OS32C-139 1330h POSTER

Multi-proxy Assessment of North Atlantic Intermediate Water During the Last Glacial Maximum and Younger Dryas

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Extensive scientific investigation has shown that ocean circulation has experienced changes through time. Studies of numerous sediment cores of the North Atlantic show that these changes in ocean circulation coincide with climate changes. In this study a three proxy approach is taken in order to determine how climate and ocean circulation are linked in the North Atlantic, where North Atlantic Deep Water (NADW) is the predominat modern water mass. This project focuses on the time interval from the last glacial maximum (LGM) through the deglaciation to the Holocene interglaciation, paying particular attention to the Younger Dryas cold interval. The three proxies used to analyze the sediment cores are the stable isotopes of carbon and oxygen in microfossil foraminifera, the radioisotopes 231Pa and 230Th in bulk sediment, and the grain size distribution of the sortable silt. During glaciation, ODP Site 984 at 1.6 km on the Bjorn sediment drift along Reykjanes Ridge was centrally located in Glacial North Atlantic Intermediate Water (GNAIW). As deglaciation began, there was a dramatic reorganization of the predominant water masses as nutrient rich water invaded the site. Small climate oscillations during glaciation appear to be a response to changes in the strength of the intermediate circulation. Strengthening of the bottom currents at the site is associated with warmings, while weakening currents are linked to cooling. The same relationship occurs at the onset of deglaciation and through the Younger Dryas. 231Pa/230Th data collected from core 103GGC on the Little Bahama Bank at 1 km indicate strong intermediate-water circulation during the Last Glacial Maximum (LGM) and the Younger Dryas, and weak circulation at the onset of deglaciation and the Holocene. These data show strong correlation with Cd/Ca data recorded in the same core by Marchitto et al. (1998). A comparison of the 231Pa/230Th and Cd/Ca data to comparable results from the Bermuda Rise indicates that the rates of production of NADW and GNAIW alternate from the LGM through deglaciation, although not always in equal proportion.

OS32C-140 1330h POSTER

Frustule-Bound Nitrogen Isotopes: Observations From Cultured Diatoms and From Late Quaternary Diatom-Rich Sediments From the Gulf of Alaska

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Nitrogen isotope records from bulk-sediment are sometimes used to infer changes in paleoproductivity. In High-Nutrient Low-Chlorophyll (HNLC) regions, δ^{15}N interpretation might seem relatively straightforward, as past increases in productivity in open systems with constant rates of upwelling should have drawn down surface nitrate concentrations and fractionation by phytoplankton would have driven the remaining pool to heavier values. However, in the Gulf of Alaska, an HNLC region, the δ^{15}N record in ODP Hole 887B is at odds with this simple interpretation. Rapidly deposited diatom-rich layers up to 1 m thick occur intercalated with diatom-poor clay throughout the core, and are coincident with Ba/Al enrichments. Despite all indications that the diatom layers respresent episodes or periods of enhanced export production, bulk sedimentary δ^{15}N values are relatively lighter within the diatom layers, implying increased relative nitrate abundance, not depletion. In order to constrain better the source of this counterintuitive signal, diatom frustules were separated from the bulk sediment by flotation, and all exposed organic matter was oxidized using perchloric and periodic acids at 135°C. Surviving nitrogen is believed to represent a proteinaceous frustule-bound component, protected within an opaline matrix from the ravages of food chain effects and diagenesis. Early results show that, within the diatom-rich intervals, frustule-bound δ^{15}N is significantly lower than the bulk sediment, by 1 to 2$^{o}/_{oo}$. Furthermore, there is variability within the frustule-bound δ^{15}N profile not evident in the bulk-sediment record. Finally, the frustule-bound δ^{15}N within the diatom-rich layers appears to be lighter than frustule-bound δ^{15}N in diatom-poor sediment, confirming the paradox presented by the bulk-sediment record. Frustule-bound nitrogen may represent fossil diatom-biomass nitrogen, a possibility currently being explored with cultured diatoms following the same acidic oxidation technique. If so, it suggests that, during the high diatom production intervals, surface nitrate was in even greater excess in the Gulf of Alaska than it is today. These observations point to an extraneous control, such as iron, on export production.

OS32D HC: Hall III Wednesday 1330h

Stratified Coastal and Estuarine Circulation III

Presiding: **M S Lozier,** Earth and Ocean Sciences, Duke University**; A Münchow,** College of Marine Studies, University of Delaware

OS32D-141 1330h POSTER

Wilkinson Basin Water-Mass Structure

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Studies of the Wilkinson basin water mass structure are conducted. Data from the June 1982 Brooks survey is used for the initial study of water mass characteristics and distributions. Parameters of Maine surface, intermediate, bottom, and slope waters are derived from the Brooks 1982 CTD casts and developed from cluster analysis using a distribution function for cluster point diffe rences in temperature, salinity, and depth. The cluster analysis yields two distinct surface water masses, one of which is warme r and less salty. The percentage of the water volume occupied by each of the five water masses is derived and expressed as a fun ction of depth and CTD cast location. An EOF analysis of the water mass temperature, salinity, and percent volume occupied is undertaken. The cloud of points represen ting each water mass in terms of temperature, salinity, and depth are derived through cluster analysis and identified as matrix elements in the SVD and covariance analysis. In one approach the vertical variances of temperature, salinity, and percentage con tent are reconstructed. In another approach the vertical temperature and salinity is reconstructed through an EOF decomposition of each water mass's cloud of points and a summation over all of them for the resultant vertical distribution. These approaches are first steps towards a feature model based on water masses. The means, standard deviation, and ranges of the water masses are derived in T,S,D space. Worthington diagrams of volumes occupi ed with existing T,S span is computed and identified for each water mass. A EOF based representation of water masses in T,S spac e is pursued. The dynamical picture is brought into the interpretation of the Wilkinson basin water mass structure. The dynamics at the locati on of each water mass is considered. The physical processes acting on each water mass in terms of formation and modification are interpreted from a GOM point of view.

URL: http://www.agu.org/meetings

OS32D-142 1330h POSTER

Using Hydrographic Data and Satellite Imagery to Describe and Estimate Mixing Across Tidal-Mixing Fronts on Georges Bank

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Tides represent an important physical forcing on Georges Bank (GB). Tidal mixing keeps central GB (<60m) well mixed year round. Deeper portions of GB vertically stratify due to positive heat/buoyancy input from late spring to early fall (May-October), with tidal mixing fronts (TMF) forming between well-mixed and stratified waters. It has been shown that TMF and shelf/slope fronts (SSF) can be located using sea surface temperature (SST) frontal segments from satellite-derived Advanced Very High Resolution Radiometer (AVHRR) SST data, and automated cloud-clearing and edge detection algorithms. This project investigates the physical process known as "bolus transfer" which is the separation and flux of eddies across fronts due to baroclinic instabilities. Our goals are to determine if this process is a major contributor to cross-frontal mixing, and resolve their mean size and seasonal cycles for determination of their interannual variability. Work is being completed through an analysis of hydrographic data and SST frontal data from AVHRR satellite imagery. The frontal segments from the satellite images are extracted, detrended, and analyzed for the northern and southern frontal regions on Georges Bank to find a common wavelength or meander scale to be compared with the hydrographic bolus transfer scale (internal Rossby radius of deformation) data. When completed, our project may assist in estimating the amount of nutrients and biology that is advected across these fronts from bolus eddies.

URL: http://celtic.cmast.umassd.edu

OS32D-143 1330h POSTER

Direct Observations and Modelling of the Secondary Circulation Associated with a Tidal Mixing front in European Shelf Seas.

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Observations in stratified shelf seas consistently reveal thin layers of phytoplankton associated with tidal mixing fronts and the base of the thermocline. This implies a continuous supply of nutrient rich water to the frontal zone and the level of the thermocline. A possible candidate mechanism is the weak cross-frontal density driven circulation associated with such fronts. While measurement of the along frontal flow is readily achieved, direct observations of the speed and extent of the transverse circulation is difficult.

Two dye release experiments were performed using rhodamine-wt injected at the sea bed in a bottom frontal zone in the North Sea during August 2000 and 2001. Dye was tracked for 76 hours, providing the first direct evidence of cross-frontal flow in European shelf waters. The results are discussed in the context of high resolution numerical model predictions of the flow regime and the source of nutrients required to sustain continual summer time primary production in a shelf seas environment.

OS32D-144 1330h POSTER

The spatial and temporal relationship between biomass and hydrography on New Jersey's inner shelf during the summer of 2001.

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As part of the Hyperspectral Coupled Ocean Dynamics Experiment (HyCODE) remote and in situ observations of the ocean's color were made on New Jersey's inner shelf to characterize its relationship to coastal circulation processes. During the summer of

2001 a plankton bloom developed that was so intense that it drew the attention of the public and the local press. During this bloom we conducted 40 20-km cross-shore shipboard surveys with an undulating CTD/fluorometery package. While each transect displayed a strong correlation between fluorescence, which we use as a proxy for biomass, and stratification the position of the biomass in temperature space varies in time. High biomass occurs either in the surface mixed layer or in a tight band in the thermocline and this positioning appears to be correlated with the physical forcing. During upwelling conditions high biomass was observed in the stratified upwelled waters inshore and tended to move offshore into the thermocline as upwelling conditions relaxed. After a storm biomass was intensified in the surface mixed layer, but moved back into the thermocline as stratification was reestablished. With these cross-shore sections a 30 day time series of the first and second moments of the biomass in temperature space is constructed for both the inshore half and offshore half of the transect. The variability of this time series is related to coastal circulation and wind and buoyancy forcing.

OS32D-145 1330h POSTER

Material Property Distributions on the West Florida Shelf

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Continental shelves are regions where estuarine water mix with ocean water to determine the material properties of the littoral zone. An overarching question regarding littoral zone properties concerns the relative importance of local and deep-ocean forcing. We address this question for the west Florida continental shelf (WFS) using in-situ data and a numerical circulation model. It is found that local forcing due to shelf-wide momentum and buoyancy input accounts for much of the synoptic, seasonal, and inter-annual variability, and adequate specification of the surface heat flux is essential to modeling the coastal ocean. The adjacent gulf of Mexico Loop Current or its eddies provide the distribution of material property isopleths at the shelf break, but whether or not these properties are advected onto the shelf is largely determined by the local forcing. Data from long term measurement beginning in 1998 and several modeling studies are used to illustrate these point.

OS32D-146 1330h POSTER

An Idealized Model of the Seasonal Variability in the Alaska Coastal Current

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The Alaska Coastal Current (ACC) is a wind and buoyancy forced, 30-50 km-wide current of low-salinity water that flows along the coast of the Gulf of Alaska from southeastern Alaska to Unimak Pass where it enters the Bering Sea. It is a consequence of the massive coastal freshwater discharge which is distributed in numerous small rivers draining from coastal mountain ranges. Seasonally, the discharge is a minimum in winter and increases through the summer to a maximum in fall. Annually, it accounts for nearly 40% of the freshwater flux into the Gulf of Alaska. The ACC can either store this freshwater, mix it offshore, or transport it to the Bering Sea.

The wind-stress along the coast of the Gulf of Alaska is generally cyclonic due to the Aleutian Low. It is strong and persistent in winter and weak and more variable in summer. The ACC is unique among coastal currents because of the downwelling wind stress, the massive, distributed coastal buoyancy forcing and the relatively-deep, nearshore bottom depths.

CTD sections across the ACC show the current to be narrow, deep and bottom-attached in winter; but wider, shallow and predominantly surface-trapped in summer. We use the Regional Ocean Modeling System (ROMS) forced by a combination of downwelling wind-stress and a half-line source coastal-buoyancy-influx as a simplified model of the ACC to examine the dynamical processes that govern the seasonal cycle. The origins of the ACC are represented by the beginning of the line source. For this model, the scales of time evolution, the dynamical balance and density balance, and the relative importance of cross-shelf mixing to along-shelf transport of freshwater are presented. The numerical simulations of the half-line source show a narrow deep 'ACC' during winter forcing and a wider, shallow 'ACC' during summer forcing.

OS32D-147 1330h POSTER

Thermal Wind Balance in a Tidally Energetic, Inner Shelf Regime

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The source region of the Delaware Coastal Current is the mouth of Delaware Bay, a shallow coastal regime with strong tidal currents. Here the buoyancy derived from upland freshwater is discharged to the inner shelf. Such a regime would seem to favor vigorous vertical friction and therefore a thick bottom mixed layer. The Ekman number should be order one.

Instead, our records of current and density from long term moorings there strongly indicate that the subtidal frequency flow is nearly in Thermal Wind Balance (TWB) with current speed rapidly diminishing and current direction veering counterclockwise as depth increases. The strongest indicator of the high vertical stratification is the large observed mean value of N/f=400, where N is the buoyancy and f the inertial frequency. The estimated bottom mixed layer thickness (using Weatherly and Martin, 1978) is only about 3m, while the water depth is 15m. The effective Ekman number is then only about 0.04.

This implies that despite the vigorous tides, the subtidal flow retains a nearly frictionless interior in horizontally two-dimensional geostrophic balance. Other inner shelf regimes sharing such high stratification, whatever its origin, may be expected to support TWB also.

OS32D-148 1330h POSTER

Observations of the Details of Coastal Upwelling Response and Relaxation Across a Simple Bathymetry

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New and detailed observations of the response of the coastal ocean off central Oregon to two cycles of northerly (upwelling) winds were made as part of the COAST experiment in the spring and summer of 2001. These observations included continuous turbulence profiling of the full water column, including the bottom boundary layer, using Chameleon.

Preliminary analysis reveals several aspects:

1.High turbulence levels beneath the southward coastal jet and in the bottom boundary layer during upwelling.

2.Relaxation of the ocean following cessation of upwelling winds is marked by a northward flow inshore and high turbulence levels throughout the water column.

3.A strong internal tide frequently dominates the cross-shelf flow field and energizes the bottom boundary layer. A two-day time series at midshelf helps to quantify the effect on the upwelling circulation.

4.Dense bottom fluid migrates up the sloping shelf at peak speeds of 9 cm/s in response to upwelling and in agreement with an estimate from Ekman transport. It then migrates back down during relaxation.

5.Cross-shelf transport of fluid is revealed by thin tendrils of fluid in mid-water column with high optical backscatter (880 nm), propagating from the highly productive inner shelf. These tendrils are high in chlorophyll.

These observations were made as part of the COAST experiment.

OS32D-149 1330h POSTER

Three-Dimensional Flow in a Coastal Upwelling Zone

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Mass balance calculations are performed on the flow along the inner New Jersey shelf during the summer upwelling season of 1996 using horizontal water velocities obtained from a series of moorings containing four acoustic Doppler current profilers (ADCPs) and eight electromagnetic current meters. Empirical orthogonal functions (EOFs) analyses are employed to extract the components of the flow field that are resolved by the moorings and produce an index of three-dimensionality. Two EOF modes explaining a total of 75% of the variance are used to examine the flow. The first mode containing 68% of the variance represents the along-shore flow, while the second mode explains the along-shore variation of this flow.

A comparison of the new three-dimensional index with density fields obtained from ship hydrographic profiler surveys reveals that the three-dimensionality of the flow field is a function of the horizontal spatial structure of coastal upwelling and buoyancy intrusions from the Hudson Coastal Current. The derivation of the three-dimensional index and the effect of coastal upwelling and buoyancy intrusions on this index through the along- and cross-shore momentum balances are discussed.

OS32D-150 1330h POSTER

Modeling Salinity Transport in Florida Bay; A Subtropical Estuary

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ABSTRACT: A three dimensional hydrodynamic model of the Florida Bay was developed and calibrated. The model solves the conservation of water mass, momentum, and salt equations using a semi-implicit finite difference algorithm for the exterior vertically averaged flow, and a vertically implicit procedure for the interior flow and salinity on a space staggered grid system. The model was used to simulate the three dimensional salinity structures in the study area in response to high freshwater discharges from the main land. Model results were evaluated graphically and statistically against various numerical criteria and field observations to quantify the accuracy of model predictions and to quantitatively evaluate the success of the model calibration and verification. Comparisons between model predictions and field observations of salinity time series indicated that the model was successfully calibrated and that the model captured the impacts of freshwater discharges on salinity structure before, during, and after these events. Model predictions of salinity structure, over the water depth, also showed that water column characteristics varied from stratified, to well mixed, and back to stratified within several days during those high-flow discharge events. The geographical extent of high freshwater impacts, however, was limited to areas close to shorelines near the mouth of all creeks. Good agreement between model predictions and field observations during model calibration indicated that the model replicated the observed freshwater impacts on salinity structure in Florida Bay and that the model can be used as a tool to evaluate management alternatives to minimize freshwater impacts on salinity structure in the study area.

OS32D-151 1330h POSTER

On the Processes Linking Florida Bay to South Florida Coastal Seas

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As part of the South Florida Ecosystem Restoration Prediction and Modeling Program, a series of data have been collected in the coastal seas surrounding Florida Bay. The area of interest occupies the southern tip of Florida, adjacent to the Gulf of Mexico (Southwest Florida Shelf) and the Atlantic (Florida Keys Atlantic Shelf) via the Florida Straits. Florida Bay is generally divided into different subregions, according to differences in the dynamics in the neighboring coastal areas. Our data indicate that these subregions are closely

linked by circulation and exchange processes responding both to local and remote forcing.

The seasonal variability in the circulation is examined with current meter data and near-surface trajectories. Examination of wind time series indicates that the subtidal variability has a strong dependence on wind forcing. A mean southward flow is found in the transition area between the Gulf of Mexico and the Atlantic subregions and it varies in strength depending on Loop Current position. Drifters released near the Shark River north of Florida Bay along the Southwest Florida Shelf have a strong southward component, indicating that upstream low salinity sources may alter the salinity distributions of Florida Bay and the Florida Keys.

Results from the Miami Isopycnic Coordinate Model (MICOM) support the strong linkage between Florida Bay and the adjacent Gulf of Mexico and Atlantic coastal areas. They also indicate that remote buoyancy forcings may have an influence on the local hydrography, such as low salinity waters due to the Mississippi outflow that may reach the Florida Bay area.

OS32D-152 1330h POSTER

Modeling the Coastal Circulation in the Gulf of Lions,NW Mediterranean sea,With Regard to the MOOGLI3 Experiment,Wintertime 1999

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Hydrological observations and ADCP data have been collected on the whole Gulf of Lions during the MOOGLI3 experiment (11 January - 22 january, 1999). This experiment is keeping with the french Programme National d'Environnement Cotier, which aims at improving the understanding of the dynamical and biological features of coastal ecosystems.The data analysis of this cruise has already shown several phenomena such as formation of dense waters on the continental shelf, upwellings or bathymetry effects on the general circulation.

Now, thanks to a 3D ocean model, we intend to explain the mechanisms of these typical but also original winter processes which take place on the continental shelf and the slope. The topography,the strong atmospheric forcing, an important input of freshwaters and finally a general circulation flowing along the continental slope, play a crucial role in the dynamic. By modeling,we try to determine their respective contributions.

Our tool is a primitive equations, sigma coordinate model with a free surface.Its initialisation is performed with the tangent linear to the model (linearized version of the primitive equations)

OS32D-153 1330h POSTER

Ensemble Based Description of the Forecast Error in a coastal Hydrodynamic Model of the Gulf of Lions

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The characterization of model errors is still a very challenging but universal problem in earth science modeling. Indeed whatever the model used to mimic nature is, the forecast must always be compared to observations and be adjusted to fit them within the limit of their own observational error estimates. However, to achieve this, one must necessarily be able to evaluate one s trust in the model and in the observations, this being closely related to the determination of the density of probability associated with both the model and the observations.

Our objective is to describe the forecast error density probability of a coastal ocean model using an Ensemble technique. The model is a 3D primitive equation model resolving both high-resolution topographic, river and wind forcing. The Monte-Carlo approach deals with model and observation errors in a natural way and is particularly well-adapted to coastal non-linear studies in so far as higher order moments are implicitly retained in the covariance equation. Statistical assumptions are made on the uncertainties related to the various forcing (wind stress, open boundary conditions), to the initial state and to the basic model parameters and random forecasts associated to these known errors are carried out. The evolution of these errors is thus traced through the modeling procedure. The computation of the Central Empirical Orthogonal Functions (CEOFs) of the forecast Ensemble variance leads eventually to a physical description of the model forecast error subspace in model state space. The time evolution of the projection of the Reference forecast onto the first CEOFs clearly shows the existence of specific model regimes associated to particular forcing conditions. The CEOFs basis is also an interesting candidate to define the Reduced Control Subspace for assimilation and in particular to adjust such transitions in model state space.

We applied the above methodology to the penetration of the Liguro-Provenal Catalan Current over the shelf of the Gulf of the Lions in North-Western Mediterranean together with the discharge of the Rhne river. This region is indeed well-known for its severe topographic and atmospheric forcing.

OS32D-154 1330h POSTER

Interannual Variability and Sensitivity Study of Ocean Circulation in Prince William Sound, Alaska From 1995-1998

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Interannual variability and sensitivity study of ocean circulation and thermocline structure of Prince William Sound, Alaska were examined using a 3-D circulation model. The wind data were from buoy and weather stations of the sound.

A four-year (1995-1998) simulation compared well with field observations of circulation and monthly mean sea surface temperature at NOAA Station 46060. Seasonal circulation patterns were characterized by combined cyclonic and anticyclonic gyres in the central sound in January to April, and a strong cyclonic gyre in the central sound in September to December. The size, position and strength of the gyres in the central sound showed interannual variability.

Sensitivity studies showed the relative importance of each model forcing: 1) Wind has more impacts on the vertical temperature and salinity structure, and surface circulation. Without wind, the surface current was reversed and the magnitude of the depth-integrated transport in the central sound was reduced.2) tide current is important to surface and bottom mixing. Without tide, the thermocline depth becomes shallower; 3) the magnitude of the Alaska Coastal Current (ACC) inflow was one of the factors affecting the depth-integrated transport of the gyre in the central sound. As ACC inflow decreases, the depth-integrated transport of the gyre in the central sound also decreases. If ACC inflow was doubled, it would increase the mixlayer depth significantly; 4) the surface T/S restoring is critical to maintain T/S seasonal cycle and the circulation patterns in the sound. Salinity was more important to the central sound circulation patterns than temperature.

The numerical oil spill drift experiments showed large interannual variability of the trajectories between 1995-1996 and 1997-1998. The result indicates a large interannual variability of the self-cleaning capability of the surface water in the inner sound.

OS32D-155 1330h POSTER

Numerical Simulations of the Gulf of Mexico Forced by Quikscat - Derived Winds

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A numerical simulation of the Gulf of Mexico using the Navy Coastal Ocean Model is used to study the ocean response to episodic wind forcing over the West Florida Shelf. The model is forced by objectively gridded winds measured by the Seawinds scatterometer aboard the Quikscat satellite, combined with ETA atmospheric model analysis data. The numerical simulations are validated with in-situ observations to show the impact of different wind forcing products on the modeled ocean circulation. Particular attention is paid to episodic weather events, such as tropical systems. This West Florida Shelf study serves as an ideal testbed to determine how scatterometer-derived winds can best be used to force regional ocean models.

OS32D-156 1330h POSTER

Dense water transportation due to mesoscale eddy on continental shelf

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Propagation of a mesoscale eddy on continental shelf was investigated with the reduced-gravity model. Many observations and experiments have shown that instabilities generate mesoscale eddies. It's well known that the mesoscale eddy have rotational eddy current, and can propagate by itself . If the mesoscale eddy consisted of the dense water is generated in the polar region , the eddy could transport the dense water from the generation area. And it is important to understand the propagation mechanisms of the eddy for understanding polar sea dynamics. Therefore we shed light on topographic effects on transportation mechanisms of the dense water eddy. A reduced-gravity model is used for a homogeneous bottom layer beneath an infinitely thick upper layer. Only the bottom layer has motion, while the upper layer does not. Some inclination of bottom and interfacial displacement, and quadratic bottom drag coefficient were examined. Numerical experiments showed that eddies moved northeastward in each inclination of bottom slope. Northward Translation velocity of the eddy incleased with steepening the bottom slope. The northward transportation is interpreted as the topographic beta effect and nonlinear effect of secondary eddies. Also eddy moved northward , because of bottom friction. The result is consistent with previous studies, and suggests contribution of eddies transportation of the dense water toward basin.

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A Model Study of Ventilation of the Mississippi Bight by Baroclinic Eddies: Local Instability and Remote Loop Current Effects

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Results from a $1/12^{\circ}$ resolution numerical study of the Gulf of Mexico using the low dissipation 4th-order-accurate DieCAST model show strong ventilation of the Mississippi Bight (MB) by eddies of size 50-100 km. MB eddies occur throughout the model year. These eddies are strongest during winter when surface cooling reduces the stabilizing effects of stratification, and augments lateral density gradients as buoyant modified Loop Current (LC) water meanders northward into the southern MB region through the northeastern Gulf of Mexico (GOM) eddy field. The eddy field is generated by frontal eddies at the edge of LC warm core water, both before and after separation from the LC, which disperse the LC buoyant water away from the LC core. SeaWiFS images(e.g., November3, 1997) show behavior similar to model results.

Annual cycle surface forcing by surface momentum (wind stress), freshwater (rivers plus p-e) and heat (radiation plus heat exchange with atmosphere) are used. Surface freshwater and heat sources are derived by combining model dynamics and surface salinity and temperature climatology.

URL: http://www.ssc.erc.msstate.edu/DieCAST/

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Response of the New England Shelfbreak Front to Strong Wind Forcing

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The shelfbreak front south of New England is subject to a wide variety of forcing mechanisms including strong winds in winter. During the Shelfbreak PRIMER experiment in February 1997, hydrographic surveys using a SeaSoar and a shipboard ADCP provided finely resolved sections and repeat quasi-synoptic maps (1 day or less spent per survey, 13 km between cross-shelf lines) of the front. Wintertime conditions were marked by strong wind stresses (0.5 N/m^2) and surface cooling (500 W/m^2). Seaward of the front, there was a warm core ring that affected the water mass properties of the outer shelf.

The response of the front to the passage of two strong wind events was observed. Northeastward winds led to the rapid offshore transport of cool, fresh shelf water in a 30-m thick surface layer. We compare observations to simple ideas about offshore Ekman transport.

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El Niño Influence on Shelf Currents and Temperature in Central California

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Moored current, temperature, salinity, and pressure data were collected at three sites that transect the narrow continental shelf offshore of Davenport, CA starting in August 1996 and continuing to the spring of 1998. This data set allows a comparison of oceanographic conditions prior to (8/96 to 3/97) and during (8/97 to 3/98) the last major El Niño. During this El Niño, mean temperatures over the 8-month time period were about 3°C warmer than during the prior year at all of the sites. Correlations between near-surface and near-bottom temperatures, and between near-surface temperature and wind stress decreased during the El Niño compared to conditions the year before. The mean amplitudes of the alongshore currents are more strongly poleward during El Niño at sites over the mid shelf and near the shelf break. There was a general tendency for the energy in alongshore currents to move toward lower frequencies during the El Niño, particularly at the sites further offshore. However, the autospectral amplitudes of the alongshore currents in the synoptic wind band have less energy during El Niño than in the prior year. The processes that force the shelf flows changed in relative importance. The local alongshore wind stress was less important in driving shelf currents during the El Niño when much of the wind-induced upwelling (and downwelling) was confined to close to the coast. The observed strong poleward shelf currents on the mid to outer shelf are not clearly tied to local forcing, but are remotely driven, most likely by slope currents further offshore.

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Observations of Wavelike Phenomena in the Santa Barbara Channel Using HF Radar.

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Observations of circulation patterns in the Santa Barbara Channel reveal distinct flow features within the low-frequency band centered around periods of approximately 14 days. Harms and Winant (1998) observed propagating cyclones in the 10-25 day frequency band. Auad and Henderschott (1996) and Auad et al. (1999) characterized the relationship between low-frequency flow in the 6-18 day frequency band and forcing by wind stress and remote adjusted sea level. The observed flow was explained as low mode coastally trapped wave propagation of a hybrid wave with characteristics of both Rossby and Kelvin waves. We present analysis of the same isolated low-frequency flow phenomena as resolved with a CODAR HF radar network located on the mainland margin of the channel. Hourly stream functions based on three years of velocity data spanning the Santa Barbara Basin are decomposed into frequency domain EOFs for the 10-20 day band following the method of Wallace and Dickinson for extracting propagating features (1972) as implemented by Auad and Henderscott (1996). Two significant modes explaining approximately 85% of the velocity variance are described. The first mode (50% variance) describes a series of alternating cyclones and anticyclones that propagate west at approximately 6 cm/s (as observed by Harms and Winant). This mode has the characteristics of a trapped Rossby mode (TRM) resonating in a closed basin with the geometry of the Santa Barbara Channel and period of 14.4 days. The second mode (35% variance) shows characteristics of a coupled long wave (Kelvin mode) and topographic Rossby wave with a period of 13.3 days. Geostrophic and ageostrophic velocity components are investigated and divergence of the surface layer is quantified. Upwelling/downwelling associated with anticyclonic/cyclonic eddies of the first mode was found to intensify near the western sill of the Santa Barbara Basin.

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Current Observations Offshore of Pearl Harbor During the Ehime Maru Recovery Operations

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Since 1995 the Geochemical and Environmental Research Group (GERG) at Texas AM University has operated a system of automated, near real-time oceanographic buoys off the Texas coast (the Texas Automated Buoy System, or TABS) in order to support the time-critical, decision-support needs of the Texas General Land Office (TGLO) for oil spill prevention and response. In late May 2001, GERG received a request from the Naval Oceanographic Office to supply two TABS buoys to assist in the recovery of the Japanese fisheries training vessel *Ehime Maru*. GERG subsequently received permission from TGLO to loan the NAVY two TABS buoys. The two buoys were assembled, tested in a configuration to use Honolulu's cellular phone system for data transfer, and shipped to Hawaii in a sea cargo container. The two buoys arrived in Pearl Harbor on July 12, 2001 and were deployed on July 18 within 2-3 nautical miles of the shallow water landing site; a site offshore of Pearl Harbor and adjacent to the Honolulu International Reef Runway. One of the buoys, a TABS I buoy (designated as "Y") equippped with a single point, near-surface current meter, was deployed to the west of the proposed landing site. A second buoy, a TABS II buoy (designated as "X") equipped with meteorological sensors, an ADCP, and a near surface current meter, was deployed to the east of the landing site.

These buoys have been supplying half hourly data since deployment. Analysis of the current meter data for the period from deployment to mid-October shows that the semi-major axes of the tidal ellipses are aligned along the bathymetry. The dominant tidal constituents are M2, M4, and O1 having maximum semi-major axis amplitudes of 7.6, 5.1, and 4.7 cm s^{-1}, respectively. Tidal amplitudes generally decrease close to the bottom. Semi-minor axes are small compared to major axes (< 0.5 cm s^{-1}) and have a zero-crossing at mid-depth (∼20 m) indicating a change from cyclonic to anticyclonic rotation of the tidal vector. Tides account for 33% and 5% of the total alongshelf and cross-shelf variance.

Near-surface cross-shelf motions are not significantly correlated at any frequency at the two buoy locations; along-shelf motions are significantly correlated at tidal frequencies and indicate a westward propagating tidal phase.

Unfiltered record-length mean current speeds have a subsurface maxima at 18 m depth of 11.8 cm s^{-1} decreasing to 9.1 cm s^{-1} near bottom. At buoy "X" net transport at the 6 m depth was westward propagating along the bathymetry. At the 44 m depth net transport was onshore.

Analysis of the winds from buoy "X" and winds from the nearby Honolulu airport, show that the winds are not significantly correlated at any frequency. Generally the wind speed at buoy "X" is higher than at the airport.

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Saline Water Intrusions onto the Southernmost Mid-Atlantic Bight Shelf

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Two mooring deployments (Ocean Margins Program; OMP) on the continental shelf region with three boundaries composed of northern, eastern and southern lines between Cape Henry and Cape Hatteras on the east coast (less than 76 m water depth) of the United States from middle February to early May 1996 (deployment 1) and from early July to early October 1996 (deployment 2) often revealed the presence of the saline water having salinity of more than 34.5 psu due to the proximity of the Gulf Stream. The saline water was observed on the shelf through almost whole water column with center on the mid- and bottom- (surface-) layer(s) at the east (south) region of southern (eastern) boundary, and penetrated to 7 15 km distance from the shore with saline water core (about 36 psu) at the southeast corner (about 37 km from the shore) of the OMP region. During the periods of two deployments, two intrusions occurred at southeastern boundary and four at southern boundary with time scales ranging from 5 to 20 days. These saline water intrusions are resulted from different manner at each layer such as penetration of Gulf Stream water, upwelling favorable wind, and upwelled flow within bottom boundary layer. These observed saline water onto the shelf occurred at the same time with inflows into the southeastern part of OMP region. The speed of intrusions onto the shelf indicated a flow of 5 to 25 cm/s directed in the cross-shelf direction. This stronger intrusion speed was found at shallower mooring site of southeast corner region of southern boundary.

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Heat and Fluid Circulations in the Coastal Area of the Island of Hokkaido, Japan

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Subsurface heat flow distribution in and around the island of Hokkaido is characterized by the abrupt transition from the low or normal heat flow in the Pacific side to the high flow in the northeast marginal sea and the southwest volcanic region and nearby Japan Sea. This paper aims at examining mechanical and chemical processes governing the superficial and deep heat and fluid circulations in the upper crust of the southwest area of the island and surroundings. Various mass-transfer phenomena between the Japan Sea and the continental area may be based on the marine and submarine origins respectively of the lower Pleistocene sediments and the volcanic formations of the island.