

removed, there were no apparent differences in parasite species diversity or equilibrium between streams or between sites within streams. High nitrate levels in aquatic systems are indicative of eutrophication and may be harmful to wildlife and humans. Our study adds to the developing knowledge of bio-indicators of environmental quality in stream habitats.

OS11F-86 0830h POSTER

Heavy Metal Uptake of Biotic Versus Abiotic Sediment Sources in the Filter Feeding Blue Mussel *Mytilus Trossolus*.

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Within freshwater and marine ecosystems, bivalves occupy an important intermediary position linking lower trophic to higher trophic level organisms. Bivalve invertebrates are excellent candidates for metal uptake studies due to their feeding behavior, their widespread abundance in North American marine ecosystems, and the fact that they are major food sources for higher order vertebrates. In order to quantify the amount of metal being transferred from the environment into biota, basic variations in ecosystems and organism behavior need to be considered. Given their ecological and economic importance, research investigating the various geochemical and physiological conditions that maximize metal accumulation in these species is needed. As a consequence, my research focuses on the uptake of biotic and abiotic sediment components by the blue mussel, *Mytilus trossolus*. My primary hypothesis is that the blue mussel uptakes an equivalent or greater concentration of heavy metals via its diet due to the ingestion of organic particles contaminated with metals versus just inorganic metal particles.

M. trossolus is an intertidal filter feeding bivalve that is able to adapt its ingestion rate of suspended particles based on carbon content and particle size. Keeping this unique behavior in mind, feeding various sediment matrices that fall within the preferred particle range of *M. trossolus* (under 100µm) is key in ensuring a maximal uptake rate. In addition, both high and low carbon sources have been combined with particle size in producing synthetic feeding matrices. In-lab feeding experiments using various synthesized biotic (bacteria) and abiotic (Cd, Mn, Pb oxides) food sources have given us valuable information on the uptake and potential toxicity of heavy metals. Upon the completion of these experiments, an Atomic Absorption Spectrophotometer was used to analyze over 500 mussel tissue samples for the presence of the above metals. Using these results, I have been able to determine that both abiotic and biotic sources of metal uptake need to be considered when monitoring heavy metal transfer within ecosystems.

OS11F-87 0830h POSTER

The Effect of Elevated CO₂ Detritus on the Foraging Decisions of Crayfish (*Orconectes virilis*)

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With the atmospheric concentration of CO₂ expected to double in the next 50 years, research elucidating impacts to the biosphere are important. Many tree species show a decreased nutritional quality of leaves when reared under elevated CO₂ conditions. In riparian lotic systems where leaf litter comprises up to 99% of the carbon foundation of the food web, changes in leaf chemistry as a result of increased CO₂ may affect the behavior of organisms that feed on those leaves. Crayfish are macroinvertebrates in these lotic systems that locate food by chemoreception. A y-maze was used to determine crayfish preference for detritus reared under the current CO₂ concentration of 360 ppm (ambient, AMB) or twice the current concentration, 720 ppm (elevated, ELEV). Stimuli consisted of: 1) fresh detritus, 2) detritus leached for 24 hours, and 3) leachate from detritus. Within these preparations were three treatments with pair-wise combinations of stimuli: AMB x CONTROL, ELEV x CONTROL, and AMB

x ELEV. Behavioral parameters measured from videotapes were initial arm choice, time spent in each arm, and time spent at each source. Initial arm choices were tested with a Chi Square and times were tested with paired t-tests within each treatment. Crayfish preferred AMB stimulus over ELEV or CON when offered fresh detritus or leachate. There were no differences in the ELEV x CON treatment. When offered leached detritus, crayfish showed no preference for any stimuli. These results demonstrate that crayfish can discriminate chemically between AMB and ELEV detritus, that AMB detritus is preferred, and that crayfish are attracted by chemicals diffusing from the leaves. Since, as omnivores, crayfish can function as keystone species in detritus-based systems, these changes in crayfish foraging decisions can affect the whole community.

OS11G HC: Hall III Monday 0830h

Coastal Sedimentation I

Presiding: M A Allison, Tulane University; C A Nittrouer, University of Washington

OS11G-88 0830h POSTER

Wave propagation simulations in muddy environments along the Louisiana coast

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Much of the insight into nearshore hydrodynamic processes (waves, currents, sediment transport) gained recently is due to a series of massive field experiments (eg. Duck '97) conducted on nearly plane beaches of medium grained, quartz sand. Worldwide, though, approximately 80% of non-rocky coastal regions are mixed sand, silt, and mud, often dominated by cohesive sediments. The applicability of existing numerical models to these environments is doubtful.

In this work, the effects of different sedimentary environments on wave propagation along the Louisiana coast are compared using three months of WAVCIS wave and wind observations and SWAN-based numerical simulations. We focus on two locations: at station CSI-3, south of Atchafalaya Bay system, in a cohesive sedimentary environment; and CSI-5, located south of the Terrebonne Bay, in a sandy environment. Despite virtually identical local wind measurements, observed wavefields differ significantly, with across the spectrum wave attenuation observed in the muddy environment. Comprehensive numerical simulations were conducted using SWAN with nowcast wind stresses from the Navy COAMPS model at 0.2 degree resolution. As expected, simulation results compare well with observations for the CSI-5 site, while at CSI-3 wave energy levels are significantly over-predicted.

The results illustrate the weak performance of current wave models in cohesive sedimentary environments, and demonstrates the magnitude of their wave attenuation effects in comparison with other mechanisms.

URL: <http://wavcis.csi.lsu.edu>

OS11G-89 0830h POSTER

Fluid mud Sedimentation on the Innermost Western Louisiana Continental Shelf

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The Atchafalaya River is a major tributary of the Mississippi River and discharge is leading to the formation of a new delta lobe. Sediment deposited by the Atchafalaya is transported westward by storm currents parallel to the coast. The Atchafalaya experienced a period of high discharge in March 2001, associated with spring runoff. Sediment cores were taken in May 2001 from the inner Louisiana Shelf 100 km

west of Atchafalaya Bay and landward of the 10 m isobath. Box cores displayed an apparently continuous gradient from muddy water to watery mud, rather than an obvious sediment-water interface. Cores were analyzed for grain size, porosity, radioisotopic activity and x-radiography. Preliminary analyses reveal a high porosity (<95%) mud layer 15-23 cm thick that contains vertically uniform ⁷Be activities. X-radiographic inspection reveals the lack of biologic activity so isotopic profiles probably reflect primary physical deposition associated with Atchafalaya discharge and storm driven along-shelf transport.

OS11G-90 0830h POSTER

Seasonal trends in sediment dynamics on the Po River continental shelf

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With the objective of learning how sedimentary processes create strata in a shallow, deltaic setting, we have initiated investigation of sediment dynamics on the Adriatic continental shelf at the mouth of the Po River. This work uses a combination of water-column profiling and bottom-boundary-layer time-series measurements for the period from December 2000 to October 2001.

In October 2000, a 100-year flood event on the Po River deposited a sediment layer up to 15 cm thick on the continental shelf. When discharge was still elevated soon after the flood (December 2000), water-column profiling following the flood showed the surface plume to be patchy, with lowest salinity and highest suspended-sediment concentrations close to the main distributaries of the Po. The surface plume over the shelf was generally 1.5 m thick and contained suspended-sediment concentrations of up to 50 mg/L. During the spring survey, the surface plume thinned to less than 0.5 m, and had low concentrations (< 25 mg/L). Intermediate nepheloid layers were seen at shallow depths (12-17 m water depth) throughout the year, but primarily during June 2001 along transects in the vicinity of the main distributaries. These layers appear to correspond with a weak density contrast. A bottom nepheloid layer was observed during all cruises, but primarily during December 2000 and January 2001, when conditions in the Adriatic Sea were energetic and recently-deposited sediment may not have been highly consolidated.

Sediment was actively resuspended during storms, as seen in the correlation between wave orbital velocities and suspended-sediment concentrations measured at the tripod location. At the time-series location (12-m water depth) the sediment flux was primarily to the south-east during the winter and spring, in events consistent with forcing by the strong, cold, Bora winds. Although sediment concentrations are low throughout the water column during profiling, < 50 mg/L, we do see significant concentrations, up to 2 g/L (12-cm above the bed) in the time-series measurements of sediment concentrations during large wave events. Rapid sediment deposition from the surface plume appears to occur in response to river discharge events on the Po continental shelf. Subsequent storm events can cause transport in intermediate and bottom nepheloid layers, which move sediment away from the zone of rapid deposition during the flood.

OS11G-91 0830h POSTER

The use of In-line Laser Holography in the Analysis of Sediment Erosion

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Coastal sediment stability has been extensively studied through the measurement of the critical shear stress required to initiate particle erosion, using instruments such as the cohesive strength meter (CSM) and the Gust microcosm, among others. Such work has included analysis of the biogenic stabilisation potential arising from the growth of benthic algae, principally diatoms, as a biofilm on the sediment surface. The production of extracellular polymeric substances (EPS) by algae contributes to this stabilisation by forming a gel-like matrix at the sediment surface. Low-temperature scanning electron microscopy (LTSEM) has been used to visualise the microfabric of the sediment, in particular the binding of sediment particles by the EPS.

This present study extends this work by investigating the nature of the eroded particles using in-line laser holography. A ruby red laser was passed through a microcosm erosion chamber in which artificial and natural sediments were eroded. A three-dimensional holographic image of the particle field above the sediment was recorded in which eroded particles could be examined independently or as part of the erosion field. Initial work used a variety of sediments (sand, glass beads, mud) with different concentrations of added EPS and demonstrated the importance of EPS in determining the tertiary structure of the eroded flood material. In addition, the influence of natural biofilms grown in situ was also investigated. Data presented will include analysis of the fine scale structure of the sediments using LTSEM linked to critical stress conditions and the eroded material. This combined approach of LTSEM and holography under controlled stress conditions gives new information on the mechanisms of biogenic stabilisation by polymer secretions. Initial holographic studies have shown good resolution for discrimination between EPS, sediment particles and diatom cells, and shown the erosion process using particle field holography for the first time.

OS11G-92 0830h POSTER

Evidence for Widespread Mixing-Induced Convective Sedimentation from Surface Plumes

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Water from a flooding river intruding into the ocean typically results in a surface layer of sediment-rich water over a saline ambient fluid. One mechanism by which the sediment from these hypopycnal plumes can fall through the stratified and stable water column is convective sedimentation (CS). CS can take many forms, but refers to the effective removal of material without allowing it to separate from the surrounding fluid. Preliminary experiments of CS using natural sediment in a quiescent settling tank were performed to measure the subtle signatures (temperature, salinity, and sediment concentration) of CS processes. These experiments aid in the characterization of the diverse physics that can impact CS, and they help guide future modeling efforts. In addition, we have constructed a new experimental facility, which uses a race-track flume to produce a steady flow of sediment laden freshwater above a saltwater basin. A series of experiments with natural sediment from the Eel River were conducted in this facility to accurately simulate the turbulence structure of a highly-concentrated river mouth. These experiments were performed such that the viscous dissipation rate is reflective of natural river plumes. We have established that CS will occur at riverine sediment concentrations commonly found on many river margins (400-600 mg/L). The results of these experiments show that convection is dependent on sediment concentration, water-column stratification, and dissipation rate. Application of these results show that CS can be found on most small mountainous river systems and that the flux of sediment due to CS can be at least as strong as flocculation-enhanced settling.

OS11G-93 0830h POSTER

Seasonal Deposition of Sediment Near the Mouth of the Po River

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In October 2000, a 100-year flood of the Po River occurred. ⁷Be, a short-lived radioisotope (half-life 53.3 days), was used to examine the thickness of the flood deposit during a cruise in December 2000. The deposit was found to have thicknesses up to 15 centimeters and was located immediately adjacent to the distributary channels at the river mouth. Without knowing the source function for ⁷Be discharge, ⁷Be thicknesses might be minimum estimates for true thicknesses of the flood deposit. The location of the deposit is linked to the low-energy conditions present in the Adriatic Sea at the time of flood sedimentation. The flood signature was identified in x-radiography (physical stratification), ⁷Be (uniform activities), and grain size (high clay percent). The Po deposit differs significantly from deposits observed after floods of the Eel River (northern California). A major difference between the flood deposits is the location (at the Po River mouth; seaward and downstream of the Eel River mouth), which highlights the distinct difference in energy conditions of the Adriatic Sea and the North Pacific Ocean.

Subsequent cruises in June 2001 and October 2001 have followed the fate of the Po flood layer, and have examined changes occurring during the winter/spring and the summer months, respectively. These studies have found depositional layers exhibiting different trends than those observed in December 2000. The causes of these differences could be related to varying influences of the deltaic distributaries and to subsequent transport and mixing of sediment. The significance of these seasonal variations for the longer-term sediment-accumulation pattern near the Po River can be observed (e.g., through use of ²¹⁰Pb geochronology; half-life 22.3 years) along the sediment dispersal path southward.

OS11G-94 0830h POSTER

Pattern of Sediment Distribution in Setentrional Coast of Rio Grande do Norte State, Northeastern Brazil

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Systematic mapping of the Setentrional Coast of Rio Grande do Norte State, northeastern Brazil, between Sao Bento do Norte and Macau cities, reveals the pattern of sediment distribution on this area. This domain belongs to a larger complex in PETROBRAS oil exploration research. The study area configuration was strongly affected by a Mesozoic-Cenozoic vertical tectonism. Geologically, the area is part of the Potiguar Basin. The terrestrial portion of the basin has a trough limited by NE-SW faults. The offshore portion of the basin is limited by E-W and NW-SE faults that form the boundaries of a homocline dipping towards the ocean. The graben and horst structures present on the Potiguar Basin played an important role on the shelf morphology and sedimentation. A sediment distribution chart for this area was obtained on basis of interpretation of remote sensing images, seismic profiles (side scan sonar, ecobathymeter and Boomer), as well as surface sediment sampling on the shelf and vibrocore on the shoreline. Analysis of this data set shows that the oceanographic and geomorphological features as well as the coastal evolution and tectonic setting of the northeastern coast of Rio Grande do Norte State may explain the distributional pattern of sediment found around this coastal zone. Sand dune fields, lagunes, mangroves and sand spits characterize the shoreline. A minimum of four beachrock lines are found both on the shoreline and on the inner shelf. Seaward a belt of siliciclastic sands are found nearshore along the longshore drift followed by a complex of mixed carbonatic-siliciclastic medium grained sands at intermediated zone while bioclastic gravel are found most after 10 m water depth. The biogenic content is mainly represented by coralline algae (Melobesya and Halimeda) and benthonic foraminifera although we can find ostracode, gastropode and bivalves in minor amounts. Quartz is the principal component in the terrigenous sediments with heavy minerals as accessory. Mud sediments are restrict to areas near estuaries and on river canyons. Side scan sonar records reveals a seabed covered by well-developed sandwaves of different scales, showing the efficiency of longshore drift. Boomer records show the existence of paleo-channels cutting the Galinhos spit, confirming ancient system of island barrier developing for the current spit.

OS11H HC: 316 B Monday 0830h

The North Atlantic Ocean and Its Changing Climate I Climate

Presiding: B Dickson, CFEAS, The Laboratory; T M Joyce, Woods Hole Oceanographic Institution

OS11H-01 0830h INVITED

Exploring the Role of the Atlantic Thermohaline Circulation in Rapid Climate Change

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Ocean-atmosphere interactions in the North Atlantic are responsible for heat transports that keep northwestern Europe 5-10°C warmer than it would otherwise be. This is caused by the ocean's thermohaline circulation (THC), driven by temperature and salinity differences. However, existing THC patterns might not continue: climate models suggest that the increasing atmospheric greenhouse-gas burden could dramatically weaken the THC and associated circulation systems within a few decades. Furthermore, palaeo-data indicate large and rapid variability in North Atlantic THC strength during the past 20,000 years, and recent observations on the extent and thickness of Arctic sea-ice show that a new regime shift may already be underway. The UK has recently decided to fund a large observation-based programme to investigate the dynamics and sensitivity of the North Atlantic THC, and the climatic consequences of potential rapid changes. It will focus on delivering: (i) the establishment of efficient and cost-effective systems for detecting and quantifying THC change; (ii) the identification of the main northern high-latitude drivers of the THC; (iii) an improved fundamental understanding of interactions of THC dynamics with the atmosphere and cryosphere; (iv) quantitative palaeo-estimates of past THC changes and their climatic consequences; (v) advances in conceptual understanding of the THC. I will outline the major elements of the programme as they have been defined to date.

Next, I will present the dynamical ideas behind, and current planning work toward, efforts to observe the Atlantic THC on a continuous basis. Such monitoring will be a prerequisite for the ultimate goal of predicting THC variability. In particular, I will discuss the possibility that a continuous observing system could be based on density time series over the whole water column, at the western and eastern boundaries. These measurements would be combined with monitoring of the boundary current transport, bottom pressure variations near the margins, and wind and altimetric information along the section combining the endpoints. I will present design studies of such observing systems based on the output of numerical models.

URL: <http://www.nerc.ac.uk/funding/thematics/rcc/>

OS11H-02 0845h

Trends in Arctic Ocean Freshwater and Heat Content Over Decadal and Seasonal Time Scales, 1950-1989

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Variations of Arctic Ocean freshwater and heat content were examined from 1950 to 1989 to provide both a historical reference and first-order estimate of trends for the two Arctic Ocean climate variables. Over the latitude interval 65° N to 90° N, gridded fields of Arctic Ocean salinity, temperature and density from the surface to depths of 4 km were extracted at 50 x 50 km horizontal resolution from the Environmental Working Group (EWG) Atlas for the study period.

Using data from four decades (1950 - 1959, 1960 - 1969, 1970 - 1979 and 1980 - 1989) and two seasons