OS43A CC: 220 C-E Thursday 1330h

Ocean Sciences Posters II

Presiding: **K Lamb,** University of Waterloo**; B Qiu,** University of Hawaii at Manoa Department of Oceanography

OS43A-01 1330h POSTER

Beach Profile Behaviour in Tidal Environments: A Morphological Model

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Tourism is an important economical activity in Spain that represents 10% of its GDP and provides a million jobs. Spain is the world's second more visited country, receiving 7% of world tourists. Eighty per cent of these visitors choose their destination somewhere along the 2500 km of beaches. Consequently, many efforts are currently addressed to their maintenance and conservation. However, the coastal management policies must be sustained by the deep knowledge of the beach behaviour and the physical processes implied. A morphological model, with certain predictive capacities, to describe the beach profile behaviour is proposed, integrating the wave and tide influence. It is based on the concept of the two-section (surf and shoaling) equilibrium beach profile, and has been validated with field and laboratory data. The model is described by means of two parameters: the modal tidal range and the dimensionless fall velocity (Ω). Tide is considered a local variable whose principal effect is the lengthening of the intertidal or surf profile. The greater the tidal range, the wider the intertidal profile. The dimensionless fall velocity defines the transition from dissipative to reflective situations in beaches of any given tidal range. The morphological changes predicted by the proposed model in the surf and shoaling sections occur in the opposite direction. Whilst in the surf profile the slope close to the high tidal level becomes steeper and the concavity of whole section increases; in the shoaling profile, the upper part flattens resulting in a less concave section related to the decrease of Ω. In this transition, the slope break between surf and shoaling profiles becomes smoother and difficult to identify. This work was funded by projects REN2003-02822 MAR, REN2003-03233 MAR, VEM2003-20093-C03-03 of the Spanish MCYT and PGDIT03RMA30101PR of the Galician Government (XUGA). Contribution No. 304 of XM2 group.

OS43A-02 1330h POSTER

Recent Developments of the Mercator Assimilation System (SAM): Towards the Seek Filter

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The French MERCATOR project is developing several operational ocean forecasting systems to take part in the Global Ocean Data Assimilation Experiment (GODAE). Prototype systems are designed to simulate (1) the Atlantic and Mediterranean Sea (from $1/3^o$ to $1/15^o$), and (2) the global ocean circulation (from 2^o to $1/4^o$). The first generation assimilation scheme referred to as SAM1 has been implemented in the operational system. It provides routine weekly analyses and forecasts. SAM1 includes an altimetry-only version (SAM1-v1), and a fully multivariate version (SAM1-v2) permitting to assimilate vertical profiles and SST in addition to altimetry (JASON, ERS-2 and GFO). The SAM1 scheme is based on the SOFA reduced order interpolation scheme (LEGOS, Toulouse). It uses vertical/horizontal separation of error statistics, and order reduction in the vertical in terms of multivariate Empirical Orthogonal Functions (EOFs) of temperature: T, salinity: S, and barotropic streamfunction: ψ. The next generation assimilation system referred as SAM2 is being developed from the SEEK (Singular Evolutive Extended Kalman) algorithm (LEGI, Grenoble). This scheme is a Reduced Order Kalman Filter using a 3D multivariate modal decomposition of the forecast error covariance as well as an adaptive scheme to specify parameters of the forecast error. The use of the SEEK filter and its 3D modal representation for the error statistic is intended to overcome some of the limitations of SAM1 in highly inhomogeneous, anisotropic, and non-separable regions of the world ocean such as shallow areas, as well as in the surface layer. A second objective for SAM2 will be to consistently propagate error estimates between successive assimilation cycles. We also developed several methods in order to generate 3D EOF basis both from local or global EOF calculation. Comparisons between these various multivariate approaches (SAM1 and SAM2) will be presented and discussed.

OS43A-03 1330h POSTER

NEW DATA OF RIA DE VIGO SHALLOW GAS FIELDS (NW SPAIN)

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The Ria de Vigo is located on the passive Atlantic margin of southwestern Galicia (NW Spain), the ria coast known as Rias Baixas. The Ria de Vigo physiography presents a distinctive funnel shape, with an areal extent of 176.4 km2. San Simon Bay is a small shallow basin located at the innermost part. It consists of an N-S elongated embayment of 10 km long and 4 km wide with a maximum depth of 10 m. Rande strait connects this bay with the rest of the Ría de Vigo which has a N45E of main axis and 55 m of maximum water depth as its mouth. The ria and its inner bay have a clear tectonic control related to the major faults systems (NE-SW, N-S). The most significant freshwater input to the ria comes from several relatively small rivers that flow into San Simón Bay, which behaves as an estuary. The rest of the ría is under strong oceanic influence (tides and waves) and exhibits a residual circulation in two layers. Winds play an important role in the circulation causing upwelling and downwelling cycles with a strong seasonal pattern which provoke higher marine productivity in summer than during winter. Interpretation of new high resolution seismic records (2004 survey) has allowed mapping of shallow gas accumulations and gas seeps in San Simón Bay for a first time. X-ray photographs and voids of cores are semi-indirect evidences of gassy sediments. Furthermore, bubbles of gas coming out from the seabed in San Simon Bay have been digitally recorded in the Rias Baixas. Analyses (GC-MS) of bubble samples confirm the presence of methane. Preliminary isotope data indicate a biogenic origin of this gas. Concerning to the generation of gas in San Simón Bay, it is suggested that there are three different sources of biogenic gas: (1) microbial methane generation from the organic matter accumulated in the subtidal sediments, (2) drainage of an ancient peat horizon located under the present intertidal sediments and (3) fluids migration throughout faults. It is interpreted that the present location of the peat horizon and the cemented beach facies correspond to variations in the relative sea-level. These variations in San Simon Bay are due to the combination of tectonic and the global rise of sea level occurred after the last glacial episode.

OS43A-04 1330h POSTER

THE PRESENT SEABED OF THE GALICIAN "RIAS" AND THE ADJACENT CONTINENTAL SHELF (NW SPAIN)

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New data from the continental shelf off the southwest of Galicia are presented. The objective of this study is to characterize the present seabed topography, geomorphology and surface sedimentary distribution of the three major Galician Rias (Arousa, Pontevedra and Vigo) and their adjacent continental shelf. For the performance of a detailed bathymetry, available echo sounder data were processed and interpreted. Side Scan Sonar and High Resolution Seismic lines (540 km) were studied in order to elaborate a geomorphological seabed map. The sedimentological analysis of a total of 702 Shipeck samples has allowed us to also perform the grain size distribution map of the area. The obtained bathymetry shows that the seabed topography of the rias is very irregular with a maximum depth of 50 m at their mouth. The adjacent shelf presents a flat profile, showing small irregularities due to the existence of rocky outcrops and coarse sandy patches. Sediments on the seabed of the rias are composed of both terrigenous and biogenic deposits with a major axial deposit of cohesive sediments relatively rich in organic matter. Towards the shoreline and in the outer part of the rias, sediments become coarser and are mainly composed of mixed siliciclastic and skeletal sand or gravel. In the case of the Ria de Pontevedra, the main deposit of finer sediments is located at the inner part of the ria, where marine energetic conditions are less important. In the Rias de Vigo and Arousa finer sediments are also deposited along its central axis. In the shelf, two sandy mud patches occur at depths ranging from 100 to 130 metres with a variable width ranging from 2 to 11 km and a total length of approximately 70 km. These mud areas are controlled both by hydrodynamics and topography. At the southernmost part of the inner shelf, a gravely sand belt occurs all along the shelf parallel to the plutonic and/or metamorphic outcrops lineation which separates the shelf from the rias, at depths ranging from 80 to 100 metres. Despite several authors attribute these sediments a fluvial origin from the portuguese river systems in the south, we consider that this gravely-sand belt appears as a combination of the local erosion of the nearby outcrops and the reworking of relict sediments from the rias. At the middle shelf, and parallel to the mud patches, an elongated field of muddy sand is located at an average depth of 140 metres. It is interrupted by a coarser grain size patch in front of the southern mouth of the Ria de Vigo. The outer shelf is characterized by the presence of a large field of sands, probably relicted. They are supposed to have laid down during the last glaciation, smoothing out the pre-existing topographical features.

OS43A-05 1330h POSTER

Heat Balance in the Subantarctic Mode Water From ARGO data

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Two years of data from the ARGO float array are exploited to observe the formation and modification processes of Subantarctic Mode Water (SAMW). The seasonal cycle, in terms of mixed layer depth and temperature cast, is well resolved and we focus on the seasonal heat budget. The question of a dominant balance in the oceanic budget between ocean heat storage and air-sea fluxes is explored. Heat content calculations conducted using the float profiles are compared with a newly developed satellite air-sea flux and NCEP climatological products. Mixed layer depths are computed and the role of Ekman transport is considered.

URL: http://argo.ocean.fsu.edu

OS43A-06 1330h POSTER

The Relationship Between the Diagenetic Cycles of Reducible Iron and Manganese Oxides and Dissolved Organic Carbon (DOC)

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Field evidence suggests that the fate of sedimentary DOC is intimately linked to the diagenetic cycles of iron and manganese in marine sediments. Co-variations of their concentrations in sediment pore water [1], as well as the release of DOC upon the reductive dissolution of authigenic iron and manganese oxides [1] suggest that sorption (i.e., co-precipitation and/or adsorption) onto these oxides may play an important role on the diagenetic behavior of DOC. Whereas the diagenetic cycling of iron and manganese between oxic and

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suboxic sediments is well documented, DOC pore water gradients have most often been interpreted uniquely as indicative of a flux of DOC out of the sediments to the overlying bottom waters [2-5]. This interpretation stems from our inability to resolve a subsurface DOC sink from the vertical distribution of sedimentary particulate organic carbon (POC). This DOC sink, if it exists, would considerably alter our views of the mechanisms that regulate DOC fluxes across the sediment-water interface as well as their quantification. Sorption onto authigenic metal oxides may also lead to a molecular and isotopic fractionation of DOC. Furthermore, if DOC sorption to metal oxides is a reversible process, it may buffer pore water DOC concentrations and release to the overlying waters. Oxic surface sediments recovered from the St. Lawrence Estuary and the Saguenay Fjord were incubated under anaerobic conditions and extracted with a mild reducing agent to determine the amount and composition (molecular and isotopic) of the DOC associated with the authigenic iron and manganese oxides. Preliminary results from the study will be presented. References: [1] Deflandre et al. (2002) Geochim. Cosmochim. Acta, 66; 14, 2547-2558. [2] Alperin et. al., (1999) Geochim. Cosmochim. Acta, 63; 3-4, 427-448. [3] Burdige et al., (1999) Geochim. Cosmochim. Acta, 63; 10, 507-1515. [4] Holcombe et al., (2001) Limnol. Oceanogr., 46; 2, 298-308. [5] Papadimitriou et. al. (2002) Mar. Chem., 79, 37-47.

OS43A-07 1330h POSTER

Contributions of Wind Forcing and Surface Heating to Interannual Sea Surface Height Variability in the Atlantic Ocean.

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Inteannual sea surface height variations in the Atlantic Ocean are examined from 10 years of high-precision altimeter data in light of simple mechanisms that describe the ocean response to atmospheric forcing: (1) local steric changes due to surface buoyancy forcing and a local response to wind stress via ekman pumping, and (2) baroclinic and barotropic oceanic adjustment via propagating Rossby waves and quasi-steady Sverdrup balance respectively. It is shown that most of the interannual sea level variability is related to local response to heat fluxes changes (more than 50% in the eastern North Atlanic). Except in a few places, a local response to wind stress forcing is less successful in explaining sea surface height observations. In this case, it is necessary to consider large scale oceanic adjustments: first baroclinic mode forced by wind stress explain more than 30% of interannual sea level variations in the eastern North Atlantic or in the South Atlantic (between 30 and 40 $^{\circ}$ S) and in the range of 70 % in the latitude band 17-20 $^{\circ}$N. A quasi-steady sverdrup response is also observed between 40 and 45 $^{\circ}$N.

OS43A-08 1330h POSTER

Multi-Platform Seabed Classification of Georgia Strait, British Columbia (Canada)

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This paper presents the results of a multi-platform seabed classification in Georgia Strait. This study is part of an NSERC CRD project to establish a methodology to efficiently develop a comprehensive understanding of the seabed, based on the integration of the classification of acoustic data from multiple sonar platforms with suitable auxiliary groundtruth data. Two different data sets are classified and integrated in this paper. Classification of the backscatter of Simrad EM1002 multibeam data generated a high spatial resolution map related to the seafloor geology. Classification of high-resolution Huntec seismic lines in the same area produced a map of the subbottom seabed geology that can be compared to the multibeam seafloor classification map. The main challenge addressed in this paper is that EM1002 often operates in 3 discrete modes to optimize the quality of the bathymetric data. Generally these modes are depth related, with a longer acoustic pulse used in areas where the seafloor is deeper. For classification purposes, this means that each mode has to be treated separately, because the pulse length strongly influences the backscatter statistics. From here, a general multibeam classification was developed from the 3 separate classification results and integrated with the seismic classification results.

OS43A-09 1330h POSTER

Testing the Reliability and Sensitivity of Foraminiferal Transfer Functions Based on the Modern Analog Technique (MAT)

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Quantitative estimates of past sea-surface temperatures (SST's) based on surface sediment calibration data sets of planktic foraminifers and modern SST's have been widely used in the interpretation and modeling of past climates. One widely used approach, The Modern Analog Techniques (MAT) relies on comparing a downcore sample to the Brown University modern Global Data Base of 1265 seabed samples and choosing either the10 or 5 most similar modern samples using the squared-chord distance similarity metric. The SST's above the best modern analogs are then averaged to produce the downcore SST estimate. We have chosen a set of 8 modern sea-bed samples from the Global Data Base with a wide range of foraminiferal compositions; 3 from the Pacific, 3 from the Atlantic, and 2 from the Indian Ocean and have generated duplicate foraminiferal census counts from sets of 5-6 random splits from each of our 8 samples so that we can: 1. compare the degree of similarity between duplicate samples so that we can evaluate the differences in dissimilarity values that can be attributed to counting error and begin to better understand the sensitivity of the chosen dissimilarity measures to ecologically produced differences in foraminiferal composition, 2. evaluate differences in how the duplicate samples choose analogs from the Global Data Base, and 3. test the sensitivity of the MAT's ability to accurately and precisely predict SST's using analogs from the Global Data Base for each set of duplicate samples. Comparison of the dissimilarity coefficients within each set of duplicate samples produces maximum dissimilarity values that range from 0.03 to 0.14. Both mean and maximum dissimilarities are greatest in sample sets from the low latitudes. The 5 best analogs chosen from the Global Data Base for samples within each set of duplicates generate average dissimilarities that range from 0.01 to 0.04. However, between a total of 8 and 12 different modern analogs were needed to find the 5 best analogs for all the samples within a particular set of duplicates, with no regional pattern in this number observed. The warm and cold SST estimates generated using the SST's above each of the 5 chosen analogs exhibit a wide range of variation, particularly for the three sample sets from the high latitudes. The three subpolar sample sets exhibit a 3.4, 1.1, and 1.0 degree C range in their cold SST estimates. There is no clear relationship between differences in SST estimates and differences in the average dissimilarities within duplicate sample sets. Using 10 instead of 5 modern analogs to estimate SST's produces somewhat better results for 4 of the 8 sample sets and similar results for the remaining 4. Our results suggest that foraminiferal samples with dissimilarity values of up to 0.15 are not detectably different from duplicate foraminiferal census counts and should be considered excellent modern faunal analogs for any fossil sample. In addition high latitude samples seem to be produce somewhat less reliable SST estimates than low latitude samples. Finally, our results suggest that, when estimating past SST's choosing to average the SST's above the 10 best analogs produces more accurate (and precise) results, particularly in situations where the Global Data Base contains adequate modern analogs.

OS44A CC: 520 A Thursday 1530h

Rachel Carlson Lecture *(joint with U)*

Presiding: **J A Carton,** University of Maryland

OS44A-01 1535h

Beyond Correlations: the Search for Mechanisms Underlying Coupled Climate/Ecosystem Variability in the Oceans

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Correlations between variables describing some part of the earth's climate system and others associated with some part of oceanic ecosystems are widely used to suggest the existence of causal linkages. I will consider the dangers inherent in using such correlations for predictive purposes, and argue that real predictive skill demands identification of the underlying connective mechanisms. As an example, I will describe a possible mechanistic explanation for observed correlations between the winter state of the atmosphere over the North Pacific Ocean and the success of various North Pacific salmon fisheries. This same context will be used to demonstrate that the crucial final step, that of testing candidate mechanisms, is presently severely limited by lack of long-term data sets that include biological variables other than fish catches. Identification and understanding of the mechanisms connecting variability in climate and large marine ocean ecosystems is both economically essential, and increasingly urgent as the earth's climate system moves into states outside the experience of observational earth sciences in the modern age.

OS51A CC: 524 C Friday 0830h

General Ocean Sciences II

Presiding: **H Sun,** Rider University**; J E Friddell,** ERDC-Cold Regions Research and Engineering Laboratory

OS51A-01 0830h

Decadal Changes in the North Atlantic Subpolar Circulation

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Observations of sea surface height reveal that dramatic changes have occurred over the past decade in the mid-to-high-latitude North Atlantic Ocean. Altimeter data from TOPEX/Poseidon mission show that subpolar sea surface height increased during the 1990s and the geostrophic velocity derived from altimeter data shows a decline in the subpolar gyre circulation. Combining the data from earlier satellites, Seasat (1978) and Geosat (1985-1988), we find that at the late 1990s the subpolar circulation may actually be considerably weaker than in the (late 1970s and) 1980s. Direct current-meter observations in the boundary current of the Labrador Sea support the circulation trend of the 1990s and, together with hydrographic data, show that the mid-to-late 1990s decline extends deep in the water column. Based on analysis of the local surface forcing we find that buoyancy forcing over the northern North Atlantic has a dynamic effect consistent with the altimeter data and hydrographic observations: a weak thermohaline forcing and the subsequent decay of the domed structure of the subpolar isopycnals would support the observed decline of the gyre circulation. Only continued remote and in situ observations will show whether this 1990s change is temporary or part of much longer term variability.