OS61D-11 1140h

The Influence of Shelf Geometry on the Supply of Iron and Manganese to Surface Waters in a Coastal Upwelling System

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Iron can be a key element regulating ecosystem structure and primary productivity in coastal upwelling systems. Shelf sediments are the most important source of iron to these systems. In July, 2002, we tested the hypothesis that regions of the coast where the continental shelf is narrow will receive relatively less iron input than regions of the coast where the shelf is broad. We used a combination of underway surface mapping of iron, manganese, nutrients and pCO_2, vertical profiles of Fe, Mn and biological parameters, and high resolution 3-dimensional mapping of nitrate, particle abundance, chlorophyll fluorescence, and dissolved organic matter concentration from a towed, undulating platform.

Surface-water iron and manganese concentrations were significantly lower south of Monterey Bay, off Point Sur, where the shelf is about 1.5 km wide, than north of Monterey Bay, near Davenport, where the shelf is about 10 km wide. During non- upwelling conditions over the broad shelf, dissolvable iron concentrations in surface waters were as high as 3.5 nM nearshore, and decreased to 0.4 nM 20 km from shore. Dissolved manganese concentrations measured at the same time were about 25 nM nearshore and 6 nM 20 km from shore. During non-upwelling conditions over the narrow shelf, in contrast, dissolvable iron concentrations in surface waters were less than 1.6 nM nearshore, and decreased to less than 0.4 nM within 10 km from shore; surface manganese concentrations in the region were uniformly around 3 nM. The onset of upwelling brought higher iron concentrations to the surface in both regions. However, whereas iron levels reached 6 nM in upwelled water over the broad shelf, they were less than 2 nM in upwelled water over the narrow shelf. In general the distribution of manganese was coupled to that of iron, with significant decoupling most likely driven by photochemistry. For example, vertical Mn profiles all showed a near-surface maximum, while Fe profiles did not, and surface Mn concentrations were biased towards higher values during daytime. These results will be discussed in the context of mechanisms of trace metal supply and mobilization, the contrasting biological productivity in the two regions, and implications for iron input during glacial periods of low sea-level stand.

OS62A MCC: Hall D Saturday 1330h

Wind-Driven Processes Along the U.S. West Coast Continental Shelf II Posters *(joint with B, T)*

Presiding: **T Garfield,** San Francisco State University**; P A Wheeler,** Oregon State University

OS62A-0225 1330h POSTER

Particle Size Distributions Over the Oregon Continental Shelf During Upwelling: Relationship to Inherent Optical Properties

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Phytoplankton size is a significant factor in the flow of energy within a pelagic community, whereby larger particles are often indicative of regions with high nutrients, productivity, and export. Particle size distributions have traditionally been measured using a variety of techniques that require discreet sampling (e.g. Coulter Counter), but may also be derived from optical parameters, which provide the possibility of continuous measurement. Several studies have shown theoretical and empirical relationships between the slope of a particle size distribution and the slope of light attenuation as a function of wavelength. The exact relationship depends on the type of particles that make up the size distribution, specifically their absorption and scattering characteristics.

Here we look at the variability of particle size distributions and corresponding fluctuations in spectral attenuation for natural assemblages of phytoplankton off the Oregon coast during the upwelling season. Particle size and optical data were collected during May-June 2002 as part of the NEP GLOBEC program. Size distributions in the range of 2-60 μm were measured from discreet samples using a Coulter Multisizer II (Beckman Coulter), and attenuation by particles was measured continuously along the cruise track at nine wavelengths using two ac9s (WET Labs). Size distributions varied substantially over the study region in both the along-shore and cross-shore directions. Distinct size populations were present in different water masses as indicated by physical parameters. Optical properties varied in a similar fashion, and were largely driven by chlorophyll concentrations. The spectral slope of attenuation was related to both chlorophyll concentration and size distribution. Optical modeling using Mie Theory was consistent with the empirical observations, and both suggest unique relationships between size distribution and attenuation for sediment-dominated waters (previous studies) and phytoplankton-dominated waters (this study), respectively. Given the relationship for phytoplankton-dominated waters, we propose that optical surveys may be used as a proxy to monitor spatial and temporal variations in phytoplankton size distributions in coastal regions, and therefore to study the dynamics and fate of primary production.

OS62A-0226 1330h POSTER

Mesoscale Structure of Bio-Optical Properties Within the Northern California Current System, 2000-2002

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Mesoscale mapping of the hydrographic and bio-optical properties of the Northern California Current System was conducted during spring and summer 2000, 2001, and 2002 off the Oregon coast. A towed, undulating vehicle carried a CTD, two fluorometers, a multi-wavelength absorption and attenuation meter (ac-9), and a PAR sensor. In addition, an ac-9 and a Fast Repetition Rate fluorometer (FRRf) collected bio-optical data on surface waters throughout the mesoscale surveys. Multiple onshore-offshore transect lines provided repeated crossings of velocity jet and frontal boundaries, and allowed resolution of physical and bio-optical parameters on horizontal scales of 1km or less and on vertical scales of 1-2m. Our multi-year results permit assessment of the linkages and the degree of coupling between physical and bio-optical patterns during strong upwelling and strong downwelling events, as well as during low-wind relaxation intervals. The location of the coastal jet and the upwelling front fluctuated considerably under the variable forcing regime, with more extensive mesoscale structure in all parameters in late summer relative to spring, as current meanders developed around subsurface topography (Heceta Bank) and moved offshore near Cape Blanco. Sharp horizontal gradients in autotrophic biomass were observed across the boundaries of the coastal jet and the upwelling front, with chlorophyll levels often in excess of 5-10 mg m^{-3} on the inshore side of the fronts. Horizontal gradients also were observed in the spectral slope of attenuation and dissolved absorption as well as in the physiological properties of the autotrophic assemblages (as determined with FRRf). Details of the spatial correlations of physical and bio-optical parameters will be presented.

OS62A-0227 1330h POSTER

Dye tracer studies of wind-driven upwelling on the Oregon shelf

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A series of dye releases from a small boat during the summers of 2001/2002 has investigated cross-shelf circulation in a region dominated by intermittent wind-driven upwelling. The aim was to make direct, Lagrangian observations of the pathways of cross-shelf flow during active upwelling. Lagrangian techniques provide insight that is not available from Eulerian measurements because of the dominance of alongshelf flow.

Preliminary results will be reported, with emphasis on a release from August 2002, made as winds transitioned from weakly downwelling-favorable to weakly upwelling-favorable. Dye was seeded in an alongshore streak at 20m depth in 55m of water, a little beneath the pycnocline. Of note was the rapid onshore spreading of the dye patch, having a cross-shelf extent of 5km after 48 hours, and extending into shallow water (less than 20m bottom depth). The dye remained largely isopycnal, following the upper edge of the bottom boundary layer onshore. The offshore edge of the patch became associated with a strong temperature inversion - a warm layer, apparently composed of subducted near-surface water. This dataset will provide an opportunity to determine the source of water in such inversions and to evaluate potential mechanisms for their formation.

OS62A-0228 1330h POSTER

Modeling study of upwelling processes over the Oregon shelf

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Time-dependent, three dimensional circulation on the continental shelf off Oregon is studied using the Princeton Ocean Model (POM). The objective is to investigate the flow dynamics, the across-shelf transport, and the nature of the small scale turbulence field associated with the temporal and spatial variability of upwelling on the Oregon shelf during summer 2001. The study applies forcing from observed winds and heat flux for May-August 2001. Model variables compare favorably with current, temperature, hydrographic and turbulence measurements from the 2001 Coastal Ocean Advances in Shelf Transport (COAST) field experiment. The results show that strong offshore transport occurs in the surface/bottom layers near the coast and over Heceta Bank during upwelling/relaxation, respectively. Opposite conditions occur, however, onshore of the 100 m isobath over the south-east region of the bank where northward currents associated with a cyclonic circulation are found. Relatively large values of across-barotropic-streamline transport are found at the outer edge of the bank along the 200 m isobath and off Cape Blanco. Analysis of the balance of terms in the equation for potential temperature reveals that decreasing water temperatures over the bank are caused mainly by across-shelf and vertical advection. Alongshore advection, however, leads to low-density water around the southeast edge of the bank. Relatively large values of turbulent kinetic energy (TKE) are found in both the surface and the bottom boundary layers, with the higher intensity near the coast and over the bank during upwelling. As the upwelling wind relaxes, the TKE weakens quickly at the surface while high values remain near the bottom during the development of northward currents as part of the pressure gradient driven relaxation response. In the time-averaged alongshore momentum equation, strong nonlinear advective effects balance a northward ageostrophic pressure gradient force over the bank contributing to the formation of a local cyclonic circulation.

OS62A-0229 1330h POSTER

Spatial and Temporal Patterns of Dissolved Phosphorus Distribution in Coastal Waters of Central Oregon

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As part of the CoOP-funded COAST project, we have analyzed 0.4 um- and 0.2 um-filtered water samples for Total Dissolved Phosphorus (TDP), Soluble Reactive Phosphorus (SRP, sometimes referred to as Dissolved Inorganic Phosphate (DIP), or simply phosphate). The difference between TDP and SRP provides an estimate of Dissolved Organic Phosphorus (DOP) concentration. Dissolved phosphorus (P) analyses are complete for the Spring (May 2001) and Summer (August 2001) cruises of the seasonal COAST study. Surface water samples from these two cruises have also been analyzed for bulk water Alkaline phosphatase (APase), a phosphohydrolytic enzyme that can render DOP compounds bioavailable, as well as for cell-specific APase using Enzyme Labeled Fluorescence (ELF).

Depth profiles of TDP, DOP and SRP from both spring and summer cruises show highest DOP concentrations occur in the upper water column, but that many of the deeper water samples also contain resolvable DOP. In spring, DOP ranges from 10-40% of TDP in the upper 40 m of the water column, with highest proportions (30-40%) in the upper 5 m. DOP concentrations range from undetectable to 0.5 uM. In summer, DOP in the upper 10 m of the water column ranges as high as 80% of TDP, averaging 40%. The average fraction of DOP in the upper 20 m in summer is 22-28%, for 0.4 and 0.2 um filtered water, respectively. DOP concentrations in summer range from undetectable to as high as 1.8 uM. Thus in summer, the segregation of the DOP concentration maxima to the upper water column is compressed into the upper 20 m, and DOP concentrations are significantly higher. In spring, in contrast, DOP maxima are expanded to occupy the upper 40 m, and concentrations are lower.

Bulk-water (e.g., unfiltered) Alkaline phosphatase activity is present in surface waters during both spring and summer, but can only be clearly resolved in samples with low levels of SRP. More samples showed ELF activity than showed APase activity, illustrating the higher degree of sensitivity of the ELF technique over the standard fluorometric technique applied to bulk waters. The fluorometric technique is now being applied to particulate samples concentrated from bulk waters, and improved detection is anticipated, permitting us to resolve APase activities in samples for which activities in the bulk water are too low. The presence of APase activity in waters with low SRP yet high DOP concentrations suggests that DOP may play a role in meeting the phytoplankton phosphorus demand in this system.

OS62A-0230 1330h POSTER

Production and Fate of Organic C and N in the Wind Driven Coastal Ocean off Oregon

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The most immediate products of primary production in coastal upwelling systems are particulate and dissolved organic carbon and nitrogen. During The Coastal Ocean Advances in Shelf Transport (COAST) project we collected discrete water samples from transects across a narrow shelf (CH line) and across a broad shelf (Heceta Bank) in May and August 2001. Analyses included inorganic nutrients, particulate organic carbon (POC), particulate nitrogen (PON), dissolved organic carbon (DOC) and dissolved organic nitrogen (DON). The four pools of organic material comprise most of the organic carbon and nitrogen in this coastal system. The partitioning of N and C will be presented and analyzed to determine:1) What fraction of incoming nitrate is assimilated and accumulated as PON and DON?, 2) What forms and how much organic nitrogen are exported from the shelf? 3) What forms and how much organic carbon is exported from the shelf? and 4) How do the ecosystems of the narrow and broad shelf differ with respect to nutrient dynamics and C and N cycling?

OS62A-0231 1330h POSTER

Coastal upwelling and plankton bloom dynamics observed in atmospheric O_2/N_2 and CO_2 records at Trinidad, California.

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Coastal upwelling in May 2002 coincided with a sharp reduction in atmospheric O_2/N_2 recorded at our baseline air observatory at Trinidad Head, California. The observed reduction in atmospheric O_2, attributable to air-sea gas exchange with upwelled waters depleted in oxygen, was followed by a period of calm winds and clear sky, and within days atmospheric O_2 increased to above pre-upwelling levels. Dissolved oxygen samples collected offshore near Trinidad during the post-upwelling period indicated surface waters supersaturated in O_2 (up to 184 percent saturation) overlying waters at 10-15m depths still depleted in O_2 (as low as 77 percent of saturation). SeaWiFS Chlorophyll *a* images indicated concentrations of 50-60 mg/m^3 the week of May 17-24, within days of the cessation of upwelling. The combination of SeaWiFS images, temperature and wind records from ocean buoys and our atmospheric record of O_2/N_2 support our interpretation that a regional O_2 sea-air flux related to the post-upwelling plankton bloom was captured in our record. The hydrographic measurements support the interpretation of the atmospheric record and further suggest that the majority of the ocean primary production represented by the Chlorophyll *a* in SeaWiFS composite images was confined to the upper 5-10 meters of the coastal ocean at the locations sampled.

OS62A-0232 1330h POSTER

Mesoscale Bio-acoustic Surveys in the Northern California Current System

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During spring and summer 2000, two mesoscale mapping cruises surveyed the northern California Current system from 41.9-44.6N and about 150 km offshore. Concurrent with the physical and bio-optical measurements made from a towed undulating vehicle (SeaSoar), a multi-frequency (38, 120, 200, and 420 kHz) towed bio-acoustics instrument collected backscatter data. The bio-acoustics were collected in 12 s ensembles (about 50 m horizontal resolution) and 1 m vertical bins, comparable to the resolution of the SeaSoar measurements, allowing for close evaluation of the physical control of biological distributions on these scales. The acoustics were sea-truthed using nearby MOCNESS samples. Predicted scattering was computed for each net sample using body lengths in a randomly-oriented bent cylinder scattering model, a reasonable approximation for both copepods and euphausiids. Predicted volume backscattering for the MOCNESS samples explained 44% of the variance of the nearby acoustics backscatter, a typical result in this context. A non-negative least squares inverse method is applied in conjunction with the scattering model, yielding estimates of biomass in four size classes over the entire survey region. For the spring 2000 case, we also compare our bio-acoustic results with zooplankton measurements made with an Optical Plankton Counter (OPC) mounted on the SeaSoar vehicle. The overall mean OPC and acoustic zooplankton estimates agree moderately well for the 5-9 mm and 9-17 mm size classes, with biovolumes within factors of two. For the 1-5 mm size class, the mean OPC value is an order of magnitude larger than the acoustic estimate. On the other hand, the 1-5 mm bio-acoustic map reveals some mesoscale spatial structure over a submarine bank which the OPC does not show. The different methods of observing zooplankton will be discussed in more detail. Preliminary bio-acoustic results from other years (2001 and 2002) off the Oregon coast will also be shown.

OS62A-0233 1330h POSTER

Variability in Sea Surface Temperature Fronts off the U.S. West Coast

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Operational sea surface temperature (SST) derived from NOAA's Geostationary Operational Environmental Satellites (GOES) provides a temporal advantage over SST derived from polar-orbiting satellites: each location is observed 24 times per day. Regions with persistent cloud cover, such as off the coast of California, may benefit from increased observational frequency. Using hourly, cloud-masked SST from GOES-10, a daily-averaged SST product is produced that provides a large spatial SST field for use by an edge-detection algorithm. The near real-time daily frontal products produced at NESDIS/ORA, along with long-term analysis and composites, indicate preferential locations of frontal boundaries, especially upwelling fronts. Additionally, these locations and other products being produced by NESDIS provide information regarding regions of convergent flow, which may have important biological implications regarding fisheries management and the ocean environment.

URL: http://manati.wwb.noaa.gov/tmi/fronts/

OS62A-0234 1330h POSTER

Shelf Penetration of California Undercurrent Waters in the CoOP-WEST Study Region at Bodega, CA

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The CoOP WEST (Wind Events and Shelf Transport) program is a process oriented study of the wind driven upwelling and response by the biota. The study site off Bodega, CA is located over a narrow shelf which allows transport of oceanic water into the upwelling region. The California Undercurrent is a persistent subsurface current with maximum northward speed found at around 100-150 m depth that transports tropical and subtropical waters northward along the continental margin. One objective addressed by CoOP-WEST is the role that these waters transported from the south may have in the upwelling system.

In order to sample the California Undercurrent, the CoOP-WEST survey region extends over the continental shelf and slope. Current and hydrographic measurements at the offshore end of the survey lines are designed to sample into the California Undercurrent. The shipboard ADCP data are used to locate the core of the the California Undercurrent. The two hydrographic data sets, the hydrocast station data and the underway Scanfish data, are then used to map the extend of the California Undercurrent water up onto the shelf. The extent and variability of California Undercurrent water on the continental shelf, as observed during the first four survey cruises on the R/V Point Sur, are presented.

OS62A-0235 1330h POSTER

Patterns of Phytoplankton Assemblages Across the Northern California Coast Measured During Wind Events (CoOP WEST Study)

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As part of a NSF funded project (Coastal Ocean Processes; Wind Events and Shelf Transport - CoOP WEST) to determine the fate of upwelled nutrients and primary productivity, the composition of the phytoplankton assemblage was examined off northern California during June, 2000, May/June, 2001 and January and June of 2002. Cruises took place during three upwelling seasons, and one non-upwelling season. Near surface phytoplankton samples were collected along the D transect line, running perpendicular to the coast, from D1 at Bodega Bay, to D8 40 miles offshore. Cells were enumerated using the Utermohl technique and phase contrast microscopy. For all June cruises, high levels of chlorophyll and phytoplankton cells occurred following upwelling events, and were dominated by diatoms. Taxonomic observations for each year show that the diatoms were mostly of the genus Chaetoceros, and dominated when larger cells were the major contributors to total phytoplankton biomass. Diatoms typically were seen at D stations closer to the coast (D1 to D5), and their numbers increased with relaxation of the winds when nutrients were available to be consumed. A phytoplankton community made up of flagellates and smaller cells occurred seaward of D5, and there was a shift to these smaller cells at D1 to D5 later in the upwelling response, as nutrients were depleted. In 2001 the spatial shift from an inshore community dominated by diatoms to an offshore community dominated by flagellates was much less pronounced. Also different in 2001 was the appearance of picoplankton such as Synechoccocus sp. that were observed towards the end of the field study. In the winter of 2002, a non-upwelling period, flagellates were the primary constituents of the phytoplankton community, and chlorophyll measurements were significantly lower than the June measurements. These inter-annual and seasonal differences in the phytoplankton assemblages are likely attributable to different wind event patterns between the three study years.

OS62A-0236 1330h POSTER

The Response of Nutrients and CO2 to Wind-Driven Coastal Upwelling Measured During the CoOP-WEST study

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Newly upwelled water may have initial pCO2 concentrations two to three times higher than atmospheric values with correspondingly high nitrate and silicate concentrations. With aging of this water the biological pump plays an important role in reducing these concentrations as chlorophyll phytoplankton biomass is produced. pCO2 may be reduced to values well below atmospheric values, and nutrients depleted to near detection levels. Nutrient and pCO2 data were collected during underway surveys modes in the upwelling area near Bodega Bay, California during the CoOP WEST study. High levels of pCO2 ($>$ 1000 μatm) and surface nutrients (nitrate $>$ 40 μM, silicate $>$ 50 μM) were observed during the Spring 2000 and 2002 cruises, which were characterized by persistent winds and strong upwelling. In spring 2001 upwelling was less intense with concurrently lower concentrations of pCO2 and nutrients. The winter cruise (January 2002) showed low concentrations of nutrients and no elevated pCO2 concentrations. The fate of pCO2 and nutrients in these different years will be discussed in the context of the coastal phytoplankton community.

OS62A-0237 1330h POSTER

Productivity Performance of the CoOP-WEST Upwelling Region off Bodega Bay, CA: Comparison With Other Coastal Upwelling Systems.

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The incorporation of upwelled nutrients into phytoplankton by new production offers a means to compare the relative performance of upwelling regions in converting available nitrogen to biomass. The shift-up model of upwelling new production has been used to compare the maximum productivity rates and biomass accumulation of a set of well-studied coastal upwelling systems and evaluate their realization for new production. During the NSF funded CoOP WEST study, we measured new production using N-15 labeled nitrate uptake by different size-fractions of the phytoplankton, along with nutrients and biomass concentrations. The data collected during the CoOP WEST upwelling-favorable cruises in spring/summer 2000, 2001 and 2002 allow a comparison of production during different upwelling nutrient conditions within a single system, and to other previously studied systems. The fate of new production and its performance off northern California is compared with the coastal upwelling locations of Point Conception, California; Monterey Bay, California; Cap Blanc, northwest Africa and 15°S, Peru.

OS62A-0238 1330h POSTER

The Surface Circulation of the Santa Barbara Channel and the Santa Maria Basin Inferred from a Model Simulation (1993-1999) with Data Assimilation

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The 1993-1999 circulation of the Santa Barbara Channel and the Santa Maria Basin is simulated using the Princeton Oceanic Model. Two numerical experiments are carried out: without and with data assimilation. Wind data from ECMWF data set and buoy data are used in the simulation.

The comparison analysis shows that the model result generally agrees with observation and the assimilation of the temperature improves the results. The basic characteristics and seasonal variation of the circulation in this region, such the cyclonic circulation and the convergence and offshore flow at the Point Arguello are shown in the simulation. The analysis of seven-year time series of the model results indicates that there are multiple-timescale variations of the circulation in this region.

OS62A-0239 1330h POSTER

A Modeling Study of Lagrangian and Eulerian Shelf Flows due to Periodic Wind Forcing

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The circulation of fluid on the continental shelf is greatly influenced by the wind stress magnitude and direction. Many shelf regions experience periods of fluctuating alongshelf winds, causing shifts between upwelling and downwelling conditions. The upwelling and downwelling responses are not symmetric. We seek to understand these asymmetries and their implications on the Eulerian and Lagrangian flows. We use a two-dimensional (variations across-shelf and with depth; uniformity alongshelf) primitive equation numerical model to study shelf flows in the presence of periodic, zero-mean wind forcing. The model bathymetry and initial stratification is typical of a broad, shallow shelf during summer. After an initial, transient adjustment, the response of the Eulerian fields is nearly periodic. Despite the symmetric wind stress forcing, there exist both mean Eulerian and Lagrangian flows. The mean Lagrangian displacement of parcels on the shelf depends both on their initial location and on the initial phase of the forcing. The use of mean parcel positions during a cycle for calculating displacements helps to remove the dependence on phase. In an experiment with sinusoidal wind stress forcing of 1 dyne cm^{-2} maximum amplitude and 6 day period, the mean Lagrangian displacements were largest in the surface and bottom boundary layers. Parcels initialized near the bottom within 50 km of the coast can be displaced to the surface at the coastal boundary over several periods. Parcels initially in the upper 10 m within 25 km of the coast form large, irregular orbits, yet remain within this region. Parcels initialized in the middle of the water column offshore of about 15 km form almost closed orbits after one period and migrate slowly downward over many periods. Eulerian mean velocities, in contrast, have no dependence on initial phase. The Eulerian across-shelf mean velocity field shows 2 cm s^{-1} onshore flow in the bottom layer from the coast to 30 km offshore and in the top layer from 10 km to 20 km offshore. Offshore flow of this magnitude is found both onshore of and below the surface region of onshore flow. Corresponding to regions of onshore flow are upward vertical velocities of 1 $\times$ 10^{-3} cm s^{-1} with similar downward velocities in regions of offshore flow.

OS62A-0240 1330h POSTER

Three-dimensional response of the ecosystem to upwelling off the Oregon Coast

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Time-dependent, three-dimensional response of the ecosystem to upwelling off the Oregon coast is studied using the Princeton Ocean Model (POM) and a coupled five-component ecosystem model (NNPZD) (Spitz et al., 2002). The spatial and temporal variability of the ecosystem during the summer 2001 on the Oregon shelf is investigated. High mean surface phytoplankton values are found near the coast and extend over Heceta Bank, with a pattern similar to the cold surface temperature. The standard deviations of phytoplankton are the largest on Heceta Bank, where northward currents associated with a cyclonic circulation are found near the coast during relaxations. Vertical sections show that higher standard deviations are found deeper on Heceta Bank (44.2 N) than at two northern sections (44.7 N and 45 N). This corresponds also to higher standard deviations of nitrate at depth. The maximum mean surface zooplankton is located offshore of the maximum phytoplankton. The low standard deviations of zooplankton found at the surface near the maximum mean zooplankton values indicate that this pattern is a quasi-permanent feature during the 2001 upwelling season. The highest standard deviations of zooplankton are found near the coast and near the 200 m isobath. A complete description of the relative contribution of physical and biological forcing to the ecosystem response will be presented.

OS62A-0241 1330h POSTER

Comparison of Hydrostatic and Nonhydrostatic Models in the Coastal Ocean.

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Models employing the hydrostatic approximation have long been the standard for numerical simulations of the coastal ocean. As computational performance has improved and our understanding of ocean physics developed, these models have been pushed to higher resolution to uncover the role smaller scale phenomena play on the mesoscale circulation. However as the vertical and horizontal length scales of the processes of interest converge nonhydrostatic effects which are neglected by these models become of first-order importance. The dynamics at these scales can involve energetic mixing which may significantly feedback into the larger scale circulation. Examples include the breaking of internal waves and enhanced mixing over small-scale topography. In this study we compare the performance of a hydrostatic model to that of a non-hydrostatic model in two-dimensional coastal ocean settings. The hydrostatic model to be employed is ROMS. The non-hydrostatic model is a version of Clark's cloud-scale meteorological model which has been adapted for oceanic application. Both models are formulated in generalized sigma-coordinates which make them favorable for simulating flow over continental shelf topography. The two models are configured with identical spatial resolutions to accommodate direct comparisons. The generation and propagation of internal waves are compared in simulations of wind and tidally forced stratified flow over topography including a case representative of the circulation at Stonewall Bank off the Oregon coast. Shoreward propagation of large amplitude internal waves established by an imposed displacement of the pycnocline at model initialization is also explored. The comparisons reveal both areas of parameter space where the solutions are comparable and ones where they differ significantly. The most apparent difference in these experiments rests in the inability of the hydrostatic model to represent the balance between non-linear and dispersive effects that arise in internal solitary waves.

OS62A-0242 1330h POSTER

Simulation of Wind-Driven Circulation on the Northern California Coast

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Time-dependent, three-dimensional circulation on the continental shelf off California in the region from 37.75°N to 40.25°N is studied using the Regional Ocean Modeling System (ROMS). ROMS is a free-surface, hydrostatic, primitive equation ocean model that uses generalized sigma coordinates in the vertical and orthogonal curvilinear coordinates in the horizontal. A limited area curvilinear grid with realistic local topography is specified. The grid extends 465 km alongshore and 225 km offshore (204 by 100 grid cells) with 40 vertical levels. The response of the coastal ocean during summer 2001 upwelling conditions to forcing by observed wind stress and estimated heat flux is examined. Strong upwelling favorable conditions persist throughout the majority of the simulation period. The model simulations show an energetic southward coastal jet that dominates the structure of the alongshore flow over the continental shelf. Interaction of the wind-forced flow with headland features leads to separation at Point Arena and Point Reyes. These flow separation events provide a mechanism for eddy generation on the shelf. When upwelling conditions relax, northward currents develop near the coast. These northward currents vary in strength alongshore but are typically stronger to the south of Point Arena and Point Reyes. Comparisons of the model output with data collected during the WEST (Wind Events and Shelf Transport) field experiment will be presented and the associated dynamics discussed.

OS62A-0243 1330h POSTER

Model Dynamical Balances within the California Undercurrent

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The California Undercurrent (CUC) is a subsurface current that flows poleward year-round off the west coast of North America even though the surface wind stress and resulting surface currents are equatorward over a significant part of the domain for much of the year. Poleward undercurrents such as this have been observed along all the major eastern oceanic boundaries of the world, which suggests that the mechanism for their generation and maintenance may be a common one. Despite this, the dynamics of these currents are not well understood. In this work, the CUC is studied by analyzing numerical simulations from the Naval Research Laboratory's Pacific West Coast (PWC) model and Navy Coastal Ocean Model (NCOM). Both are primitive equation models with 30 sigma levels in the vertical and approximately 9 km horizontal resolution, with domains extending from 30°N to 49°N latitudes and from 135°W longitude to the U.S. west coast. For the PWC model, boundary conditions are obtained from one-way nesting within the global Navy Layered Ocean Model, which is a 7-layer, 1/16° ocean model, and surface wind forcing is obtained from the Coupled Ocean-Atmosphere Mesoscale Prediction System (COAMPS) 10 m winds at 27 km resolution for the year 2000. NCOM is one-way nested within a global NCOM model with 1/8° resolution and 40 vertical levels, and is forced by COAMPS surface winds for the year 2001. Both models contain features of a poleward undercurrent, although with significant spatial and temporal variability. An analysis of the momentum balance in the CUC is carried out by depth-averaging terms in the momentum equations, either over the full water column or over an intermediate range of 125 m to 500 m, the typical depth range of the undercurrent. The terms are then projected onto the local direction of depth-averaged velocity to decompose the balance into along-current and cross-current components.

OS62B MCC: Hall D Saturday 1330h

Data Integration, Publication, and Archival (DIPA) II Posters *(joint with GP, V)*

Presiding: **C Constable,** Scripps Institution of Oceanography**; J Helly,** University of California, San Diego

OS62B-0244 1330h POSTER

Virtual Oregon: A Proof-of-Concept for Seamless Access to Distributed Environmental Information

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Virtual Oregon is a new data coordination center established at Oregon State University in order to: (1) archive environmental and other place-based data on Oregon and associated areas; (2) make those data accessible to a broad spectrum of agencies and individuals via innovative web interfaces; (3) identify key data sets that are not yet available and encourage their collection and dissemination; and (4) facilitate development of statewide standards for archiving, documenting, and disseminating data. Rather than co-locating researchers and data in a physical center, Virtual Oregon employs a distributed architecture that occupies multiple locations while users are presented with the illusion of a single, centralized facility. This approach was selected not just to maximize the impact on campus students, faculty, and staff but also to service broader interactions with extension agents and other members of Oregon State's statewide community.

Virtual Oregon builds on regional GIS centers and databanks in a wide range of disciplines, providing decades of research data on topics as varied as coastal processes, climate, biodiversity, land ownership, water quality, wildfire, and agricultural production. There are four distributed nodes, each serving as a center and clearinghouse for distinct types of information and services:

- Department of Geosciences (College of Science): geospatial coverages, digital aerial and ortho imagery and associated base data - Forestry Sciences Laboratory (USDA Forest Service and Oregon State's College of Forestry): ecological and resource management databases; data analyses; data from computational simulations - Northwest Alliance for Computational Science and Engineering (NACSE): databases based on specimen collections, field observation, images, or analysis of historical documents; user interface design - Valley Library: published maps, books and archival publications, gray literature, photographs and video

Data are harvested from a variety of individuals and research centers and maintained in the distributed nodes using enterprise RDBMS products (Oracle, Sybase, and Microsoft SQL Server) residing on UNIX and Windows platforms. Query Markup Language (QML, a middleware product developed at NACSE) supports database-to-Web interactions by transparently performing queries across multiple RDBMSs and displaying the results as though from a single source. Web-based mapping interfaces (powered by ESRIs Internet Map Server and Spatial Database Engine products) can also be used to explore data visually.

In a proof-of-concept under development, users currently have the option of beginning with either the "thematic" or "place-based" interfaces. Ultimately, users will be able to move freely back and forth between the two paradigms, for example initially narrowing the scope of inquiry based on discipline or attributes, moving to the visual interface to refine the search based on location or some set of geospatial characteristics, then moving back to query-based exploration to delve to fine levels of detail. Usability engineering methodologies are being applied so that all navigation and query mechanisms are both maximally productive and easily learned by novices.

URL: http://virtual-oregon.nacse.org

OS62B-0245 1330h POSTER

New Challenges in Sample-Based Data Implementation

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Geochemical data on rocks are now widely available in relational databases (PetDB, GEOROC, NAVDAT) served over the internet, using the schema of Lehnert et al. (2000). The widespread access to data has significantly increased the overall efficiency of researchers. It has aided the complete range of research activities including teaching, proposal writing and publication, and allows people from related fields to address geochemical problems (e.g Kellogg 2002).

Future advances have to include more than simply adding more analytical data in the same formats: (1) A scheme of universal sample identification will be essential for terrestrial samples to allow compilation of data from different sources on the same sample. How to develop and implement such a scheme is challenging and should happen in coordination and cooperation with existing and emerging efforts for terrestrial sample archives (e.g. Goldstein et al., 2001). (2) The ability to integrate geochemical with geophysical and geological data is vital. Visualization of data on maps and comparison of geochemical data to grid-based data presentations requires effective integration of relational databases with GIS and other information technologies such as XML. The industrial and government orientation of widespread commercial products may not satisfy the specific and flexible needs of researchers. (3) Easy access to other published material needs to be dealt with in terms of intellectual property. For example, published sample location maps are often not available in digital format, and reproduction of those (copyrighted) maps from publications, with links to the data would be valuable. It would also be useful to provide access to pdf files of complete publications through a simple database link, which would require a different level of cooperation with publishers. (4) Derivative products that compile data from different sources and their presentation on appropriate maps or other visualizations would be a further advantage for a wide variety of research problems. Automated update of such products would require successful resolution of the previous three challenges.

Goldstein, S.L., W. Melson, Geochemical News: 108: 19-20, 2001.

Kellogg, J.B. et al., Geochim Cosmochim Acta 66, A391, 2002.

Lehnert, K. et al., Geochemistry, Geophysics, Geosystems 1, 2000.

URL: http://www.ldeo.columbia.edu/RidgePetDB

OS62B-0246 1330h POSTER

The Integration and Enhancement of Seafloor and Land Topography With Satellite Data

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This presentation will illustrate several useful techniques to integrate disparate marine and land data. Six data sets were combined, so that a variety of geophysical information is represented while preserving spatial detail through the entire elevation range. There is significant utility in bringing these data together in a single map/image.

The color component of the image depicts bathymetry in the marine setting and vegetation distribution on the land areas. The colors of the marine portion of the image were derived from Smith and Sandwell's bathymetric solution below 72 degrees of latitude and ETOPO5 data above 72 degrees of latitude. The color is scaled to accentuate bathymetric features, such as the continental shelf and mid-ocean ridges. The color component of the land was enhanced from an AVHRR false color infrared dataset that was acquired from WorldSat International. These colors on the marine and land data sets were draped over the textural component of the image. A key objective of this map was to preserve as much of the tectonic detail as possible for the complete bathymetric and topographic range. The marine textural information was derived from Sandwell and Smith's bathymetric and gravity solutions. The land texture came from