal advection, dispersion and chaotic advection have been proposed, but quantifying and predicting the Lagrangian transport of marine particles in the ocean remains a challenge. In a marginal basin like Cobico Bay, particle trajectories show a great deal of sensitivity to location and time. Chaotic advection is traditionally thought as the principal influence to Lagrangian transport due to interaction of significant tidal currents and complex geographic features. A kinematic model of Cobico Bay is also constructed to investigate Lagrangian behavior based on the residual current from the dynamical ocean model. Numerical particles are released at different tidal phase and tracked through time-depended tidal currents with different amplitudes and spatially varying phase lags. Lagrangian coherent structures are distinguished to evaluate the flushing and resident time of different part of tidal channel. The results suggest chaotic advection happens when spatial phase lag of tidal current is great enough and particles may be transported to quite different regions though they were initially released very closely.

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A SIZE-RESOLVED METHOD FOR FLOCCULATION PROCESSES OF FINE-GRAINED PARTICLES

The transport of fine-grained particles in estuarine and coastal waters is influenced by flocculation processes (aggregation and floc breakup). Aggregation is caused by collision and subsequent adherence between particles, and breakup is mainly due to turbulent stress. As a consequence, the particle size and settling velocity vary with time in the water column, and can be orders of magnitude larger than those of primary particles. In this study the variations in floc size and settling velocity are simulated via a size-resolved method, which approximates the real size distribution of particles in different size bins and solves for each bin a mass balance equation. The zero- (0-D) and one-dimensional (1-D) simulations have been carried out. In 0-D study the median floc size (D50) is proportional to the ratio of initial concentration and Kolmogorov microscale. In the 1-D simulation, on the other hand, the floc size distribution and settling velocity not only are influenced by turbulence-induced flocculation but also by competition between diffusion and settling. Simulation over a tidal cycle shows that floc sizes during high water slack are greater than those during maximum flood or ebb currents.

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MODELING TIDAL DYNAMICS AND TIDAL DATUMS IN THE PACIFIC NORTHWEST REGION

A tide model has been developed for the Pacific Northwest region in support of developing a vertical datum transformation tool. VDatum. The model domain extends from Pt. Buchon, California, to north of the Juan De Fuca Strait. The two-dimensional version of the Advanced Circulation (ADCIRC) model is employed to simulate barotropic tides and depth-integrated tidal currents. A high-resolution unstructured grid was created to better represent the complex shoreline and fine bathymetric features. The generated tidal dynamics and elevation data in this region will be used to generate tidal datums, including mean lower low water (MLLW), mean low water (MLW), mean high water (MHW) and mean higher high water (MHHW), as well as tidal constituents, are derived based on the simulated tidal water levels and validated against available observations at various tidal gauges obtained from NOAA’s Center for Oceanographic Product and Services. The results of water discharge on the tidal dynamics and datums in the river/estuarine system will also be discussed.

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ORIGINS OF LARGE WAVE-SHAPED BEDFORMS ON THE FLOOR OF MONTEREY SUBMARINE CANYON

Multibeam surveys and ROV dives revealed a field of bedforms from the headdown to ~1000m depth along the axis of Monterey Submarine Canyon. These bedforms range from 20–70m in wavelength and 1–3m in height. The asymmetry of these bedforms suggests that wave-driven canyon migration. Current measurements show tidal oscillations of up to 80 cm/s, with down-canyon current dominant. Empirical models show that flows of these magnitudes are capable of generating sandwaves of the observed sizes. However, variations of the local and flanks of the bedforms showed sequences of strong or moderate clay-clasts firing upward into sand - a stratigraphy typical of gravity-flow deposits. Moreover, three boulder-sized monuments buried 40cm in the bedforms at different locations were translated ~150m down-canyon within a 3-day period, suggesting forces other than tidal currents as the cause. A multi-faceted investigation is underway that includes mapping and geophysical surveys, sediment coring, and ADCP mooring and STED (Self Triggered Event Detector) deployment. In this paper, we present the latest data and analyses that characterize possible mechanisms for forming the observed bedforms and their spatial variation.

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SEDIMENT TRANSPORT FROM THE MISSISSIPPI AND ATCHAFLAYA RIVERS TO THE LOUISIANA/TEXAS SHELF

Fluvial sediment dispersal strongly impacts temporal and spatial variations of turbidity and nutrients in estuaries and continental shelves. This has motivated the development of a three-dimensional coupled hydrodynamic and sediment transport model for the Louisiana/Texas (LaTex) shelf. The model, implemented within the Regional Ocean Modeling System (ROMS), included delivery of sediment from the Mississippi and Atchafalaya Rivers, seabed resuspension, and suspended sediment transport by ambient currents. Waves were calculated using the SWAN (Shallow WAves Nearshore) model. The calculations represented a year, 1993, that included large storms and significant river discharge. Additionally, data from the LaTex field program provided measurements of bottom boundary layer conditions for May–June, 1993. Model results indicated that on the LaTex shelf both wind-driven currents and storm waves cause sediment resuspension. While much material from the Mississippi was delivered to deep water, a large amount was transported westward to mix with Atchafalaya sediment in the vicinity of the Dead Zone. This model will later be linked to a biochemical model and evaluated using data from the MCH2 (Mechanisms Controlling Hypoxia, 2) experiment.

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THE MEDITERRANEAN OUTFLOW IN A NORTH ATLANTIC SIMULATION

Output from a high resolution, basin scale, North Atlantic simulation is used to study the circulation of the Mediterranean outflow water (MOW) in the Gulf of Cadiz and in the Northeast Atlantic ocean. The model is based upon the hybrid coordinate ocean model (HYCOM) and includes the Richardson number-dependent entrainment parameterization of Xu et al. (2006). As observed, the simulated MOW flows transform from a bottom-trapped gravity current out of the Strait of Gibraltar into a well-bounded, downstream in the Gulf of Cadiz. When the plume spreads further west beyond the Cape of St. Vincent, the inshore, upper part of the plume turns around the Cape and flows northward along the western coast of Iberian Peninsula; the offshore, lower part of the plume continues westward into the northeast Atlantic Ocean. This spreading pattern agrees in general with the scenario described by Danailut et al. (1994). The simulation also suggests that the eddies play a bigger role in carrying MOW westward than northward.
nonlinearity affects not only the profile of individual wave components but also broad-band irregular ocean waves, the spatial and temporal spectra and correlations of the waves. This is illustrated for regular (Airy vs. Stokes) waves, nonlinearity affects the focusing and variations of light fields beneath a dynamic ocean. The codes are optimized by variance reduction techniques. Even with a supercomputer and massively parallel computations, it would be impossible to simulate all the relevant processes with reasonable accuracy. Yue, K. P.

We conducted an analysis of historical satellite imagery to characterize the seasonal and inter-annual variability of SST (14 years) and chlorophyll-a (9 years) in the New Zealand. Our analysis shows that SST and chlorophyll-a remain high in winter months with a secondary peak in the late winter. Surface chlorophyll-a decreased dramatically in early spring as the water column stratified. The winter bloom, when light levels are low and mixing is high, suggests that phytoplankton populations are not constrained by low light (Sverdrup) which we hypothesize may be typical on shallow broad shelves. In addition, inter-annual variability in SST and chlorophyll-a are evident and appear to be set by conditions during the winter months.

Chant, R. J.

We have developed a model of the Maine Coastal Current in response to local forcing as the hindcast is forced by a climatological monthly mean at the open boundaries. In addition, the hindcast in the Gulf of Maine Ocean Observing System (GoMOOS) nowcast/forecast system. The surface forcing is derived from the North American Regional Reanalysis, and satellite derived sea surface temperature is assimilated in the model to constrain the heat budget. The hindcast is compared with the historical database of Fisheries and Ocean Canada and National Marine Fisheries Service. Preliminary analysis focuses on the interannual variability of the Maine Coastal Current in response to local forcing as the hindcast is forced by a climatological monthly mean at the open boundaries. According to Yue and Chant (2016), the hindcast in the last 5 years is compared with the GoMOOS nowcast of 2002-2006 that uses a daily open boundary condition derived from the NCEP Regional Ocean Forecast System.

Yue, X.

We conducted an analysis of historical satellite imagery to characterize the seasonal and inter-annual variability of SST (14 years) and chlorophyll-a (9 years) in the New Zealand. Our analysis shows that SST and chlorophyll-a remain high in winter months with a secondary peak in the late winter. Surface chlorophyll-a decreased dramatically in early spring as the water column stratified. The winter bloom, when light levels are low and mixing is high, suggests that phytoplankton populations are not constrained by low light (Sverdrup) which we hypothesize may be typical on shallow broad shelves. In addition, inter-annual variability in SST and chlorophyll-a are evident and appear to be set by conditions during the winter months.

Yue, X.

We have developed a model of the Maine Coastal Current in response to local forcing as the hindcast is forced by a climatological monthly mean at the open boundaries. In addition, the hindcast in the Gulf of Maine Ocean Observing System (GoMOOS) nowcast/forecast system. The surface forcing is derived from the North American Regional Reanalysis, and satellite derived sea surface temperature is assimilated in the model to constrain the heat budget. The hindcast is compared with the historical database of Fisheries and Ocean Canada and National Marine Fisheries Service. Preliminary analysis focuses on the interannual variability of the Maine Coastal Current in response to local forcing as the hindcast is forced by a climatological monthly mean at the open boundaries. According to Yue and Chant (2016), the hindcast in the last 5 years is compared with the GoMOOS nowcast of 2002-2006 that uses a daily open boundary condition derived from the NCEP Regional Ocean Forecast System.

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Laboratory experiments simulating ocean CO$_2$ sequestration by acidifying bathypelagic seawater with CO$_2$ gas or buffer solutions were conducted to examine the influence on bacterial activity. Here, bacterial production (H-leucine incorporation rate) and the proportion of viable cells (elongated cells under the inhibitor of cell division) were measured. It was observed that moderate acidification (−0.6 in pH unit) increased both parameters. Further acidification over −1.0 in pH unit, on the other hand, depressed both. Bacterial activity was supposed to be quite sensitive to the degree of acidification. Also, the results strongly indicates the presence of some bacterial species in the bathypelagic layer which can be activated with moderate acidification as the consequence of CO$_2$ sequestration.

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VARIABILITY OF FRESHWATER DISTRIBUTION IN THE CANADA BASIN OF THE ARCTIC OCEAN IN 2000S

Freshwater inventories of surface and halocline waters in the Canada Basin are comprised of inputs from rivers, sea-ice melt and low salinity Pacific water and removal due to sea-surface evaporation. To assess interannual variability of these freshwater inputs, a suite of geochemical tracers were collected from 2000 to 2007: oxygen isotope ratio and alkalinity are used to distinguish sea ice meltwater/brine rejection from other freshwater inputs and nutrients are used to identify Pacific water distributions. Horizontal maps show that the relative contribution of these components vary significantly according to regional sources. Shelf-basin exchange is shown by the lateral transport of freshwater and brine from the continental shelves into the Canada Basin. Substantial inter-annual differences are found in both horizontal and vertical distributions of freshwater components.

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MIXED LAYER HEAT BALANCE ON SEASONAL TO INTERANNUAL TIMESCALES IN THE WESTERN TROPICAL PACIFIC: AN OGCM STUDY

We examined the mixed layer heat balance, using an ocean general circulation model, on seasonal to interannual timescales in the western tropical Pacific, where variations in the relatively high SST are closely related to the East Asian climate through atmospheric convective activities. On the seasonal timescale, the SST is dominated by the surface heat flux and subsurface processes, such as entrainment, during summer, while by the surface heat flux and the meridional heat advection due to the enhancement of the Mindanao Dome during winter. On interannual timescales, the mixed layer heat balance in the western tropical Pacific exhibits a seasonal dependency: the SST variability is mainly influenced by the surface heat flux during summer and by the oceanic interior process during winter. This well explains the seasonal relationship between the local SST and precipitation anomalies in the western tropical Pacific: their correlation shows negative values in summer, while positive in winter.

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ASSESSMENT OF DYNAMICS OF CHROMOPHORIC DISSOLVED ORGANIC MATTER IN COASTAL ENVIRONMENTS BY EEM-PARAFAC

Excitation-emission matrix (EEM) fluorescence techniques have been widely used to characterize chromophoric dissolved organic matter (CDOM) in coastal environments. However, since the EEMs are often composed of various types of overlapping fluorophores, it may be difficult to properly evaluate CDOM dynamics in coastal based solely using the EEM “peak picking” technique. In the present study, parallel factor analysis (PARAFAC) was applied to decompose EEMs into individual fluorophore components for samples collected at Ise Bay, Japan. Four humic-like and three non humic-like fluorescent components were identified by PARAFAC and the dynamics of each of the fluorescent components was evaluated separately. The spatial distribution of the three non humic-like fluorophores suggests an autochthonous, estuarine origin for these components. The linear relationships between salinity and abundance of two of the four humic-like components observed in the bay area, suggests a terrestrial origin, probably riverine as conservative behavior for these components was observed. In contrast, non-conservative mixings of the other two humic-like components were found in the bay area, suggesting sources other than riverine inputs.

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RING AND WESTERN BOUNDARY CURRENT INTERACTIONS - TWO SCENARIOS

More than two decades ago, one of us proposed two scenarios for the interaction of a cold core ring and a western boundary current (the Gulf stream): 1) the ring coalesces completely with the stream; 2) the ring exchanges mass and pressure energy with the stream but is then reorganized to form a ring free from the stream. The first scenario was successfully proved in series of papers, particularly Olsen (1980). However, the second one had lack of sufficient evidence to demonstrate this scenario really takes place. In February 2007, we made a direct observation of a cold core ring collision with the Kuroshio making use of Moving Vessel Profiler (MVP). We cut through the ring and the Kuroshio. The data demonstrate that the mass and the energy of ring were exchanged with those of the Kuroshio. According to the satellite altimeter data, the ring reorganized and increased in size. Clearly, this new data set demonstrates the second scenario is real. We present the detail of our data set and the data analysis. Examples of ring interactions in both the Kuroshio and Gulf Stream are summarized.

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A SYSTEMATIC OBSERVATION OF METHANE PLUME BEHAVIOUR AROUND SEAFOAM COLD SEEPAGE

Cold seepages are characterized as rapid upward transports of methane from deeper part to the sea surface. Prior to reach the sea surface, methane meets downwards diffusing seawater sulfate, it is oxidized anaerobically by a consortium of microorganisms that use sulfate as an oxidant. A significant portion of the bicarbonate produced after the sulfate reduction near the seafloor. When the methane fluxes are much, direct methane bubbling occurs and the bubble jet blows up in the water column due to the buoyancy. Then the diffusive and dispersal processes will be enhanced. The methane bubbles and the dissolution and dispersion process have been numerically studied by the authors. The results suggest that the behavior of methane plume is susceptible to current profile among the several factors. In the previous studies, however, there are few cases that methane concentration in the water column and current profile were simultaneously measured in the same area. In order to obtain the both data and reconstruct the numerical model, the R/V Tansei-maru cruise KT-06-26 including CTD-cast with seawater sampling and ADCP mooring were carried out at the Umitaka Spur off Joesu region, eastern Japan Sea. Magnificent methane flare has been reported at the Spur. The mooring system composed of three ADCP with two 3-D current vector instruments was deployed for ca 58 hours. During the deployment, 24 CTD-casts with seawater sampling were conducted.

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REMOTE SENSING STUDIES OF MERIDIONAL OVERTURNING CIRCULATION IN NORTH ATLANTIC OCEAN

Although satellite remote sensing measurements are commonly used in oceanographic research, very few of these studies address deep ocean convection (DOC) as it relates to Meridional Overting Circulation (MOC). The major limitation of using remote sensing measurements directly results from their poor temporal and spatial resolution, with respect to the characteristic features of deep water convection. However, features associated with prior and post deep water formation have much larger spatial and longer time scales compared to the convective plumes. This talk will focus on detecting and monitoring the preconditioned flow and lateral exchange features resulting from prior and post deep convection, respectively. Using several sources of data, including heat and vapor exchange, and horizontal and vertical flow fields, we have created a composite data set that allows the analysis of horizontal flow fields and the vertical water column structure that are associated with DOC. The improved understanding of DOC and MOC results from this study will allow us to better access its impact on climate change and thus help to detect the early onset of rapid climate change. Preliminary results will be discussed in this presentation.

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temperature and salinity observations with three kinds of background error covariances: (1) a Gaussian-type, (2) a hybrid-type that augments (1) with flow-dependent BV structures and (3) a hybrid-type that augments (1) with flow-independent EOF structure. Our results show that the analyses derived from the multivariate, hybrid background error covariances have the improvement over the one derived from the Gaussian background error covariance. The improvement can be found in both the temperature and salinity fields, especially in tropical Atlantic. Among them, the analysis incorporated with BV information has the significant impact in the salinity field, which encourages the CGCM to predict a warm anomaly in 2006.

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LARGE-SCALE EDGE WAVES GENERATED BY HURRICANE WILMA’S LANDFALL

Direct observations of the storm surge induced by Hurricane Wilma’s landfall on the West Coast of Florida on October 24, 2005 revealed a formation of a wave pulse propagating alongshore as Wilma moved inland and the surge was no longer sustained by wind forcing. The height of the wave pulse exceeded 1.5 m in detailed sea level data but its magnitude was obscured in direct surge measurements because it propagated during the stage of low tide. The duration of this wave pulse was ~6 hrs and the propagation speed varied in the range of 10-25 m/s indicating some dispersion of the initial disturbance. The wave pulse was followed by a train of much weaker oscillations during the next 24 hrs. The observed wave is identified as an edge wave of large spatial and temporal scales. Preliminary model calculations demonstrate a generation of edge waves with large spatial and temporal scales by a fast-moving circular storm system crossing the shelf at a close-to-normal angle. The pulse structure forms when the shelf width is comparable with the storm’s spatial scale.

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WATER MASS FORMATION AND CIRCULATION IN THE PERSIAN GULF

The circulation and water mass transformation processes in the Persian Gulf and the water exchange with the Indian Ocean through the Strait of Hormuz are studied using the HYbrid Coordinate Ocean Model (HYCOM). The Persian Gulf is a shallow, semi-enclosed marginal sea where the Persian Gulf Water (PGW), one of the most saline water masses in the world, is produced due to the arid climate. The PGW flushes out of the Persian Gulf as a deep outflow through the Strait of Hormuz and induces a surface inflow from the Indian Ocean, driving an inverse-estuarine type water exchange. The model results compare favorably with observed features, particularly with the measurements in the strait. The model suggests that deep waters are formed both in the northern gulf and in the southern gulf during wintertime and contribute with different seasonal cycle to the total deep outflow through the strait. The circulation in the gulf exhibits strong seasonal signal, and the annual cooling/heating cycle of the surface heat flux is identified as responsible for the seasonal variability by changing the vertical mixing.

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CENSUS OF MARINE LIFE: TECHNOLOGIES FOR BIOLOGICAL RESEARCH THROUGH OCEAN OBSERVATORIES

The Census of Marine Life is an international research program that studies the diversity, distribution and abundance of marine life. As part of this mission, Census projects are developing and demonstrating technologies to collect information, in an automated way in situ, about marine animals and their migratory patterns. In addition, Census scientists have advanced tag technologies enabling them to employ marine life as platforms for sensors. Tags on marine predators have gathered more physical oceanographic information than any conventional system, including the Argo float system, and can transmit those data to satellites. Many of the technologies used within Census research - tags, sensors and receivers - can be integrated in ocean observatories, thus providing a major biological component to these systems. The goal of the Ocean Biogeographic Information System, which houses all Census data, is to become interoperable with the data infrastructure of the Global Ocean Observing System to better address ecosystem concerns associated with global change, fisheries and pollution.

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RECENT THERMOHALINE CHANGES IN THE NORTHERN NORTH ATLANTIC

The coupled breeding, implemented in the NASA GMAO coupled general circulation model (CGCM), is designed to capture the growing errors related to the atmosphere- ocean coupled instability in an interannual time scale (e.g. ENSO). The derived coupled bred vectors (BV) are originally used as the initial ensemble perturbations for the purpose of improving season-to-interannual ensemble forecast skill. In this study, we incorporate the oceanic component of the BVs into the data assimilation (DA) procedure to explore the possibility of improving the DA performance through the background error structures. The potential impact is investigated through the DA experiments, which assimilate
Combining hydrographic (CTD), moored, profiling ARGO-float and expendable bathythermograph (XBT) measurements in the central North Atlantic, we document significant changes in its upper, intermediate (Labrador Sea), deep (Iceland-Scotland Overflow/ Northeast Atlantic) and bottom (Denmark Strait Overflow) waters that have occurred during the past two decades. Affected by vertical and lateral mixing, these waters evolve along their spreading pathways. The similar seasonal-to-decadal scale signals in the thermocline characterize different adjacent major basins in the North Atlantic, implying that there is a persistent inter-basin advective exchange pattern which contributes to the large-scale connections and interactions in the Atlantic climate and eco-systems. The moored and ARGO measurements were used to fill both spatial and temporal gaps in the CTD data. Continuous time series constructed from the ARGO data for the Labrador, Fringer and Greenland basins supported the warming that was apparent in the temporarily sparse CTD & XBT data. Other questions addressed are: Does the recent warming occur in a steady/continuous way or in jumps? What is the contribution of the seasonal changes to the multyear trends? What is the rate of deep convection?

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OBSERVED DIAPYCNAL INJECTION OF SALINITY ANOMALIES

Temperature and salinity profiles from the global array of ARGO floats reveal a large amplitude seasonal cycle of density offshore of the deep western boundary currents in the sub-tropics of each ocean basin. This seasonal cycle is quantified by the summer to winter change in a bulk vertical Turner angle computed from the ARGO profiles. The injection of salinity anomalies onto previously subducted isopycnals is quantified by comparing pairs of measurements from the same profiles. Distributions of global Turner angle and basin-scale diapycnal injection metrics, such as the average overturning salinity increase and depth of penetration into stratification, are presented. These ARGO results are consistent with a conceptual model of perturbative convective mixing of a highly density compensated water column and with previous results from an OGCM hindcast. The model results are used to relate interannual variations in isopycnal salinity to sea surface salinity (SSS) and to discover the generation mechanisms for the SSS anomalies.

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DEPTH ZONATION OF DEEP-SEA MEGAFANAL SCAVNGERS OF THE HAWAIIAN ISLANDS

The deep-sea demersal and benthopelagic scavenging communities of Oahu and the Northwestern Hawaiian Islands were explored with the use of baited time-lapse free-vehi- cles cameras. Our aim was to identify scavenger assemblages and investigate depth related trends in community composition, species richness, and scavenging abundance. Twenty-one deployments ranging in depth from 250-4783 m yielded 37 taxa attracted to bait, including records of 5 fish species previously unknown to the Hawaiian Islands and the first occurrence of the family Zoarcidae. Cluster analysis of Bray-Curtis similarity of species peak abundance revealed 4 main depth groupings (250-500, 1000-1500, 3000-4000m) with significant separation between designated groups. A major faunal break was identified at the 500-1000m transition, where species turnover was greatest. A linear de- cline with depth was observed in scavenger relative abundance while no relationship was observed for species richness. Significant size differences (TL) with depth were found for 2 of the 4 fish species examined. Evidence of competition and predator-prey interactions between scavenging species was observed, indicating the need for caution when using baited cameras to index abundance.

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ATMOSPHERIC WEATHER NOISE AND THE TROPICAL PACIFIC SST VARIABILITY IN A CGCM

The interactive ensemble coupling strategy has been developed specifically to determine how noise impacts climate variability within context of coupled general circulation model (CGCM). This study examines the impacts of local versus non-local noise on the tropical Pacific sea surface temperature anomaly (SSTA) variability using three CGCM simulations. The control run uses the standard coupling strategy. In the first experiment, the interactive ensemble strategy is applied globally thereby reducing the noise at the air-sea interface at each grid point. In the second experiment, the interactive ensemble strategy is applied locally in the tropics only. By directly comparing the three CGCM simulations we investigate a role of local versus non-local noise on the ENSO statistics. Preliminary result indicates that a non-local noise in the North Pacific has a minor impact on the ENSO statistics including the frequency and amplitude.

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FOLLOWING A LAMINAR CHEMICAL TRAIL: STAYING ON TRACK AND BEING ON TIME

Both Tenora longicornis, a coastal marine copepod, and Hesperodiaptomus shoshone, a high- algal freshwater lake copepod, exhibit chemically-mediated mate-tracking of laminar trails designed to mimic the scent trails of their conspecific females. After trail discovery, initiated by the female the copepod precisely follows the 3-dimensional path taken seconds earlier by the female copepod mate. High-speed videography coupled with high-magnification Schlieren optics enabled us to visualize both the deformation of the odor signal and the movement of the male copepod in this behavioral assay. Males happily followed the trails we made and our observations show clear differences between the larval and adult-sized species. Tracking by the copepod around the scent trail with transport of the copepod along the path allows the aquatic micro-crustacean to have one or numerous sensors in the trail and others outside of it to facilitate edge detection using spatial sampling. We will discuss results of our 3-dimensional analyses to examine the orientation of the sensor with respect to the signal and body position to understand edge detection and error-correcting mechanisms of copepods.
inter-annual climate prediction system based on a coupled ocean and atmosphere general
POAMA (Predictive Ocean Atmosphere Model for Australia) is an intra-seasonal to
Oke, P.; Alves, O.; Yin, Y.;
most limiting nutrient and likely places a limit on chlorophyll biomass production.
induced processes bring offshore waters onshore and serve as annual and seasonal flushing
from this high N enrichment. The PREC ecosystem appears to have a buffering capacity
than climatological value, thus allowing much faster growth of baroclinic eddies.
STCC, which affect the EKE variation. The variation of EKE level was shown to be closely
in winter than in summer north of 20 ºN. The OGCM also reproduced two branches of the
with satellite data, with a maximum in spring and a minimum in fall, it revealed latitudinal de
- from 1900W to 1450E at the equator, 20N, and 20S. Although the sampling was focused on
seasonal flushing processes are used to assess the reanalysis. The Salinity and velocity fields form the POEDAS reanalysis are found to improve upon that of the
recent OI version. Intercomparisons between the POAMA ocean reanalysis and the
It has been suggested that coastal rivers deposit iron-rich sediments along the continental
which can later provide a source of bioavailable iron for coastal primary productivity.
Here we examine iron concentrations in sediments which were deposited along the northern California shelf following a major Eel River flood event in winter 2006. Concentrations of bioavailable and non-bioavailable iron were measured in sediment
cores collected shortly after the event in May 2006 and one year later in June 2007. Total
bioavailable iron in the 2006 flood layer was about 9.4±10g kg⁻¹ based on the average concen-
tration of samples and the flood layer depositional area. This represented roughly 24% of
the bioavailable iron required to support average annual productivity along the continental
shelf between the Eel and Klamath Rivers. Between 2006 and 2007 about 2.3×10⁶ g of this
bioavailable Fe was lost, suggesting that only 6% of average annual productivity could have
been supported. These results indicate that major flood deposits may only be a minor
source of bioavailable iron along California’s north coast.

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WHAT IS THE NEW ‘NEW’?
Much recent work has centred on quantifying how processes such as nitrogen fixation, mesoscale physics and dust deposition affect new nitrogen supply to the oligotrophic ocean. But how certain are we what ‘new’ nitrogen actually means? We are happy that organic material is recycled into nitrate at depth, but how can we define or measure the new nitrogen supply given the growing realisation that this nitrification happens in the euphotic zone too? We present modelling results demonstrating the significance of nitrification in surface waters: much nitrate taken up by phytoplankton in the oligotrophic gyres can be recycled in situ. We discuss the implications of this work for future observational and modelling approaches to ‘new’ production.

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WHAT DOES INFERRED OXYGEN UTILISATION RATE TELL US ABOUT OCEAN VENTILATION?
The oxygen utilisation rate (OUR) of biological activity in the ocean interior is relevant for studies over a range of oceanographic disciplines. As well as informing biogeochemical processes such as primary production and nitrogen fixation, physical processes such as ocean circulation and ventilation can be inferred from the distribution and use of oxygen. In our work, we use a full biogeochemical simulation of a medium-resolution GCM, OCCAM, to provide relevant tracer fields for the recent historical period. In conjunction with both real (CFCS, radiotracters) and idealised (ventilation, dye) age tracers, we then use the simulated biogeochemical fields to compare the inferred OUR along isopycnals with the actual modelled OUR. The region studied corresponds to Jenkins (1987)

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TEMPORAL AND SPATIAL VARIATIONS OF PHYTEPLANKTON PHOTOSYNTHETIC PHYSIOLOGY DURING THE SPRING DIATOM BLOOM IN THE WESTERN SUBARCTIC PACIFIC

Variations in photosynthetic parameters of phytoplankton during the spring bloom were investigated in the western subarctic Pacific. Photosynthetic parameters normalized by Chl. a concentration were drastically changed with development of the bloom. Light-saturated maximum photosynthesis rate ($P_{\text{max}}$) and light-limited slope ($a$) were almost constant in the first half of the bloom and then concurrently increased in the latter half of the bloom with a constant light-saturation index ($E_{\text{Ssat}}$). Maximum quantum yield showed similar temporal change. In contrast, maximum photochemical quantum efficiency of photosystem II ($\Phi_{\text{PSII}}$) increased in the first half and thereafter decreased. This difference means that the processes downstream of the photosystem II (destinations of redoxants, activities of enzymes, etc.) might control both $E_{\text{Ssat}}$ and $a^*$ during the bloom. It seems that the parallel increase in $P_{\text{max}}$ and $a^*$ resulted in massive spring bloom in the subarctic western Pacific. In general, ecosystem model uses constant $a^*$ regardless of environmental conditions and physiological state. Parallel change in $P_{\text{max}}$ and $a^*$ should be taken into account for the models reproducing ecosystem dynamics during spring diatom blooms.

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GEOPHYSICAL DISTRIBUTION OF THE FEEDBACK BETWEEN FUTURE CLIMATE CHANGE AND THE CARBON CYCLE

We examined climate–carbon cycle feedback by performing a global warming experiment using a coupled climate–carbon cycle model. The model showed that by the end of the 21st century, warming leads to a further increase in CO$_2$ level of 125ppmv. This positive feedback can mostly be attributed to land-based soil-carbon dynamics. On a regional scale, Siberia and Amazonia had intense positive feedback resulting from accelerated microbial respiration. Some regions, such as western and central North America and South Australia, experienced negative feedback, because enhanced litterfall balances the loss in soil carbon. The oceanic contribution to the feedback was much weaker than the land contribution, but the positive feedback in the northern North Atlantic was as strong as those in Amazonia and Siberia in our model. In the northern North Atlantic, the weakening of winter mixing due to warming causes a reduction of CO$_2$ absorption at the surface. Moreover, weakening of the formation of North Atlantic Deep Water causes reduced CO$_2$ subduction to the deep water. Thus, the mechanism of carbon-cycle contribution to climate–carbon cycle feedback varies by region.

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SURFACE CURRENT MEASUREMENT AND INTERIOR CURRENT ESTIMATION USING HF RADAR IN THE TSUSHIMA STRAIT

HF radar in the Tsushima strait shows large seasonal variations of a geostrophic Tsushima Warm Current (TWC) and wind driven flow (WDF). WDF is as large as TWC in some region to mask seasonal TWC variations of our interest. To reveal the TWC variation, WDF was investigated using moored ADCPs and HF radar in the strait. Despite a short (2 weeks) observation period of relatively calm and variable wind, a clockwise velocity spiral similar to a theoretical Ekman spiral was detected as the first mode of PCA. Monthly WDF and TWC at HF radar range was estimated using wind speed and bearing angle obtained from the detected spiral, and monthly geostrophic TWC was inferred by subtracting the estimated WDF from currents measured with HF radar. The inferred TWC shows clear seasonal variation: it is uniform in winter while it accompanies current counters on both sides of TWC in summer as a result of lee-side eddy generation behind large islands.

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CHANGES IN SIZE AND LIPID CLASS COMPOSITION IN EARLY DIAGENETIC PHYTEPLANKTON PHOTOSYNTHETIC PRODUCTS

Phytoplankton populations were incubated with NaHCO$_3$ under light for 1 day, followed by incubation in the dark for 29 days. The changes in the concentration of photosynthetic organic carbon (P-OC), lipid carbon (P-LC) and fractionated lipid carbon (P-LFC) were followed by mass spectrometer combined with an elemental analyzer. Changes in the P-LFC on the particulate fraction (>0.7μm) showed that PL degraded more slowly than TG, resulting in the higher remaining ratio of PL than TG. This result suggests that structural lipids are more stable than storage lipid. The contribution of dissolved fraction in P-OC, and P-LC increased with the progress of diagenesis, and the accumulation of stable lipid materials increased. The decomposition was confirmed. Although the size composition in P-OC readily approximated to that of OC in the ocean surface water, the contribution of dissolved fraction in P-LC on day 30 was obviously lower than that of LC in marine environments.

These results indicate that size compositions of LC are established by diagenesis of photosynthetic lipid with longer term and/or existence of lipid originated from other sources.

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ROLE OF FRESHWATER AND WATERWAY ON SALINITY REGIME AND TURBIDITY MAXIMUM ZONE IN LOWER HAN RIVER ESTUARY, KOREA

Environmental Fluid Dynamics Code (EFDC) is used to simulate an effect of major water ways and freshwater discharge on salinity features of the macro-tidal Han River Estuary in Kyunggi Bay, located in the middle of the western coast of Yellow Sea. Two-layer flow in the Yeonma Waterway and its corresponding salinity regimes are successfully illustrated. Compared with Yeomma Waterway, Gyodong and Seokme Waterways are proved to play an important role in draining freshwater into the Kyunggi Bay. Through Yeomma Waterway, less saline water in summer reaches into the Kyunggi Bay, and draws back in winter. This feature is well simulated by the model. Particularly in summer (July – September), the salinity at the Yeonma entrance shows a high gradient in salinity ranging from 15.0–25.0 psu, which is evaluated a well-balanced zone between the discharged freshwater and tidal forcings. On the other hand, the 20psu isohaline occupies the upper reach of the Yeonma Waterway in January, February and March, and starts growing from April to the Yeonma entrance. From September the 20psu isohaline ceases back to the location of January. Similar salinity profile of residual circulation in August shows the nation is drawn just above the Incheon Harbor, where is coincidently near the spoil ground. The predicted null point is expected to play a role in suspended sediment convergence, resulting in a Turbidity Maximum Zone. It is anticipated to expedite a negative effect of Incheon Harbor siltation.

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MERGING MOLECULAR AND OCEANOGRAPHIC PROCESSES IN THE SCOTIA SEA AND BEYOND

Although marine organisms with pelagic larvae are generally assumed to experience high larval retention and low levels of population connectivity, the majority of dispersal and effective gene flow is frequently unclear. Our research examines the influence of oceanographic and life history variation on gene flow in two species of Antarctic fish: Champsoscyphus gunnari and Nototenia rossii. These species are broadly sympatric in their distribution, but differ in aspects of life history that are expected to strongly affect their dispersal capabilities. We are employing two oceanographic models: a low-resolution global model to predict larval transport at the circumpolar scale, and a high-resolution regional model to investigate finer scale cross-shelf transport and retention around South Georgia. To compare predictions from the oceanographic models with patterns of population differentiation at both circumpolar and regional geographic scales, we are using mtDNA and microsatellite markers to examine historic and contemporary gene flow. Here we present data from oceanographic models in combination with genetic analyses, including evidence for inter-specific variation in mitochondrial gene flow at the circumpolar level.

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THE OBSERVATION EVIDENCE OF YELLOW SEA WATER CURRENT

Yellow Sea Warm Current (YSWC) is the main current in southern yellow sea in winter. This paper uses the data from 3 moorings in the path of the YSWC and the accordingly CTD station in the area to study the 3 dimension structure of YSWC. The results is (1) in the monthly average timescale the YSWC is stable northward from sea surface to bottom. (2) The upper layer of the YSWC bear strong influence of the winter cold surge, the direction of YSWC is often changed when circulation cold surge. (3) The lower layer of YSWC is also bear the influence of morphology but is stable northward and the currents is between 4cm/s to 10 cm/s. (4) The warm water in the bottom layer also indicate that the YSWC is stable near the bottom.
Salinity and the Ocean Water Cycle

One consequence of global warming is that the moisture holding capacity of the atmosphere should go up following the Clausius-Clapeyron relation. If the residence time of water vapor in the atmosphere (~ 9 days) remains unchanged, the stronger evaporation should lead to stronger precipitation and thus, an acceleration of the water cycle. As the oceans are the source of 80% of global evaporation and the sink for 78% of global precipitation, the accelerated water cycle would be important not only for droughts and flood variability, as well as the salinity at the surface. This study establishes a time series of evaporation-minus-precipitation over the oceans from 1979 to present by utilizing the new evaporation dataset from WHOI Objective Analyzed air-sea Fluxes (OAFlux) project and satellite precipitation from NASA Global Precipitation Climatology Project (GPCP).

We present an analysis of the variability and trends of ocean evaporation and precipitation, their response to the change in sea surface temperatures, their connection to the near-surface atmospheric circulation, and their relation to salinity trends in the ocean.

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Cross-shelf circulation in the yellow and East China seas

Satellite-ocean color data indicate a significant turbid water plume extending in the southeast direction from the southeast coasts of China to the shelf edge south of Cheju during fall-winter, suggesting significant cross-shelf currents in the Yellow Sea/East China Sea in winter that transport suspended sediments from the area of the old Huanghe mouth into the Okinawa Trough. Part of the turbid plume joins the Yellow Sea Warm Current to enter the northern Yellow Sea trough in winter. The turbid plume grows in fall, reaches its maximum expansion and intensity in winter-spring, and begins to decrease in summer. The cross-shelf currents are suggested to be associated with (1) the convergence of the Yellow Sea Coastal Current and the Taiwan Warm Current off the Changjiang mouth and (2) the time-dependent forcing of the northerly wind bursts that drives the intrusion of the Yellow Sea Warm Current.

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Sulfur Speciation in the Black Sea Anoxic Basin Sediments

We report solid phase sulfur speciation of four cores from anoxic basin sediments of the Black Sea. Cores were retrieved in April 2003 on board R/V Knorr and pyrite, acid volatile sulfides, zerovalent sulfur, organic polysulfides, humic sulfur and dithionite extractable iron content were determined. One major result is that pyrite - sulfur was the major phase in all cores (200-400 mmol/g dry), however zerovalent sulfur and humic sulfur were the second and third largest sulfur species and their concentrations reached up to about 100 mmol/g dry. Another major result is the anomalous enrichment of dithionite extractable iron and zerovalent sulfur in the central western basin core, and porewaters of this core were relatively depleted in dissolved sulfide. We hypothesize that the 1999 earthquakes in southwestern Turkey (magnitudes 7.2 and 7.4) triggered massive transpor of metal-oxide rich shelf sediments to the deep basin western, enriching the upper sediments in reactive iron minerals and causing subsequent oxidation of porewater sulfide. This process may affect the overall sulfur budget of the sea via preventing the build-up of sulfide over longer timescales.

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Mud Volcanoes in the South Caspian Basin

The locations of mud volcanoes have been mapped in the South Caspian Basin, offshore Azerbaijan. Most of the mud volcanoes are situated above anticlines that are complicated by faults. Those that develop on the flanks of structures are clustered in the southern portion of the study area. Syncline mud volcanoes are also concentrated in the south. More than 30% of the mud volcanoes have a distinctive collapse structure associated with them. Those with low relief and great areal extent are observed in the northeast. Four types have been recognized: concave, convex, flat and buried. These differences in morphology may result from the relationship between driving force (pressure) and material supply, width of conduit or could represent different stages in mud volcano evolution. Mud volcano formation is only the offshore Caspian is mainly controlled by tectonic forces and overpressured sediments. The volcanism is associated with high fluid pressure gradients (di-stresses) in the subsurface and not with diapirism as observed onshore. The mud volcano development commenced in the Lower Pliocene with the greatest activity during the Upper Pleistocene. The cycles of mud volcano activity coincides with time of high sedimentation rate, a regional contraction episode, and a major stage for hydrogen generation.

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HFCs and Other Halocarbons in the Deep Western Boundary Current

In the spring of 2007, we made measurements of HFC-22 and HFC-142b along with CFC-11 and CFC-12 on the Western Boundary Time Series (WBTIS) cruise. The CFC-11 and CFC-12 data showed elevated concentrations in the core of the upper DWBC between 1200m and 1800m that are only slightly higher than concentrations observed in 1997. This is consistent with the fact that the atmospheric concentrations of CFC-11 and CFC-12 leveled off and began to decline in the troposphere in the early 1990s. CFC concentrations cannot be used to date this young deep water current anymore. The HFC-22 data clearly shows elevated concentrations in the Deep Western Boundary Current. These concentrations are higher than the concentrations of the older deep waters of the North Atlantic, and they are substantially lower than any concentrations found near the surface. It will be possible to monitor the ages (ventilation times) for this current well into the next decade using the HFC tracers. By using the younger HFC tracers along with the older CFC-11 and CFC-12 tracers, we can extend ventilation ages to younger water masses.

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DYNAMICS OF CARBON DIOXIDE IN A MANGROVE-DOMINATED MARINE ENVIRONMENT

The importance of the coastal ocean in the regulation of anthropogenic carbon dioxide creates a need for a more robust understanding of the carbon dioxide dynamics of its constituent ecosystems. Despite their ubiquity in the tropics and subtropics, the carbon dioxide dynamics of mangrove dominated coastal environments are not well understood. A model of a mangrove dominated coastal environment was developed from diurnal studies of carbon dioxide exchanges conducted in Bermuda. Net ecosystem exchange, calcification, and air-sea gas exchange on a diurnal timescale were determined from spatially and temporally resolved measurements of carbon dioxide parameters including, temperature (T), salinity (S), total alkalinity (TA), total dissolved inorganic carbon (DIC), dissolved oxygen (DO), pCO2, and pH, in the bay system. The absence of riparian inputs and tidal creeks as relieved allowed for simpler modeling of the mangrove system itself. Previous data from Mangrove Bay along with the present study provides a time series of data to provide enhanced modeling and a richer understanding of the role of mangrove forests in subtropical and tropical coastal carbon regulation.

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PHOTobiOGEoCHEmISTRY, OR PROBING THE IMPACTS OF SUNLIGHT-INDUCED CHANGES IN NON-LIVING MATTER: EVOLVING QUESTIONS, RELEVANCE, APPROACHES, AND ANSWERS

Born in nitrogen cycle studies, photobiogeochemistry expanded in the 60s and 70s mainly by characterizing direct photolyses of known solutes (xenobiotics; nitrite, nitrate). Hybrid chemical-ecosystem model scientists began to appear. Sophisticated techniques (hplc, flash photolysis, pulse radiolysis) were first applied. Watershed 1977’s “firsts” included a thesis, a photobiogeochemistry review, and a report of singlet oxygen. The 80’s saw studies of CDOM, particles, and reactive intermediates (radicals, singlet oxygen). An interdisciplin-
ary, international conference (1983) facilitated networking and widened perspectives.

New insights sprung from systematic fieldwork (CO2, HOOC, CDOM fluorescence, surveys), in-situ experiments, and modeling. The late 80s and 90s brought a broader, deeper understanding of marine optics, the nature of CDOM, and of marine vs. river-

derived CDOM. CDOM photobleaching and photo-remineralization studies com-

mented on photobiogeochemical-microalgae connections and roles in the C cycle (DOC bioavailability, CO2, CO2) became fact. Particle studies proliferated. Now, despite its complexity, particle photochemistry appears poised for takeoff. Progress in molecular-
level studies of CDOM (structure, photophysics, bleaching) is accelerating. Constraining ocean-atmosphere connections involving DMS, COS, and CS2 seems feasible. Metal photobiogeochemistry is hot; iodine’s active photo-cycle bookmarks. Happy hunting!

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OCEANOGRAPHIC PROCESSES GENERATED BY HURRICANE IVAN

The Hybrid Coordinate Ocean Model (HYCOM) has been configured for the Gulf of Mexico (GOM) at 1/25th horizontal grid resolution and has been nested inside a basin-scale 1/12th Atlantic version of HYCOM. The nested GOM model is used to study tem-
perature variations, current patterns, transport variations, and two coastal-trapped waves (CTW).\n
Current meter data, hydrography and numerical simulations are analyzed in order to identify the circulation patterns in the Veracruz Coral Reef System (Sistema Arrecifal Veracru-

ano) in Veracruz, Mexico. Results show that the main forcing in the region is the Madden-Julian Oscillation (MJO). Statistical validation with observations consistently reveals improvement of the models as ones moves from unstable (chaotic or stochastically-
forced limit cycle), to neutral, to stable dynamical regimes. Motivated by this result, in the second part of this talk we will discuss the role played by the different components of the SF (such as westery wind bursts and the MJO) using hybrid and a fully coupled GCM.

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ON THE ORIGIN OF THE OBSERVED ENSO VARIABILITY

Three popular and controversial hypotheses that have been proposed to explain ENSO variability (EV) are H1: EV originates from deterministic low order chaos; H2: EV origi-

nates from the effect of stochastic forcing (SF) acting on a self-sustaining system; and H3: EV and variability originates from a stable system maintained by SF. In the first part of this talk we evaluate these hypotheses in a parallel way of thinking by deriving two stochastic models (SM1 and SM2) from the most outstanding example of a chaotic ENSO system: the Cane and Zebiak (CZ) model. In contrast with previous studies using the CZ model, SM1 and SM2 can admit SF that decorrelates as fast as the observed SF does (down to 3 days). The SF used in the models is estimated from observations and syn-

thetic time series are derived using a method that preserves key characteristics of the SF as its seasonality, spatial and temporal scales, and the structure and eastward propagation of the Madden-Julian Oscillation (MJO). Statistical validation with observations consistently reveals improvement of the models as ones moves from unstable (chaotic or stochastically-
forced limit cycle), to neutral, to stable dynamical regimes. Motivated by this result, in the second part of this talk we will discuss the role played by the different components of the SF (such as westery wind bursts and the MJO) using hybrid and a fully coupled GCM.

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FORAGING LEACH’S STORM-PETREL (OCEANOGRAMA LEUCORHA) DO NOT REQUIRE VOCALIZATIONS TO RELOCATE THEIR UNDERGROUND BURROW

Leach’s Storm-Petrels, Oceanograma leucorha, are burrow-nesting seabirds that breed on remote islands. Each pair of Storm-Petrels incubates one egg, each bird taking turns on the egg while its partner forages at sea. Foraging trips take approximately four days and always begin and end at night. Exactly how the seabirds are able to distinguish their burrow from thousands of others is not well-known. Some species of Storm-Petrels are thought to be aided by highly characteristic vocalizations that can clearly be heard at night, emitted both by birds flying around the colony and birds underground (Taoda and Okumura 1990). We recorded behavior in one nest and focused on analyzing calling behavior. Chatter calls and Purr-calls, inside and outside the burrow and the movements of the incubating Storm-Petrel. We observed the incubating bird take ~60+ breaks for short periods on most nights while its partner was foraging. When the foraging bird returned, during three out of four changeover events, there were no vocalizations heard from the incubating partner, indicating that the returning bird did not necessarily require vocalizations to locate its burrow.

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CIRCULATION ON THE VERACRUZ CORAL REEF SYSTEM DURING AUTUMN-WINTER 2006-2007

Current meter data, hydrography and numerical simulations are analyzed in order to identify the circulation patterns in the Veracruz Coral Reef System (Sistema Arrecifal Veracruzano) in Veracruz, Mexico. Results show that the main forcing in the region is the along coast wind stress. Tides contribution is one order of magnitude smaller and the contribution of eddies next to the shelf break seems to be negligible. Strong currents ~ 1 m/s are observed during strong wind events associated with norther.
sargassum is photodegraded under simulated sunlight with half-lives of 25–30 hours, and the spectral slope coefficients of its UV-visible absorption spectra (α ~ 16–35 nm) are in the range of 5-values generally observed in ocean water. Sargassum derived CDOM thus likely contributes significantly to remotely sensed observations of ocean color and to attenuation of solar UV radiation in the upper ocean. (Although this work was reviewed by EPA and approved for publication, it may not necessarily reflect official Agency policy).

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CARBONATE SYSTEM AND SEA-AIR CO2 FLUXES IN SPRING IN THE YELLOW SEA

The Yellow Sea (YS), along with the East China Sea (ECS) to its south represents an important continental shelf region of the Northwest Pacific Ocean. Two world major rivers (Yangtze and Yellow Rivers) discharge into the region. It is also one of the 64 most productive large marine ecosystems of the world, and has received substantial attention in the international research community. However, information regarding the distribution of carbonate system in the YS, which allows us to better evaluate the regional air-sea CO2 fluxes in the YS is limited. This study thus implies that multiple processes may be responsible for the air-sea CO2 exchange in these two neighboring coastal seas. We emphasize that a better spatial coverage is still needed to better constrain the air-sea CO2 fluxes in the two important coastal seas, and in global continental shelves at large.

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DECLADAL AND MULTI-DECLADAL VARIABILITY OF ATLANTIC SUBTROPICAL CELLS AND THE THERMALINE CIRCULATION

The tropical Atlantic is a crossroad of the Thermohaline Circulation (THC) and Subtropical Cells (STCs). It has been hypothesized that part of the THC return flow and STC upwelling in tropical Atlantic perturb the sea surface temperature (SST), which has important controls on the regional air-sea CO2 exchanges in these two neighboring coastal seas. We emphasize that a better spatial coverage is still needed to better constrain the air-sea CO2 fluxes in the two important coastal seas, and in global continental shelves at large.

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the western boundary STC of the Southern Hemisphere. It is found that the Northern and Southern interior STCs are generally in phase with those related to the deep oceanic variations of the Atlantic Niño. The western boundary STC, which we define as the NBC/NBUC flow within STC density classes, is weaker than and coherent with variability in the deeper flows, suggesting that the variability associated with wind-driven STC is overshadowed by the deep meridional overturning circulation at this latitude. A possible role of the mid- tidewater current variability of the NBC/NBUC in the tropical Atlantic meridional SST gradient mode and the Atlantic Multidecadal Oscillation (AMO) will be discussed.

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COOPERATIVE KALMAN FILTER FOR OCEAN FUNCTION TRACKING USING AUTONOMOUS UNDERWATER VEHICLES

Ocean features below the surface are typically time varying and difficult to locate. We develop a method that combines measurements from multiple autonomous underwater vehicles to localize various ocean features. Vehicle movements are coordinated to track the features for in-situ observation. We design a cooperative Kalman filter to reduce measurement noise and spatial variations in sensor data to achieve results suitable for data assimilation. The motion coordination algorithm is able to take advantage of the nowcast or forecast made by ocean models to effectively navigate the vehicles. Simulation results are presented to demonstrate the effectiveness of our method in revealing structures of underwater temperature or salinity fields.

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ON THE CURRENT-WAVE WIND INTERACTION IN THE SHOALING WAVE EXPERIMENT

This study presents two cases of the wave-current-wind interaction during the Shoaling Waves Experiment (SHOWEX). Wind, wind stress flux and wave data were obtained from Air Sea Interaction Spar (ASIS) buoys. Surface currents were measured by a High-Frequency Ocean Surface Current Radar. Two distinct types of wave-current-wind interaction were observed in the presence of the strong along-coast current from Chesapeake Bay. Current results in waves at the peak of wind-sea spectra shifting away from the wind direction; furthermore the buoyancy current front was also found to steer the stress away from the mean wind direction. As the strong along-coast current moved toward coast, the whole experiment domain was under uniform current. The wind stress and high frequency waves were observed to be steered away from the mean wind direction by the current. This effect has also been confirmed by data from the SeaWind scatterometer on board the QuikSCAT satellite. The above findings have been compared with the wave-current theories. The wind refraction under both shear current and uniform current cannot be explained by existing theories completely; therefore more work need to be done in wave-current interaction. The wind stress shifting observed from ASIS and QuikSCAT shows the wind direction retrieved from scatterometer lies between true wind direction and current direction, which is in agreement with the results from some recent studies.

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ASSESSMENT OF THE ECCO2 HIGH RESOLUTION GLOBAL-OCEAN AND SEA-ICE DATA SYNTHESIS USING THE CLIVAR/GODEA GLOBAL SYNTHESIS AND OBSERVATIONS PANEL METRICS

The Estimating the Circulation and Climate of the Ocean, Phase II (ECO2) project aims to produce an increasingly accurate global ocean and sea-ice data synthesis at resolutions that start to resolve ocean eddies and other narrow current systems, which transport heat, carbon, and other properties within the ocean. ECCO2 data synthoses are obtained by least squares fit of a global full-depth-ocean and sea-ice configuration of the Massachusetts Institute of Technology general circulation model (MITgcm) to the available satellite and in-situ data. This presentation assesses the first ECCO2 data synthesis versus a series of metrics established by the CLIVAR/GODAE Global Synthesis and Observations Panel. These metrics include misfits from sea surface height observations, climatological and in situ temperature and salinity profiles, meridional transports, heat and salt content, sea level changes, transports through key regions, water masses, sea surface temperature and transport indices, and surface fluxes.

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MULTI-SATELLITE BLENDED SURFACE MARINE PRODUCTS AND THEIR APPLICATIONS

Multi-satellite blended products of sea water surface (SWW) and temperature (SST) and their applications are presented. In addition to the traditional ship and buoy observations, SWW and SST have been operationally observed from multiple long-term satellites. Satellite observations provide superior spatial-temporal coverage, while in-situ observations provide the ground-truth for satellite bias correction. Blended products from all these resources increase both global coverage and resolution and reduce bias and analysis errors. Global 0.25° gridded products are available: 6-hourly sea winds from July 1987, and daily SST from Jan 1985 onward. In addition to their general use in physical oceanography, these products have applications include users in climate monitoring, tritium-based indices for fisheries/ecosystem, ocean natural mineral slick monitoring, and other areas such as marine aviation and transportation incident investigations, wind/wave power generation research, and education/outreach. The products are accessible through ftp, as well via inter-operable web-based data servers that provide for easy data access, visualization, subsetting and downloading in user-preferred formats, which increases the user community that can benefit from these products. Details can be found at http://www.ncdc.noaa.gov/oa/satellite.html.

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IMPACT OF THE ATLANTIC MULTIDEcadAL OSCILLATION ON NORTH PACIFIC CLIMATE VARIABILITY

Large-scale multidecadal climate variability in the North Pacific, such as the Pacific Decadal Oscillation (PDO), has been observed during the 20th century. Using a hybrid version of the GFDL coupled climate model, we show that the Atlantic Multidecadal Oscillation (AMO) provides a source of multidecadal variability to the North Pacific, and needs to be considered along with other forcings for North Pacific climate variability and change. The North Pacific response, which lags the North Atlantic forcing by several years, is generated through atmospheric teleconnections originating in the Atlantic. Oceanic dynamics and positive air-sea feedback over the North Pacific enhance the response. The results indicate that a North Pacific regime shift, opposite to the 1976-77 shift, might occur now a decade after the switch of the observed AMO to a positive phase around 1995. The origin of the AMO is highly debated. Some suggest that it is driven by Atlantic meridional overturning circulation (AMOC) variations, while others think it is induced by changes in radiative forcing. Here the mechanism, attribution and various climate impacts of the AMO will also be discussed.

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IMPACTS OF FRESHWATER FLUX FORCING ON SALINITY AND INTERANNUAL VARIABILITY IN A HYBRID COUPLED MODEL OF THE TROPICAL PACIFIC

In the tropical Pacific, ocean salinity has been proved to be important to the tropical dynamics and El Niño-Southern Oscillation (ENSO). Previously, most modeling studies have focused on the roles of forcing components of atmospheric winds and heat flux; the effect of freshwater flux (FWF) forcing and its related feedback have been examined mostly in ocean-alone models. Here we use a hybrid coupled model (HCM) of the tropical Pacific climate system, constructed from an oceanic general circulation (OGCM) and a simple atmospheric model. Interannual anomalies of evaporation minus precipitation, (E-P)anom, are constructed statistically by a SVD analysis, relating the FWF variability to SST anomalies. The constructed HCM can well reproduce interannual variability associated with ENSO in the tropical Pacific. Coupled sensitivity experiments are performed with different representations of FWF forcing within the simplified atmospheric model, consisting of climatological and anomalous FWF fields both [i.e., (E-P)clim+(E-P)anom], the climatological field and precipitation anomalies [i.e., (E-P)clim-Panom], the climatological field and evaporation anomalies [i.e., (E-P)clim+Eanom], and the climatological field only [i.e., (E-P)clim], respectively. It is demonstrated that FWF forcing can have a significant modulating impact on ENSO, with more realistic simulations of interannual SST variability in the eastern tropical Pacific (e.g., the amplitude and structure).

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IMPACT OF AN ENSEMBLE CIRCULATION-DEPENDENT INFLATION FILTER ON OCEANIC CLIMATE DETECTION WITHIN ‘BIASED’ COUPLED GCMs

This study serves as the first step of our efforts for discovering the impacts of fully-coupled GCMs’s biases on Oceanic Data Assimilation. We design first an ‘imperfect twin’ experiment using two coupled GCMs that are biased with respect to each other, in which, based on the 2005 ARGO network, observations are drawn from one coupled GCM and assimilated into the other. Using a standard ensemble filter, the assimilating imperfect model successfully recovers the upper-ocean temperature and salinity from observations, but fails to converge in the deep ocean, where model bias is relatively large compared to the ocean’s intrinsic variability represented by the ensemble spread. The inconsistency between the
well-constrained upper and poorly-constrained deep oceans generates spurious currents throughout the water column. To relax this problem, we introduce an ensemble circulation-dependent inflation filter (ECdF) which uses a pre-computed anomaly’s variance to inflate the covariance whenever a small ensemble spread would otherwise make the model “over-confident.” The ECdF greatly improves filtering performance, reducing global deep-ocean RMS errors by 30–40% for temperature, 40–50% for salinity, 70% for horizontal currents and 80% for vertical velocity. Consistently, the estimate accuracy on meridional overturning circulation, pycnocline depth and ENSO variability is dramatically enhanced.

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APPLICATION OF CROSS FLOW ULTRAFILTRATION FOR ISOLATING EXOPOLYMERIC SUBSTANCES (EPS) FROM MARINE DIATOMS

Three techniques, i.e., 1) ethanol precipitation, 2) stirred cell ultrafiltration, or 3) cross-flow ultrafiltration, both 2) and 3) followed by stirred cell diafiltration were compared for their effectiveness of quantitatively isolating exopolymeric substances (EPS) from the marine diatom Amphora sp. The results showed that ethanol precipitation was not effective in isolating and concentrating EPS from the seawater medium. Stirred ultrafiltration appeared best for harvesting EPS from this diatom. However, because of its limitations in terms of time and volume, cross-flow ultrafiltration was further improved by stirred cell diafiltration and a three-step cartridge soaking. Thus, the yield of the two ultrafiltration methods (3.0 mg-glucuronic acid/l) became comparable, and no EPS was found in the permeate. Two extracellular polysaccharides with similar molecular weights of 1000 kDa could be isolated from Amphora sp. These results are important for investigations of the gel-formation capacity of microbially produced EPS in marine environments.

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MODELING OF FRESHWATER PATHWAYS IN NEW YORK BIGHT

This study is to investigate the dispersal process of Hudson River plume on New Jersey shelf which is crucial for the local biogeochemical processes. We used ROMS with three major forces (atmospheric forcing, ambient current, and tides) to study the mean dynamics and freshwater dispersal on the mid- and outer-shelf. The model was verified through comparison with field data and CODAR observations. Comparison of simulations driven by various combinations of the three forces quantified the influence of the forces on the freshwater spreading. Ekman transport and geostrophy were identified as the two major processes in shaping the surface mean circulation, while it is the ambient current that drove the mean circulation in deep. We found three freshwater pathways, and the mid-shelf pathway explained the spread of the freshwater from the Hudson Valley. The comparison identified wind as the primary force to push the freshwater onto mid- and outer-shelf. Hudson Valley was showed to be a barrier for the freshwater transport and its role was magnified by the ambient current. Tides had minor impact on both mean circulation pattern and freshwater dispersal.

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SOUTHWARD TRANSPORT THROUGH THE TAIWAN STRAIT DUE TO TYPHOONS

As is well known, the northward transport through the Taiwan Strait is weak or even reversed in winter due to strong northeasterly monsoon while the northward transport is very strong during summer and early autumn before the northeasterly monsoon bursts. This paper is focused on the transport caused by typhoons in the Taiwan Strait. Numerical studies, using a two-way nested coupled tide-surge model (NCTSM), show that the transports caused by typhoons moving along the four devised routes, which are representative of most typhoons affecting the Taiwan Strait, direct southward. The southward transports due to typhoons were confirmed by the buoy observing data during the period from 27 Aug. to 5 Oct. 2005 when five typhoons separately affected the Taiwan Strait and they were related to local effect and/or remote effect of the wind fields of typhoons. These results indicate that the typhoon, affecting the Taiwan Strait, could induce southward transport through the Taiwan Strait, which might weaken or even reverse the well-known northward transport.

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RETRIEVE SIZE DISTRIBUTIONS OF PHYTOPLANKTON SUSPENDED PARTICLES AND DETRITUS FROM VOLUME SCATTERING FUNCTIONS IN A COASTAL WATER OFF NEW JERSEY

Phytoplankton, suspended particles, and detritus are major particulate components in a coastal environment and knowledge of spatial and temporal variations of their size distributions will provide important insight into understanding coastal dynamics of physical, chemical and biological processes. Traditional particle sizing and counting devices, such as Coulter counter or an infrasound system, while each has their own limitations, cannot differentiate among different particles and can only provide a bulk estimate of the overall size distribution. Volume scattering function measures the angular variation of light scattered by a water volume, within which each component contributes additively. The contribution by each component, in turn, is a function of their size distribution, concentration, and refractive index. Here we report an inverse modeling approach using the measured volume scattering functions to derive the number densities and size distributions of major optically important water constituents simultaneously. The method will be evaluated by comparing the results with the estimated by other instruments.

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EXCHANGE FLOW BETWEEN OPEN WATER AND AN AQUATIC CANOPY

Convective exchange produced by spatial heterogeneity in water temperature plays an important role in the transport of nutrients and other substances, in particular, between the littoral and pelagic regions of surface water bodies. During the daytime, the emergent portion of aquatic plants blocks the solar radiation from entering the water beneath them. A temperature difference is established due to the uneven distribution of the solar energy between an open and vegetated region. The temperature difference can generate density difference that can drive exchange flows between the open and the vegetated regions. A series of experiments has been conducted to investigate the exchange flow between an open and vegetated region of water, in which a random array of cylinders was used to simulate an emergent canopy. The flow pattern was captured using a CCD camera. It has been found that the open velocity entering the open region maintains a constant speed while flow into the vegetated region decelerates gradually due to additional drag. The discharge rate is controlled by the canopy region and decreases over time and with increasing drag.

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EASTERN PACIFIC FORCING OF ENSO SEA SURFACE TEMPERATURE ANOMALIES

Previous studies have described the impacts of wind stress variations in the eastern Pacific on sea surface temperature (SST) anomalies associated with the El Niño/Southern Oscillation (ENSO) phenomenon. However, these studies have usually focused on individual El Niño events and have not considered impacts on La Niña—the cold phase of the ENSO cycle. In this paper we examine effects of wind stress and heat flux forcing on interannual and interdecadal variability of ENSO and tropical Pacific from sensitivity tests using ocean general circulation model over the period from 1980 to 2002. Results indicate that in the Niño-3 region (5°N-5°S, 90°-150°W) a zonal wind stress anomaly of 0.01 N m-2 leads to about 1°C SST anomaly and that air-sea heat fluxes tend to damp interannual SST anomalies generated by other physical processes with a rate of about 40 W m-2 per 1°C. These results systematically quantitatively confirm the expectations from previous event-specific numerical model studies that local forcing in the eastern Pacific can significantly affect the evolution of both warm and cold phases of the ENSO cycle. The results are also consistent with a strictly empirical analysis that indicates a wind stress anomaly of 0.01 N m-2 leads to about 1°C SST anomaly in the Niño-3 region.

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SEA BREEZE DRIVEN OCEAN RESPONSE ON A STRATIFIED CONTINENTAL SHELF AT THE CRITICAL LATITUDE

The coastal ocean response to sea breeze forcing in the northwest Gulf of Mexico is investigated using observations and numerical simulation. The response depends significantly on a number of factors including the characteristics of sea breeze, river-associated stratification, latitude, and coastal and bathymetric curvature. The observations indicate that the river-associated stratification can significantly alter the oceanic response and this varies interannually and spatially. The maximum diurnal oceanic response usually occurs in June when there is a shallow mixed layer, strong stratification, and an approximately 2-week period of continuous sea breeze forcing. Freshwater events like, “the Great Flood” of the Mississippi River in 1993, deepen the summer mixed layer and reduce oceanic sea breeze response during that year. Numerical experiments indicate that offshore freshwater flux associated with sea breeze forcing depends significantly not only on stratification and latitude, but also the curvature of the coast and topography. Basin wide near inertial response in the form of propagating Poincare waves occurs in the numerical simulations but is limited to latitudes below 30°N, making the Gulf of Mexico unique in this regard.

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INTERACTION OF EDDIES WITH SHELF WATER IN A PARTIALLY ENCLOSED BAY

Interactions of point vortices with a step-like topography are examined through the use of a barotropic, quasi-geostrophy, f-plane, contour dynamics model and within a domain

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where the shallow region, as bounded by the topography on the north and indented coastlines on the south, has the shape of a bay. Anticyclone- and cyclone-induced interactions show remarkable differences in phenomena such as formation of topographic eddies, cross-shelf water exchanges and motion of vortices, etc. Two basic mechanisms, especially their relative importance, control the process: one is the advection of the potential vorticity front by the vortex and the other one is the propagation of topographic Rossby waves along the shelf-break. When the vortex is an anticyclone, the two mechanisms counteract each other as they force frontal deformations into opposite directions; while for a cyclone, the two work together pushing deformations eastward. This asymmetry is responsible for quite different behaviors between anticyclone- and cyclone-involved interactions.

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HURRICANE GENERATED WAVE AND WAVE-INDUCED LOADING ON COASTAL BRIDGES DURING HURRICANE IVAN(2004)

Hurricane Ivan (2004) caused significant property damage and loss of lives as it passed through the Caribbean Sea and Southeastern US. Maximum storm surge reached 6m along the Florida coast, while waves reached 20m in height and 17s in period offshore, and 1.6m in height and 4s in period inside the shallow Escambia Bay where the I-10 Bridge collapsed, apparently due to the high surge which reached the bridge deck and the wave force exceeded the connection force of the bridge. In this study, a high-resolution storm surge modeling system CHIS-SMMS is applied to simulate the waves, currents, and storm surge during Hurricane Ivan (2004). Simulated storm surge and waves are successfully validated by comparison with observed data of wave, water level, and high water mark. With validated surge and wave force, the wave loading on the I-10 Bridge is calculated during Hurricane Ivan. The results reveal that the total wave force on top of surge is 334 tons, sufficient to overcome span weight and its bolted connection and push bridge deck into water. Significant 3D flow features are simulated.

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TSUNAMI INUNDATION STUDY WITH UNSTRUCTURED GRIDS: BENCHMARKING AND APPLICATION TO THE CASCADIA SUBDUCTION ZONE

Existing inundation models for assessing tsunami hazards predominantly use structured grid techniques. For realistic applications, models based on unstructured grids have distinct advantages over structured grid models because they resolve the effects of complex geometries and bathymetry more efficiently. Here we present an efficient, robust and accurate inundation model based on unstructured grids. The model, SELF, uses a hybrid finite-element and finite-volume method and semi-implicit time stepping. The advection in the momentum equations is treated with the Eulerian-Lagrangian method (ELM). The use of the semi-implicit time stepping and ELM eliminates most numerical stability constraints, and results in greater efficiency. The wetting and drying process is incorporated in the model in a straightforward way, thus making it suitable for tsunami inundation studies. The model has been benchmarked with the first two problems published on the 3rd International Workshop on Longwave Runup Models. Recently we have applied it to assessing tsunami hazards along and off the California coast. Oregon using inputs from source models that explore the variability of Cascadia Subduction Zone earthquakes. Here we present preliminary comparisons with field mapping of the extent of paleotsunami deposits. The ultimate goal is to design a new generation of digital inundation maps for coastal communities in Oregon using state-of-the-art technology.

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NUMERICAL SIMULATION OF THE GENERATION OF NONLINEAR INTERNAL GRAVITY WAVES IN THE SOUTH CHINA SEA

When barotropic tides interact with topography, internal tidal beams form when the ratio of large-amplitude internal tidal beams or if they emerge from nonlinear waves. Two basic mechanisms lead to the formation of nonlinear wave trains, particularly during strong spring tides. While numerous observations indicate the presence of nonlinear wave trains that appear to emerge from the Luzon Strait on the eastern side of the South China Sea, it is not clear from these observations whether the waves evolve from large-amplitude internal tidal beams or if they emerge from nonlinear waves of deformation. We present results of both two- and three-dimensional simulations of nonlinear internal gravity waves in the South China Sea using the nonhydrostatic model SUNTANS in order to highlight different regimes under which the different waves can form. Results are compared with in-situ and remotely-sensed data for verification and to aid in understanding of the governing physical processes. This work was supported by ONR Award N00014-05-1-0294.

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THE BARRIER LAYER IN THE EAST CHINA SEA IN SUMMER

In summer, in the East China Sea where the temperature is roughly homogeneous in the upper layer, vertical variations of salinity may be responsible for significant density stratifications. In this paper, based on the high resolution CTD data from 1980 to 2006, we show that the fresh surface water from Yangtze River discharge play an important role in determining the density structure. Moreover, water mass with high salinity carried by the Taiwan Warm Current and Kuroshio also influence the density structure. The meeting of these fresh water and salty water may induce a strong halocline in the upper layer. This halocline induces a pycnocline that acts as a barrier layer for mixing between the surface water and the subsurface water. The barrier layer occurrence is strongly related with the Yangtze River discharge. When the discharge is large or small, the barrier layer is wide and thick or is thin and only occurs in limited area.

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A HANDS-ON PRIMARY SCHOOL ACTIVITY THAT SHOWS PHOTOBLEACHING OF CDOM AND THE USE OF REPlicATES AND CONTROLS, AND RELATES PHOTOBLEACHING TO THE WATER CYCLE

Chromophoric Dissolved Organic Matter (CDOM) is an important component in freshwater and marine ecosystems that plays multiple roles in biogeochemical cycles. Photobleaching of CDOM (reduced absorption of incoming solar radiation caused by CDOM photodegradation) increases the penetration of UV and visible radiation in the water column, with important consequences for the biotic community. We designed an intuitive, quick, and safe hands-on experiment to help primary school students visualize and understand photobleaching by using commercially available colored drinks as CDOM analogs. The class reviews the water cycle, emphasizing inputs of color from soil to rivers and then to the ocean. Students then see samples of various drinks in transparent plastic bags (some leak, making need for replicates obvious) and sit them in sunshine for several hours on a sunny day. By comparing the colors of samples exposed to sunshine with controls without exposure, students easily see the photobleaching of some chromophores. We tested this activity multiple times in a local elementary school. The school enrichment teacher’s evaluation of its educational suitability, requirements, and pluses and minuses will be presented.

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INTEGRATING SATELLITE IMAGERY AND NUMERICAL MODELS FOR COASTAL SEDIMENT TRANSPORT STUDY

Mobile Bay located on the north Gulf Coast is a broad and shallow estuary. Its bottom sediments are highly sensitive to winds because of the shallow water depth. The objective of our study is to quantify the re-suspension and transport of fine sediments in a shallow estuary by integrating numerical models with satellite imagery. We have employed the Moderate Resolution Imaging Spectroradiometer (MODIS) product that has 250-m spatial resolution and 12-bit spectral resolution. The total suspended sediment solid (TSS) is inferred from the satellite imagery according to a new relationship between MODIS red-channel data and in-situ measurements. However, the effectiveness of the inferred TSS is limited to the sea surface and the temporal resolution is also limited by the satellite scanning frequency and cloud contamination. Therefore, output from numerical models is utilized to fill the gaps in time and space. A sediment transport model has been integrated with a 3D circulation model and a spectral wave model as well as satellite imagery to gain insight into the temporal and spatial variability of suspended sediments. The methodology for combining remote sensing and numerical models can be used to study sediment dynamics in areas with limited access.

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LONG-RANGE PROPAGATION OF THE SEMIDIURNAL INTERNAL TIDE NORTHWARD FROM THE HAWAIIAN RIDGE

In the experimental Internal Waves Across the Pacific (IWAP) Spring 2006, six moorings were deployed along a 1400-km-long section from 25-37°N, while simultaneous spatial surveys were conducted in two northbound and two southbound transits. The section was selected to follow an internal-tide beam emanating from French Frigate Shoals. At each mooring, the internal tide had a spring-neap cycle, consistent with the barotropic tidal forcing at the Hawaiian ridge lagged by the expected travel time for a mode-1 wave. The

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energy flux decreased from ~4 kW/m at MP1 to ~1 kW/m at MP6. Dissipation estimates indicate ~24% of the internal-tide flux was removed within 100 km of the critical latitude, an enhancement that we attribute to PSI. The flux was also estimated using a new phase-adjustment method and an extended T/P altimeter dataset. The altimetric and moored fluxes were in good agreement. The coherent and incoherent internal tides were calculated from historical and IWAP moorings, revealing the influence of the mesoscale eddy field on internal tide propagation. The Doppler compressed expanded internal tide was observed from shipboard measurements in the southbound/northward transits.

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MODELING OF AGULHAS RING INJECTION INTO THE SOUTH ATLANTIC DURING GLACIALS AND INTERGLACIALS

Recent proxies suggest that, at the end of the last glacial, there was a significant increase in the injection of Agulhas rings into the South Atlantic (SA). This event brought about a dramatic increase in the salt influx from the Indian Ocean into the SA helping to re-start convection in the North Atlantic and leading to the termination of the Younger Dryas. We propose a mechanism through which large variations in ring production take place. We develop a semi-analytical non-linear 1½-layer model of current retroreflection from non-zonal coastline on the β-plane, supposing the outflow to be zonal. Based on this model, we define a critical value of the coastline slant γ, implying restricted possibilities for ring detachment from the retroreflection area in the 'supercritical' range of y. In the case of Agulhas rings, region rings can produce only if the retroreflection occurs beyond specific latitude where the angle is critical.

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CIRCULATION INFLUENCES ON WEST FLORIDA SHELF RED-TIDE EVENTS: FINITE VOLUME MODEL APPLICATIONS TO SHELF-ESTUARY INTERACTIONS

The three-dimensional, baroclinic circulation of the West Florida Shelf (WFS) as driven by tides, rivers, winds, and heat fluxes, is investigated in relationship to K. pseudoannulata. The eddy movements are a result of the strong wind and tidal forcing, which allow the red-tide evo-

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A MECHANISM FOR THE BIFURCATION OF THE TSUSHIMA WARM CURRENT IN THE JAPAN/EAST ASIA

By using POM, we investigate the mechanisms of two branch currents associated with the Tsushima Warm Current (TWC) in the Japan/East Sea (IES). The results from model simulations reveal that these two branch currents are both forced by the Kuroshio Current (KC) along Japan's east coast. The friction exerted by the KC induces a considerably pressure

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DISTRIBUTIONS AND DYNAMICS IN MARINE SEDIMENTS

CO₂ distributions in marine sediments are closely coupled to early diagenic reactions and transport processes, including the remineralization of organic carbon and the dissolu-

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SEASONAL INFLUENCE OF INDONESIAN THROUGHFLOW IN THE SOUTHWESTERN INDIAN OCEAN

The influence of the Indonesian Throughflow (ITF) on the dynamics and the thermodynamics in the southwestern Indian Ocean (SWIO) is studied by analyzing a forced ocean model simulation for the Indo-Pacific region. The warm ITF waters reach the southwestern Indian Ocean from August to early December, with a detectable influence on weakening the vertical stratification and reducing the stability of the water column. As a dynamical consequence, baroclinic instabil-

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TRACERS AND CLOCKS FOR EXAMINING PARTICLE SOURCE FUNCTIONS, DYNAMICS AND ACCUMULATION IN THE URBANIZED LOWER HUDSON RIVER ESTUARY

Estuaries are dynamic systems that serve as particle, sediment and contaminant traps at the land-ocean interface. Particle source functions, dynamics, and accumulation patterns in urbanized estuaries are not only affected by natural processes, but also by human activi-

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TWO-DIMENSIONAL PCO₂ DISTRIBUTIONS AND DYNAMICS IN MARINE SEDIMENTS

CO₂ distributions in marine sediments are closely coupled to early diagenic reactions and transport processes, including the remineralization of organic carbon and the dissolu-

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MICROBIAL WATER QUALITY AT A SUBTROPICAL BEACH SETTING: A TWO-DIMENSIONAL PCO₂ DISTRIBUTIONS AND DYNAMICS IN MARINE SEDIMENTS

CO₂ distributions in marine sediments are closely coupled to early diagenic reactions and transport processes, including the remineralization of organic carbon and the dissolu-

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SEASONAL INFLUENCE OF INDONESIAN THROUGHFLOW IN THE SOUTHWESTERN INDIAN OCEAN

The influence of the Indonesian Throughflow (ITF) on the dynamics and the thermodynamics in the southwestern Indian Ocean (SWIO) is studied by analyzing a forced ocean model simulation for the Indo-Pacific region. The warm ITF waters reach the southwestern Indian Ocean from August to early December, with a detectable influence on weakening the vertical stratification and reducing the stability of the water column. As a dynamical consequence, baroclinic instabilities and oceanic intraseasonal variabilities (OISVs) are enhanced. The temporal and spatial scales of the OISVs are determined by the ITF-modified stratification. Thermodynamically, the ITF waters influence the subtle balance between the stratification and mixing in the SWIO. As a result, from October to early December, an unusual warm entrainment occurs and the SSTs warm faster than just net surface heat flux driven warming. In late December and January, signature of the ITF is seen as a relatively slower warming of SSTs. Finally, a conceptual model for the processes by which the ITF impacts the SWIO is proposed.

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fuller use with better time resolution. A microbial water quality model is constructed by coupling a coastal circulation and transport model (CACE3D) with a microbe fate model. The modeling domain is a bayside beach in Miami, Florida. The hydrodynamic model results are compared with current velocity measurements. For the microbe fate model, our work shows that human shedding, dog feces and rainwater runoff are major sources; also die-off rate is extracted from experiment and literature. However, there are some modeling issues (e.g., time term such as location and number of sources plus dog and runoff). We approach this problem by performing Monte Carlo simulation: define location and number of source terms as random variables, determine their probability distribution by analyzing high resolution camera images of the beach, run the model using random input terms and analyze the results.

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META-TRANSCRIPTOME OF A EUKARYOTIC MARINE PLANKTON COMMUNITY IN TAMPAA BAY, FL

A cDNA library from mRNAs isolated after a Peridinium quinquecorne bloom in Tampa Bay, FL surface waters was constructed. Our specific objective was to develop a procedure to identify protein-encoding open reading frames from eukaryotic plankton without prior cultivation or identification. The phyltoplankton population based on RbcL COI identities consisted of organisms closely related to Skeletonema diatoms, Peridinium quinquecorne dinoflagellates, several types of chlorophytes, and a number of type-A Synechococcus. The cDNA clones from the meta-transcriptome were sequenced (aver-age size 360 bp). BLAST analysis (NCBI Genbank) revealed good homology to previously identified sequences, several of these transcripts being closely related to those of the prasinophyte Ostreococcus lucimarinus and other unicellular eukaryotes. Predicted protein homologues included genes associated with phyltoplankton growth and photosynthesis (NDH, COII, Cytb; NR, ribulose-5-phosphate carboxylase, rbcL), coi (Salamen adenoylsynthesise (converts inactive coxalins to metabolically active B), N-acetyl-γ-glutamyl-phosphate reductase (arginine biosynthetic pathway), a G-pro- tein-coupled receptor induced protein and several photosynthetic-pigment related pro- teins. Since less than 10% of the RNA sequences were RNA, the enrichment techniques for mRNAs were fairly successful.

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ENZYMIC HYDROLYSIS OF POLYSACCHARIDES IN SURFACE AND BOTTOM WATERS IN THE DELAWARE BAY ESTUARY AFFECTED BY ELEVATED (MINERAL) PARTICLE LOAD

Extracellular enzymes play a key role in global DOM cycle. They operate outside the cell where they may become associated with organic or mineral phases. This study shows evidence that elevated (inorganic) particle load in the water column affect hydrolysis of high molecular weight polysaccharides. Surface and bottom water samples, taken at three sites in Delaware Bay in December 2006, were incubated with six distinct fluorescently- labeled polysaccharides. Changes in molecular weight were monitored over time using gel permeation chromatography. At two sites, hydrolysis rates of four polysaccharides were higher in bottom than surface waters, and one substrate (pullulan) was almost exclusively hydrolyzed in bottom waters. Results of particulate-organic carbon and nitrogen as well as bacterial cell counts indicate that bottom water suspended matter was mostly inorganic and likely of benthic origin. The results propose that resuspended bacteria and/or enzymes associated to minerals increase enzymatic activities in bottom waters, and broaden the spectrum of enzyme activity in the water column with consequences on organic matter degradation in highly dynamic aquatic environments such as estuaries and coastal waters.

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THE EXPLORER OF THE SEAS OBSERVATORY: FOUR YEARS OF REGIONAL MARINE SURFACE WATER MEASUREMENTS IN THE CARIBBEAN SEA

The 31m cruise liner, Explorer of the Seas, operated by Royal Caribbean Cruises, Ltd. (RCCL), cruised from Miami, Florida through both the Eastern and Western Caribbean age each year in the Caribbean Sea and surrounding waters. Since May 2001, the flowing seawater system has operated continuously and been maintained by the two onboard technology. Lessons learned from the over five years of continuous operation will be presented along with a summary of environmental sensor data time series and seasonal averages. Instrument maintenance issues, design modifications and instrument calibration histories will be discussed. A first look at the resultant searchable database will be shown.

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TIME-VARIABLE CONVERSION OF BAROTROPIC TO BAROCLINIC M2 TIDAL ENERGY AT THE KAENA RIDGE, HAWAII

The temporal variability of internal tide generation is examined for the Kaena Ridge, the site of the near-field component of the Hawaii Ocean Mixing Experiment. Barotropic to baroclinic energy conversion for the dominant M2 tidal constituent is obtained using moored observations of currents, temperature and salinity over a six-month deployment (December 2002 - May 2003). The energy conversion exhibits low frequency variability with amplitudes ranging by a factor of two (0.5 to 1.6 W/m2) over the record. Similar amplitude variations are found for the M2 energy density at the ridge and just off the ridge as the internal tide radiates to the southwest. The observed energy conversion correlates with stratification variations near the bottom, suggesting that deep stratification over the ridge flank modulates the internal tide generation. Comparisons of numerical model simulations with the observed energy conversion will be presented.

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HYDROGEN PYROLYSIS/LIPID COMPOUND ANALYSIS OF BLACK CARBON COMPOSITION AND SOURCE IN GANGES-BRAHMAPUTRA RIVER SEDIMENTS

Though recent work shows that black carbon (BC) represents significant portions of the organic carbon (OC) exported to the ocean, our understanding of its sources and fate remains relatively poor. Catalytic hydrocracking (Hy-Py) provides information on refractory aquatic OC composition, structure and source, not available through other methods. Materials are heated at high H2 pressure with a molybdate-catalyst. Volatilized compounds produced at low temperatures (50-350°C), representing loosely bound organic components, and those produced at high temperatures (350-520°C), representing molecular ‘back-bone’, are captured downstream and analyzed for lipid biomarker composition. BC in Ganges-Brahmaputra (GB) floodplain sediments constitute 12 to 85% of the TOC and have d13C of -22 to -24‰, distinct from that of TOC -19 to -27‰. Comparison of lipid compounds in the Hy-Py products of GB sediments to that of reference materials including Chestnut wood, Franciscan mélange and Devonian Shale, together with lignin and conventional lipid biomarker data, indicate a mixture of sources for GB-BC including terrestrial plant and fossil carbon.

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SEAGRASS RESPONSE TO OCEAN ACIDIFICATION: FROM INDIVIDUAL LEAVES TO POPULATIONS

Seagrasses, a polyphyletic group of aquatic angiosperms form the bases of highly produc- tive ecosystems ranging from tropical to polar seas that support diverse assemblages of marine organisms. Despite their evolutionary and ecological success, seagrasses have high light requirements that make them vulnerable to eutrophication, sediment loading and coastal modification. Unlike most marine autrophs, the high light requirements result from CO2 limited photosynthesis because the capacity for bicarbonate utilization cannot saturate the CO2 requirements of Rubisco. Despite clear evidence for carbon limitation of photosynthesis, seagrasses thrive in high light environments, and show little evidence of light-induced photoinhibition. Increasing the availability of dissolved aqueous CO2 can increase instantaneous rates of light saturated photosynthesis by up to 4 fold. Prolonged exposure to elevated CO2 concentrations increases the concentrations of non-structural carbohydrates (sucrose and starch), rates of vegetative shoot proliferation, and flowering, and reduces light requirements for plant survival. Consequently, seagrass populations are likely to respond positively to CO2 induced acidification of the coastal ocean, which may have significant implications for carbon dynamics in shallow water habitats and for the restoration/preservation of seagrass populations.

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PROMOTING AND RESEARCHING SUSTAINABLE OCEAN SCIENTIST-EDUCATOR PARTNERSHIPS: THE COSEE-CA COSIA MODEL

COSEE California’s Communicating Ocean Sciences to Informal Audiences (COSEA) is an NSF-funded program promoting effective, sustainable scientist-educator partner- ships. COSEA (http://www.lawrencelabochscience.org/cosia) is a consortium of 6 core partnerships between ocean sciences research institutions and informal science education institutions (e.g., science centers, aquaria). COSEA’s first goal is to provide a model for establishing substantive, long-term partnerships between scientists and informal science education institutions to meet their respective educational outreach needs. To promote the development of effective partnerships, COSEA scientists and educators collaborate- ly developed and co-teach an upper division college course for undergraduate and graduate students in ocean sciences-related degree programs. The course teaching theory
that the students practice while communicating ocean sciences concepts to the public. COSIA-CA is developing dissemination models to share our "best practices and materials with non-COSIA institutions and organizations (e.g., the National Marine Sanctuaries). COSIA researchers are tracking the formation and evolution of COSIA partnerships to derive principles for developing and sustaining future scientist-educator partnerships. In this presentation, we share our partnership development strategies, mechanisms for promoting future partnerships, our dissemination model, and some preliminary research results.

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THE ELBE ESTUARY UNDER THE PRESSURE OF CLIMATE CHANGE - IMPACTS ON THE TRANSITION ZONE BETWEEN RIVER AND SEA

The Elbe is one of the largest rivers in Europe – it is 1092 km long and has a catchment area of 148,268 km². It has a funnel-shaped river mouth and its estuarine part which exhibits a remarkable salinity and turbidity gradient extends over nearly 100 km. The load of nutrients coupled with the energy from tidal action intensifies the stirring-up and cycling of nutrients from shallow sediments, making the Elbe, like other estuaries, one of the most productive systems of (acoustic) system. Anthropogenic changes in the upper and lower part of the River Elbe as well as changes in climate, caused by an increase in temperature with higher evaporation and lower precipitation, have remarkable impacts on the matter flux of this system. An internal fertilization effect leads to an unexpected increase in nutrients and particulate organic matter, which because of their long residence times in the estuarine part of the river cause summer oxygen concentrations of about 2 mg l-1 and lower.

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RADIOCARBON CONTENT OF SOOT AND CHARRED BLACK CARBON USING THE BENZENE POLYCARBOXYLIC ACID METHOD.

Black carbon (BC), a bi-product of combustion processes, is ubiquitous in the environment due to the burning of biomass and fossil fuels. Defined by a continuum from char (e.g. biomass) to soot, the structure of BC is unknown. Soot is composed mostly of condensed aromatic rings whereas char has an abundance of oxidized functional groups. We investigate whether the radiocarbon signatures of the various components of the BC structure differ from that of the bulk BC. Using the benzene polycarboxylic acid (BPCA) method, a chemical oxidation method, we quantify BC as BPCAs and measure the Δ14C values of the resulting BPCAs. The distribution of BPCAs formed provides information about the chemical structure of the bulk BC material. BPCA distributions and their Δ14C values, along with the bulk BC and Δ14C values will be presented for NIST 1649a, a wellstudied urban dust of anthropogenic origin, and wood char prepared for the BC Ring Trial, of modern origin.

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LARGE SCALE MODES OF BOTTOM PRESSURE VARIABILITY FROM GRACE AND THE ECCO MODEL - REVISITED

The ECCO baroclinic numerical model (version JPL-kf066) which assimilates altimetry and XBT, shows basin-scale modes in bottom pressure (BP) with most energy at annual, but also shorter periods. The ECCO-II high resolution baroclinic model, without data assimilation, also does. Similar modes were seen by Stepanov and Hughes (2006) in a barotropic model, and explained in terms of a mass exchange between the Pacific and Southern Ocean. We also see these modes in the GRACE monthly data, interpreted as bottom pressure variations. This presentation takes advantage of the latest releases of the GRACE data, with much improved accuracy and corrections, and also seeks to understand weaker interannual components in these signals.

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MODELING SEDIMENT DEPOSITION IN THE YELLOW RIVER MOUTH

Yellow River is famous for its high sediment concentration and it carries a huge amount of sediment into Bohai Sea during flood seasons. Recent studies indicated that the local hydrodynamics plays an important role in sediment transport and deposition at the river mouth. To analyze the sediment deposition in the Yellow River mouth, we applied the Community Sediment Transport Model (CSTM) to the whole Bohai Sea with emphasis on the Yellow River mouth. The model couples the third-generation wave model - SWAN, a regional ocean circulation model - ROMS and a suspended sediment transport model. Wave-current interactions are presented by the short wave forcing in currents, the wave effect on bottom-boundary layer, and the current effect on waves. The external driving force includes tidal forcing, wind stress, and river outflow. The sediment discharge from the river was measured at Lijn Station and was taken into account in the numerical model as a sediment source condition. The numerical results of the tidal current velocities and sediment concentration are compared with observations. The simulations show that the sediment concentration in the Yellow River mouth presents a distinctly seasonal variety and most of the suspended sediment deposits around the Yellow River mouth.

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MICROBIAL CONTROL OF PHOSPHATE IN THE NORTH ATLANTIC SUBTROPICAL GYRE

Phosphate concentrations fall into the low nanomolar range in several oligotrophic areas of the world oceans, but little is known about its in situ dynamics. Here we have budgeted the uptake of phosphate by the dominant microbial groups using flow cytometric sorting in order to assess the microbial control of this depleted nutrient in the North Atlantic gyre. The bacterioplankton was the main consumer of bioavailable phosphate. Within the bacterioplankton a group of heterotrophic bacteria with low nucleic acid content, 60% comprising of SAR11 clade cells. On the results of fluorescence in situ hybridisation, and Prochlorococcus phototrophic cyanobacteria, were the two major groups taking up phosphate. Each of these two bacterial groups was responsible for an average of 45% of the phosphate uptake, whilst Synechococcus (7%) and picoeukaryotic (0.3%) phytoplankton played minor roles in direct phosphate uptake. Hence phosphate uptake in the oligotrophic gyre is rapid and mainly by the two dominant bacterial groups and not by eukaryotic algae.
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