OS71A MCC: Hall D Sunday 0830h

Nearshore Processes IV Posters *(joint with T)*

Presiding: **N Plant,** Naval Research Laboratory**; A Reniers,** Naval Postgraduate School

OS71A-0240 0830h POSTER

Observations of Mean and Oscillatory Surface Flow in the Surf Zone

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Spatial variations in nearshore circulation often tend to occur on scales much larger than can be observed with traditional in situ arrays of instrumentation. Thus, complex numerical models designed to simulate these larger scales must rely on generally sparse field measurements to verify the accuracy of predictions. Incorporation of data into models using data assimilation techniques is helpful in keeping models tuned to the observations, and potentially enhancing their predictive capability into useful forecasts for various marine applications. Increasing the density of observations can further improve model performance, and if data is obtained in near real-time then models can be used in an operational sense on site to guide experimental design, distribution of resources, or coastal managerial and strategic military decision making. In this work, we discuss an observational technique to measure in near real-time mean and oscillatory flow over the large spatial scales associated with typical nearshore circulation. Observations of surface flow are derived from Particle Image Velocimetry (PIV) techniques applied to field data obtained from land-based video cameras obliquely oriented to overlook the surf zone. The remote nature of the video observations allows for large regions to be examined, and arrays of such cameras to extend the region of interest to many times present day capabilities. Difficulties arise when the resolution of the imagery degrades with distance from the camera; thus, the usefulness of the video-based PIV technique depends on the spatial extent over which the observations can be made. We will present observations obtained from recent field experiments that demonstrate the usefulness and limitations of the PIV techniques for typical deployments.

This work was supported by the Office of Naval Research, Coastal Dynamics program.

OS71A-0241 0830h POSTER

Optical Measurements of Low Frequency Cross-Shore Flows

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Shear waves, a recently described surf zone motion, are manifested as low frequency (10^{-2} s^{-1}) meandering in longshore currents. Due to their relatively high energy, shear waves may be an important process for cross-shore momentum flux, significantly altering the cross-shore structure of the mean longshore current. Despite this potential importance, field observations of shear waves have been limited, primarily due to the expense and logistical complications of maintaining arrays of in situ instruments. Thus it is difficult to address basic questions about their frequency of occurrence or their possible turbulent nature, particularly over a wide range of conditions and at different sites. In this abstract, we propose an optical technique to measure low frequency cross-shore motions in the surf zone, complimentary to our previously presented optical method to measure longshore currents.

Time-exposure images of surf zones, taken from video monitoring stations, represent the cross-shore pattern of wave breaking over an offshore bar as a band of elevated image intensity with the intensity maximum corresponding roughly to the bar crest. We hypothesize that intensity pattern shifts in the cross-shore direction in response low frequency cross-shore flows will force a measurable time variation in image intensity, given by

$$\frac{\partial I}{\partial t} = u(\tau)\frac{\partial I}{\partial x}$$

where τ implies the slow variations typical of shear waves. Early investigation has shown evidence for this phenomenon by the similarity between frequency-wavenumber spectra of intensity time series from long-shore pixel arrays and f-k spectra from an analogous set of current meters (Lippmann, 1992). We will investigate this technique, called gradient imaging, by comparing the low frequency variations in pixel intensity time series to low frequency variations in time series of cross-shore velocity from the 1997 SandyDuck field experiment conducted at Duck, NC. Additionally, the possible dependence of this technique on cross-shore location relative to the bar and wave height conditions will be explored.

OS71A-0242 0830h POSTER

Laboratory Rip Current Circulation from Lagrangian Drifters

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Steady and unsteady processes in a laboratory rip current are studied using video-tracked Lagrangian drifters for a range of wave and water level conditions. Coverage and run lengths are sufficient to resolve both averaged and fluctuating quantities over the visible domain.

Results show strong qualitative and quantitative dependence on wave and water level conditions. Results for some tests show classic symmetric circulation cells, while other rips exhibit a strong bias in one direction, even with shore-normal waves. Circulation is unsteady on scales generally spanning several orders of magnitude in space and time.

Circulation at startup is compared with the theory of Peregrine (1998) and broad agreement is found. Vortex shedding at startup is observed to be highly dependent on details of the initial conditions in the laboratory basin.

OS71A-0243 0830h POSTER

Simulation of laboratory rip current experiments using nearshore POM

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A hydrostatic primitive equation model, the Princeton Ocean Model (POM), has been adapted for studies of three-dimensional wave-averaged circulation in the nearshore surf zone. The model is applied here to studies of the generation and instablilities of rip currents forced by waves normal to a beach with an alongshore bar interrupted by rip channels. The rip-current system modeled is that generated in the Directional Wave Basin located in the Ocean Engineering Laboratory at the University of Delaware. POM has been modified for application to nearshore flows by incorporating forcing from gradients in the radiation stress tensor and by including the effects of wave-induced mass flux through appropriate boundary conditions on the vertical velocity at the surface. The wave-driver REF/DIF (Kirby and Dalrymple, 1983) has been embedded as a subroutine of nearshore POM so that modification of the forcing by wave-current interaction can be included. The model results are compared with laboratory measurements of currents and surface elevation (Haller and Dalrymple, 1999; Haas and Svendsen, 2002). Instantaneous and time-mean momentum balances of both the three-dimensional and depth-averaged flows are calculated. Emphasis is placed on the variations of the currents with depth. The sensitivity of the rip current system to changes in the strength of the forcing and to details of the topography is examined.

OS71A-0244 0830h POSTER

Formation of Rip Currents due to Wave-Current Interactions

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It is well accepted that rip currents are due to the alongshore variabilities in the wave field. Although rip currents are often observed on beaches with rip channels, spontaneous formation of rip currents on alongshore uniform beaches does occur. It has been argued that on a planar beach such necessary alongshore variations may arise from an instability if mutual interactions of waves and currents are accounted for. In this linear instability study, we examine the initiation of those cell-like circulations on a planar beach with normally incident monochromatic waves. Circulations are described by the depth-time averaged shallow water equations, which include a forcing due to the fast wave motions, and dissipation due to the bottom friction. Effects of currents on waves are formulated using the ray theory. The alongshore spacing of rip currents (preferred wavelength of flow patterns) and their strength are analyzed on the domain of two control parameters: the ratio of wave group velocity to bottom friction velocity which measures the response time of waves relative to that of currents, and the ratio of incident wave height to the typical water depth which indicates the energy levels of the incident waves. Constant and spatially varying bottom friction velocities are both implemented to examine the sensitivity of results to the bottom friction parameterization.

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OS71A-0245 0830h POSTER

Morphodynamical Development of Rip-Channel and Tranvserse Bar Systems

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A morphodynamical stability analysis of a straight, barred coast with waves normally incident on it is undertaken. The analysis includes hydrodynamic (period- and depth-averaged) continuity and momentum equations, energy and phase equations for the short waves, and a bed evolution equation.

Results show the development of a system of rip channels, with associated rip currents, and shoals on the shore-parallel bar. At the same time there is a development of a transverse bar system, which appears to agree with observations. Numerical experiments seem to suggest that the transverse bar system is a forced phenomenon, forced by the rip channel system, which itself is a morphodynamical instability. The energy and phase equations are necessary to model this phenomenon.

Further work is now underway to identify the physical mechanisms for this generation and to understand the importance of the energy and phase equations.

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OS71A-0246 0830h POSTER

Relative Orientation Techniques to Stabilize Aerial Video Data for Morphological Observation

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Observations of large scale sand bar morphology can be obtained from video cameras mounted on aircraft, provided accurate image to ground transformation parameter is well known. The accuracy of the image-to-ground transformation parameters depend on the accuracy of our estimates of camera position measured with onboard differential GPS sensors, the intrinsic camera model parameters determined by standard laboratory techniques, and absolute orientation parameters (pitch, roll, yaw). The limiting factor is the determination of pitch, roll, and yaw of the aircraft, which cannot be measured without having sufficient number of accurately surveyed ground control points. If we know the absolute orientation of one frame we can determine the absolute orientation of successive frames by knowing the relative orientation of the image sequence. In this work we will discuss the technique for determining the relative orientation of a sequence of images in an over-flight track. Correlation kernals are used to identify similar regions in the two views and the relative orientation is determined. Verification of the relative orientation procedures will be presented, as well as examples of the morphological variables that can be extracted from the corrected imagery.

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OS71A-0247 0830h POSTER

Data-driven modeling of nearshore sandbar position

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Nearshore morphology at a specific moment in time is based on the morphology at one or more previous time steps and on the external forcings on the nearshore, like offshore waves. A common approach to predict the temporal propagation of nearshore morphology is to rely on physical process knowledge, leading to process-based models. A second approach relies on the assessment of empirical relations in observations of the system, leading to data-driven models. For this, dynamic models, such as recurrent neural networks, with in particular auto-regressive neural networks (ARNNs, also known as NARX networks), may be suitable. So far, such data-driven approaches have rarely been used for the prediction of morphological evolution.

In the present study, we introduce the ARNN to nearshore science by investigating its suitability to model a 3.4-year long time series of video-based estimates of sandbar position sampled daily at Noordwijk, Netherlands. In discrete time an ARNN can be written as

$$\vec{X}_t = NN\left(\vec{X}_{t-1},\ \vec{X}_{t-2}, \ldots, \vec{X}_{t-M}; \vec{U}_t,\ \vec{U}_{t-1}, \ldots, \vec{U}_{t-N} \mid \vec{w}\right).$$

The modeled system state $\vec{X}_t$ at time t, auto-regressive of order M, is sandbar position, and the external forcings on the system $\vec{U}_t$, regressive of order N, are measured time series of offshore wave height, period, and direction. The applied neural network (NN) is a standard multi-layer perceptron with one hidden layer. Its uncertain parameters, or weights, $\vec{w}$ are obtained through calibration. Internal validation is used to avoid overfit solutions.

We find that the ARNN reproduces the general characteristics in the time series well for $M = 1$ and $N = 1$, using 4 neurons in the hidden layer. Intriguingly, the ARNN has captured the dominant seasonal and interannual variability in sandbar position, despite the fact that the wave forcing varies mainly on daily to weekly scales. Apparently, the ARNN has the skill to model systems with a long-term memory, that is, systems where the state at time t depends on observations and external forcings at many previous time steps. The results were found to be robust to the various choices that can be made to set up the ARNN. Future work will focus on the combination of process-based models and an ARNN, where the ARNN may be used for data-assimilation purposes.

This work was supported by the Data-Model Integration program at WL|Delft Hydraulics and by the EU-funded project CoastView.

OS71A-0248 0830h POSTER

Wave and Longshore Current Modeling on the North Carolina Continental Shelf

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The object of this work was to use a wave model to determine the importance of wave-driven longshore sediment transport to erosion and accretion of North Carolinas Outer Banks between Oregon Inlet and Cape Hatteras. A wave history was created from 10 years of hourly measurements at NOAA buoy 44014 (36.58^{o}N, 74.84^o W, 47.5 m water depth). Twenty-three reoccurring conditions were identified representing storms originating over North America, storms originating in the tropics, and low-energy periods. These conditions were used as input to the Simulating Waves Nearshore (SWAN) model, developed at Delft University of Technology, the Netherlands. Bathymetry collected during the SHOaling waves Experiment (SHOWEX) combined with National Ocean Survey (NOS) bathymetry defined the grid. Output from the SWAN model was used as input to a longshore current equation driven by both oblique wave approach and variation in wave height. A time averaged longshore distribution of velocity was produced from the 23 representative events. This distribution was compared with average yearly erosion and accretion rates measured by the North Carolina Department of Environmental Heath and Natural Resources, Division of Coastal Management. Areas of greatest long-term erosion corresponded to areas with increasing gradients of longshore velocity regardless of specific wave input. Output from SWAN was also input to the Coastal Engineers Research Center (CERC) equation for longshore sediment transport. This equation includes only transport due to the oblique approach of waves. The time-averaged distribution of immersed weight transport was compared with the average annual shoreline change, but the patterns of coastal change were not well explained, perhaps because the formulation did not include forcing by longshore gradients in wave height.

OS71A-0249 0830h POSTER

The origin of VLF-motions during RIPEX

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Very low-frequency motions (VLF), with frequencies less than 0.004 Hz, were persistently present during the RIP-current EXperiment (RIPEX) at Sand City, Monterey Bay, and reached intensities similar to the infragravity motions (Macmahan et al, 2002). The origin of the observed VLF-motions is not well understood at present. Modeling efforts by Reniers et al. [2002], utilizing a 2D flow model operating on the wave-group time-scale, showed that a good match with the observed VLF-motions could be obtained. However similar results could be achieved by decreasing the lateral mixing and omitting the wave-group forcing. A more detailed analysis will be performed to assess the effects of wave-group forcing, lateral mixing and wave-current interaction to examine the origin of the VLF motions observed during RIPEX. Results of this assessment will be presented at the meeting.

MacMahan, J., A.J.H.M. Reniers, E.B. Thornton and T. Stanton, 2002: Ripex: rip-current pulsation measurements, to appear in *Proceedings of the 28nd International Conference on Coastal Engineering*, Am. Soc. of Civ. Eng., Cardiff. Reniers, A.J.H.M., J. MacMahan, E.B. Thornton and T. Stanton, 2002: RIPEX: rip-current pulsation modeling, to appear in *Proceedings of the 28nd International Conference on Coastal Engineering*, Am. Soc. of Civ. Eng., Cardiff.

OS71A-0250 0830h POSTER

A Volume of Fluid Model for Surf and Swash Zones

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Numerical modeling of nearshore waves and currents is necessary for forecasting hydrodynamic conditions and sediment transport which are used to predict erosion and accretion patterns of the nearshore profile. A typically used hydrodynamic model can be derived from the one-dimensional depth averaged nonlinear shallow water equations (NLSWE). While this formulation has been shown to match field and laboratory data well, simplifications in the governing equations restrict the applicability of the model. For instance, the shallow water assumption means that separate models are required to shoal waves from deep water through the swash zone. Further, the depth-averaged nature yields no information regarding the vertical velocity profile and the boundary layer structure, which can be used to estimate the time dependent bed shear stress needed for sediment transport formulations. To overcome some of the drawbacks to the depth-averaged NLSWE, a 2D (x,z) volume of fluid model derived from the full Navier-Stokes equations has been modified for predicting sea surface elevations and depth dependent fluid velocities across the surf and swash zones. The volume of fluid approach discretizes the model domain into individual fluid volumes and calculates the appropriate force balances in each control volume and the flux of water across each control surface. Comparisons to laboratory data collected in a wave basin show excellent predictive skill for the sea surface elevations, while prediction of cross-shore fluid velocities suffers from over-prediction during the passage of broken waves. Model/data comparisons and model development including an upgrade from a constant eddy viscosity to a 2-equation turbulence closure scheme will be discussed.

OS71A-0251 0830h POSTER

Turbulent Bore Wave Propagation on a Linear Sloping Beach

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Turbulent bore waves formed after wave breaking on beaches have been studied in the field with natural incident waves and in laboratory wave tanks for monochromatic incident wave spectra. The present research attempts to extend previous results both by focussing on broadband incident wave spectra and by looking carefully at the evolution of the turbulent bores in a highly instrumented wave tank. In our current research, turbulent bores are generated in the Max Hammond Wave Tank at SRI with a 1:25 sloped linear beach by two types of incident spectra: a monochromatic sine wave spectrum for repeatable experiments and a JONSWAP spectra (gamma=3.3) for more realistic incident waves. Instrumentation employed for measurement of bore propagation includes: 20 capacitive wave height gauges, a Ku-band Doppler radar and simultaneous video recording. There is also both a surface PIV and volume PIV capability for reconstructing fluid flow in the bore wave volume and on the surface but these measurements are not included in the experiments reported here. We have also developed a wavefront tracking algorithm that retrieves bore propagation velocity from the video imagery as a function of position. In this paper, we present measurements of the phase speed of bore waves as a function of bottom depth for a range of wave breaker types from gentle spillers to violent plungers for both monochromatic and JONSWAP broadband incident spectra. Our results are compared with shallow-water Boussinesq model predictions. The goals of this research are to improve prediction of turbulent bore waves in realistic conditions and develop remote sensing techniques for retrieving bathymetry and other surf-zone properties of the nearshore environment.

OS71A-0252 0830h POSTER

Depth-varying Eddy Viscosity and Short-wave Forcing in SHORECIRC

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The quasi-3D nearshore circulation model SHORECIRC developed at the University of Delaware (Svendsen et al 2002) is based on the mathematical frame work of Putrevu and Svendsen (1999). In that work, they determine the horizontal variation of the depth-averaged velocities from the short-wave-averaged depth-integrated horizontal momentum equations. These equations include depth integrals of the depth varying velocities which act as a momentum dispersive mixing mechanism. The depth-dependent velocities are solved from the local non-integrated momentum equations and use to evaluate the integrals in the depth averaged momentum equations. The only assumption invoked in Putrevu and Svendsen (1999) is the hydrostatic pressure. However, when applying Putrevu and Svendsen (1999)'s work to the numerical model SHORECIRC, further simplifications, such as using depth-uniform eddy viscosity and shallow water theory for the short wave forcing are introduced, enabling the 3D dispersive terms to be integrated analytically. In the present work, we will extend the SHORECIRC to relaxing these simplifications to include the depth-varying forcing and eddy viscosity. To achieve this, the Chebyshev polynomials are utilized to approximate the short-wave-forcing and eddy viscosity. The 3D dispersive terms are therefore solved numerically. As the first step, we will investigate the effect of depth-varying forcing and eddy viscosity on longshore and cross-shore currents in different situations including rip currents.

OS71A-0253 0830h POSTER

Comparison of Bottom Stresses Computed From Wave Observations and a Wave Model

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Bottom stresses due to wave action were computed from observations made by both a surface wave buoy (NBDO 45007, located in the middle of the southern basin of Lake Michigan), and subsurface pressure sensors located at various positions in southern Lake Michigan between 1998-2000. These stresses were compared to those computed using the results of the GLERL-Donelan wave model implemented on a 2-km grid. Although the model does a good job of calculating the observed wave heights, it tends to predict periods shorter than those actually observed. This is turn causes the stresses calculated from the modeled wave parameters to be generally lower than those calculated from the wave observations.

When the stresses derived from the buoy observations are compared to those derived from the wave model parameters, the two agree over 85% of the time as to whether no movement, bedload movement, or resuspension will occur. However the bulk of this agreement (about 74%) occurs when both stresses predict no movement. A comparison of the stresses derived from the pressure readings to those derived from the wave model gives similar results. The two stresses agree about 85% of the time as to whether no movement, bedload movement, or resuspension will occur, with over 50% of the agreement occurring when both estimates predict no movement. The lower percentage of times when no movement was predicted is because the bulk of the pressure readings were made during the fall and winter, when the waves were larger than during the spring and summer (when many of the buoy observations were made). In the cases where both stresses predict particle resuspension, the stress derived from the observations averages 0.6 Pascals more than the stress derived from the wave model parameters. This difference increases to between 0.85 and 1.9 Pascals when only one - but not both - of the stresses predicts resuspension.

The calculation of particle resuspension rates usually depends upon the value of the excess shear stress (the calculated stress minus that required for resuspension), so the lower stresses calculated from the wave model parameters will cause the amount of resuspension to be underestimated. This may be a significant problem when results are needed at a specific site, but for lake-wide models other sources of error (in particular the lack of knowledge about the type of bed material at many locations) will probably be more important. In these applications the underestimation due to the use stresses derived from a wave model may not be too significant.

OS71A-0254 0830h POSTER

Observation of Wave Spectra Near a Submarine Canyon

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The capability of linear models on wave transformation over areas of complex bathymetry was examined using statistical tests of field measurements near Redondo Beach, California. While the accuracy of numerical models is overshadowed by the steep topography, a simple formula, Green's law, which states that $H \propto H_0 h^{-1/4}$ with wave height H, deep-water wave height H_0, and depth h, is found to provide reasonable approximation for wave height.

OS71A-0255 0830h POSTER

Local and Far-Field Effects of Commuter Ferry Wake in New York Harbor: Implications for Mitigation

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Anthropogenic sources of waves in New York Harbor have grown in recent years to the point that they are presently the dominant source of wave energy. Small fast commuter ferries account for the bulk of this growth. Between 1996 and present, fast-ferry traffic across the Hudson has seen an order of magnitude increase in both ferry crossings and ferry routes.

Pressure time series recorders were co-located with profiling acoustic Doppler current, turbidity, and conductivity meters, deployed synoptically in strategic harbor locales for seven-day periods in summer and fall of 2002. Analysis of the sea-surface elevation time series revealed a semi-diurnal increase in wave energy coinciding with peak ferry use during morning and evening rush-hours. The measured wave energy levels during rush-hours was well above the wave energy levels measured overnight, when ferries were no longer in use. During rush-hours, the time-series of sea surface elevation appeared as a persistent background of waves with periods between 1.5 and 4.5 seconds containing intermittent, well-defined packets of high amplitude waves which appeared to be coincident with local ferry passage. The temporal pattern of sea-surface elevation throughout the weekday was repeated throughout the workweek. However, during weekends, the magnitude of the background wave energy level was approximately one half the magnitude of the energy level measured during any given workweek day. The amplitude of waves within the intermittent packets remained nearly constant for the entire week.

The local, near-field effect of ferry traffic is visible in the sea surface elevation time series as intermittent packets, whereas the far-field effects, integrated harbor-wide, is seen as the background sea-state. The dual nature of the wave energy creates an implication for efforts attempting to mitigate the wave conditions. For conditions when the background sea-state is acceptable, small adjustments to individual ferry tracks and speeds relative to a specific site within the Harbor can be an effective method for reducing the local wave energy at the site. If conditions persist where even the background sea-state is unacceptable, a more global approach (adjustments to the entire ferry system) would need to be implemented to reduce the background sea-state to acceptable levels. Alternatively, the wave energy tolerance for the specific sites would need to be increased.

OS71A-0256 0830h POSTER

Time-Varying Record of Sediment Resuspension Under Waves on the Inner Shelf of Santa Cruz, CA

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Measurements of currents, waves, and suspended sediment concentration and grain size collected in 9 m water depth off the Santa Cruz wharf provide a nearly continuous, high-resolution time series of sediment resuspension by long-period, shallow-water waves. Instruments deployed during the 48-hour experiment in July 2002 include a downward-looking acoustic Doppler current profiler (PCADP), acoustic velocimeters (ADVF), backscattering sensors (both optical and acoustic), pressure sensors, and a LISST 100C (Laser In Situ Scatterometer and Transmissometer). Sampling at a rate of 1 Hz, the LISST recorded the volume concentration (to 0.5 μL/L) and grain size (in 32 log-spaced classes between 2.5 and 500 μm) of suspended particles at a height of 35 cm above the bed. The instrument also recorded percent transmission (to 0.1%), pressure, temperature, and time for each sample. Sedimentological parameters calculated for each sample include the mean, standard deviation, and median diameter (D50) of suspended particles. Cumulative distribution functions can also be calculated for each sample to plot individual size-frequency diagrams. Wave heights of 1-2 m persisted during the experiment, with periods of 11-14 s. Bottom currents due to tides were small (less than 5 cm/s) relative to orbital wave velocities, which frequently achieved magnitudes of 50 cm/s. Initial analysis of concentration and grain size of suspended sediment indicate resuspension of bed sediment occurred on the time period of individual waves. Suspended sediment mass concentrations ranged between 100 and 1300 mg/L using an average density of 2.8 g/cm^3. The median grain size of suspended material was frequently 75-125 μm with periodic pulses up to 425 μm. Concentration and grain size are positively correlated, suggesting that increases in velocity entrain increasingly coarser particles.

OS71A-0257 0830h POSTER

Comparison of Three Independent Estimates of Bottom Stress on the Inner Shelf

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Bottom shear stress was estimated from observations of wave and current velocities measured off Grays Harbor, Washington between May 4 and June 6, 2001, during the spring transition from storm-dominated winter conditions to summer upwelling. A downward-looking pulse-coherent acoustic Doppler profiler (PCADP) and two acoustic-Doppler velocimeters (ADVs) were deployed on a tripod at 9-m water depth. The PCADP recorded velocity profiles in eight 0.1-m bins beginning approximately 0.08 m above the bottom (mab) at 1 Hz for 20 minutes every hour. The PCADP also recorded pressure and distance to the bed along each of its three beams. The two ADVs were synchronized and sampled three components of velocity at points separated by 0.8 m (horizontally in the cross-shore direction) and located about 0.5 m above the bed. The ADVs sampled at 20 Hz for 20 minutes every two hours, timed to coincide with PCADP measurements. These data were used to estimate bottom shear stress with: (1) the log-profile method; (2) a modified eddy correlation technique; and (3) a dissipation-rate method, calculating ADV velocity spectra in the inertial subrange. Bottom stress was also calculated with traditional drag coefficients and a standard wave-current bottom boundary layer model. The underlying assumptions that form the foundation of the methods often were not met and, in general, the methods did not agree very well. Although friction velocities calculated from all methods (except the dissipation-rate technique) were within a factor of about 2 and tended to vary with similar patterns, they were not well correlated. Estimates of shear velocities from Reynolds stresses tended to be higher than those from the log profiles and the dissipation-rate estimates were higher by a factor of 5 8. Although some of these differences may be attributed to measurement noise and artifacts of the tripod or instrument configuration, they are also consistent with higher-than-expected eddy diffusivities and enhanced coupling between the bottom and overlying flows. A tentative hypothesis for these results is that the scale for boundary layer thickness depends on large-scale roughness (i.e., features bigger than wave ripples) and/or a time scale longer than incident-wave periods (e.g., infragravity motions).

OS71A-0258 0830h POSTER

The determination of bottom friction using data assimilation methods

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The amount of bottom frictional dissipation present in the nearshore has a pronounced effect on the mean and time-varying properties of the circulation field. Yet there is significant uncertainty in the parameterization for bottom friction as well as the value of a corresponding friction coefficient. Several recent studies have suggested that the friction coefficient is spatially varying with larger values present in the surf zone. It is hypothesized that its value is dependent upon features of the bottom boundary (e.g. existence, size, and orientation of bedform) and of the overlying fluid motions (e.g. breaking-generated turbulence), though the functional dependences are unknown. In the absence on concrete guidance about the size and variation of the friction coefficient, the application of state-of-the-art circulation models to the nearshore typically involves the assumption of a spatially nd temporally constant friction coefficient. Repetitive model runs are then used to slowly iterate on the value of the friction parameter until acceptable levels of skill are obtained. However, there are more integrated ways to utilize observations in models using data assimilation techniques, and there is evidence in the literature that such techniques can lead to a better understanding of the spatial variations in bottom dissipation (see Egbert and Ray, Nature, 2000 for a discussion of findings regarding the dissipation of tidal energy).

In this study we carry out preliminary work with synthetic data to asses our ability to reconstruct information about the frictional dissipation in the surf zone given time series of longshore and cross-shore current velocities in the interior of a domain of interest. We concentrate on a barred longshore uniform bathymetry and construct an adjoint model for the depth-averaged equations of motion in the nearshore using a weak-constraint assumption (implying that the dynamics dictated by the governing equations are not perfect). The solution to the circulation problem is constrained to minimize a positive definite functional for the entire available data set. The solutions then represent a best fit to the dynamics and available data within the specified dynamic and measurement error bounds. In the context of this work we will explore the dependence of our solutions to assumed error covariances and assess the necessary quantity and quality of data input into

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the modeling scheme to obtain good estimates of spatially varying frictional dissipation.

OS71A-0259 0830h POSTER

Estimates of Hydrodynamic Roughness and Bedform Heights in a Wave-Dominated Flow

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Hydrodynamic roughness, a critical parameter in predicting sediment resuspension and transport, can vary with grain size, bedforms, and saltating sediment. We used velocity profiles in the bottom boundary layer to estimate hydrodynamic roughness, and used these estimates as well as images from rotating head sonars to estimate bedform height. Velocity measurements were taken in the bottom boundary layer with a high resolution acoustic Doppler profiler (PCADP) as part of a larger study of sediment transport on the ebb-tidal delta of Grays Harbor, Washington in May and June 2001. The study site was just outside the surf zone (mean depth ≈ 9 m), where wave-induced motions dominated the near-bottom velocities and sand resuspension occurred frequently. The PCADP measured velocity in eight 10-cm cells at 1 Hz for a 20-minute burst every hour. Friction velocity due to current $u*_c$ and apparent bottom roughness z_{0a} were determined by fitting burst mean velocity profiles from the PCADP to logarithmic profiles. Of the log fits, 55% met acceptance criteria of burst mean greater than 5 cm/s and correlation coefficient (R^2) between the data and the logarithmic curve greater than 0.96. Hydrodynamic roughness k_b was estimated using the Grant-Madsen model for wave-current interaction iteratively until the model $u*_c$ converged with values from the log fits. The estimates of k_b ranged from 10^{-4} to 0.1 m and varied inversely with bottom orbital velocity, consistent with the expected response of ripple height to wave energy. The contribution of saltating sediment to k_b was estimated to range from 0.2 to 1 mm, which was negligible except during periods of greatest wave energy. Bedform height estimated from the k_b values compared favorably to theoretical predictions of ripple heights based on the wave conditions during the experiment, as well as to bedform heights inferred from sonar images collected during the experiment.

OS71A-0260 0830h POSTER

Spatial variation of near bed concentrations

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Analysis of spatial variation in sediment transport over bedforms is limited by a lack of field observations. With the use of modern state-of-art numerical models for flow and sediment transport this problem can be overcome. In this paper, we use a two-dimensional numerical model Dune2d for evaluating the spatial variation of near bed suspended sediment concentrations on flat and rippled bed. Dune2d couples 2-D Navier Stokes equations with multiple bed load models and seabed morphology (Tjerry, 1995). The model allows for arbitrary wave forcing with a mean current over different bedforms. Validation of the bed load and suspended load modules has been performed for two different bedforms (a flat bed and a megaripple). We rely on existing observations of velocity and near bed suspended sediment concentrations obtained during the Sandy-Duck experiment. The observations were taken over two different bedform conditions. It is noticed that the suspended sediment concentrations in the lowest 1.7cm range bin vary considerably from the suspended sediment concentration observation in the upper water column. These observations are assumed to partially be a measure of the bed load. The observations are compared with the model predicted suspended sediment concentrations integrated over the lowest 0.85cm of the water column. The vertical integration height alters the magnitude of the concentrations considerably but not the phase. The Engelund and Fredsoe(1976) model thus predicts these near bed concentrations. The model results are sensitive to the assumed instrument location with horizontal variability which is correlated to the bedform variability. In this presentation we examine the spatial variability over the two bedforms.

OS71A-0261 0830h POSTER

Modelling Time and Length Scales of Scour Around a Pipeline

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The scour and burial of submarine objects is an area of interest for engineers, oceanographers and military personnel. Given the limited availability of field observations, there exists a need to accurately describe the hydrodynamics and sediment response around an obstacle using numerical models. In this presentation, we will compare observations of submarine pipeline scour with model predictions.

The research presented here uses the computational fluid dynamics (CFD) model FLOW-3D. FLOW-3D, developed by Flow Science in Santa Fe, NM, is a 3-dimensional finite-difference model that solves the Navier-Stokes and continuity equations. Using the Volume of Fluid (VOF) technique, FLOW-3D is able to resolve fluid-fluid and fluid-air interfaces. The FAVOR technique allows for complex geometry to be resolved with rectangular grids. FLOW-3D uses a bulk transport method to describe sediment transport and feedback to the hydrodynamic solver is accomplished by morphology evolution and fluid viscosity due to sediment suspension. Previous investigations by the authors have shown FLOW-3D to well-predict the hydrodynamics around five static scoured bed profiles and a stationary pipeline ("Modelling of Flow Around a Cylinder Over a Scoured Bed," submit to Journal of Waterway, Port, Coastal, and Ocean Engineering).

Following experiments performed by Mao (1986, Dissertation, Technical University of Denmark), we will be performing model-data comparisons of length and time scales for scour around a pipeline. Preliminary investigations with LES and k-ϵ closure schemes have shown that the model predicts shorter time scales in scour hole development than that observed by Mao. Predicted time and length scales of scour hole development are shown to be a function of turbulence closure scheme, grain size, and hydrodynamic forcing. Subsequent investigations consider variable wave-current flow regimes and object burial. This investigation will allow us to identify different regimes for the scour process based on dimensionless parameters such as the Reynolds number, the Keulegan-Carpenter number, and the sediment mobility number. This research is sponsored by the Office of Naval Research - Mine Burial Program.

OS71A-0262 0830h POSTER

Beach protection by a system of permeable groins

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A new type of permeable groin (called System of Groins Maltec-Savard - SGMS) has been installed at three eroded sites located in the coastal area on the north shore of the St. Lawrence, Quebec, Canada. In this area, the narrow sandy beaches with sandy or sand-silty cliff of variable height (10-15 m) are exposed to obliquely incident waves arriving from both west (summer) and east (autumn), and to tidal currents (maximum tidal rate is 4.3 m). The periods of summer waves equal 3-5 s, with wave heights of about 0.4-0.7 m. In the autumn, major storm waves reach periods of up to 7-10 s, with wave heights of 1.0-1.2 m.

The new groins are sediment traps formed by a central double and permeable groin with several smaller lateral, groins installed on one or both sides of the central groin (Boczar-Karakiewicz *et al.*, 2001). The permeable central and lateral groins are structured by inserting double ranges of wooden piles (diameter of about 10 cm). The space between the ranges of piles (some 0.8 m wide) is filled with tree branches (e.g., the top parts of pine trees, a waste product of the local forest industry). A permeable grid covering the top of the groins forms a cage that holds the branches in place. The lateral groins, are identical but much shorter than the central groin. The whole system dissipates the incident energy of wave- and tidally-generated currents and causes accretion of sand transported by these currents. The GSMS also allows the by-pass of some sediment to adjacent zones without groins.

Observations and results of measurements from three experiments field show that: (1) a sandy beach in front of a coastal cliff secures its stability and attenuates the erosion caused by waves and tidal currents; (2) permeability and flexibility of the SGMS causes the accretion of sediment in the protected area without erosion in the neighboring zones; (3) the SGMS does not generate wave reflection and any secondary current; (4) the materials of the groins are easily available, and the cost is low (waste material of the local forest industry); (5) the construction is simple and can be carried out by low-skilled labor force.

Boczar-Karakiewicz, B., W. Romanczyk, N. Roy, N. Pelletier, L. Maltec and J.-P. Savard. 2001. New method of beach protection adapted to coastal zones of the estuary of the Saint Lawrence river, Quebec, Canada. *Proc. Can. Coast. Conf.*, Quebec, QC, Canada: 201-214 (in French).

OS71A-0263 0830h POSTER

WAIKIKI: Analysis of an Engineered Shoreline

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Waikiki Beach is world famous, yet major segments of the Waikiki stretch have little to no sand at high tide. Despite the fact that the beach is largely of human construction, much of what the world perceives as "classic Hawaii" is derived from the experiences of visitors on the sands of Waikiki Beach.

Current research in Waikiki is a cooperative effort between the State Department of Land and Natural Resources and the University of Hawaii to produce a quantitative data set at the highest possible resolution and accuracy to describe beach change at Waikiki. The monitoring effort takes advantage of aerial photogrammetry and beach profile techniques to observe long-term and short-term shoreline variations. The engineering history of Waikiki is described as a major component of the historical shoreline analysis.

Historical aerial photographs and topographic survey sheets are used to establish a 75-year shoreline history (1926-2001) for Waikiki Beach. A reweighted least squares regression is applied to the most recent trend in the data to calculate shoreline change rates. Shoreline change trends are highly variable, operating on a littoral cell level. While 2 of 7 littoral cells have experienced accretion over the period, the remainder of the shoreline is characterized by erosion with an overall mean erosion rate of 0.3 m/yr.

Bi-monthly beach profile surveys (2000-2002) at 22 transects reveal short-term variations of the shoreline. A relationship between beach width and corresponding sand volume change, established from the beach profile data, is applied to historical shoreline change data to establish a history of sand volume fluctuations. A net increase in beach volume since 1951 reflects the magnitude of human intervention in Waikiki. However, we observe significant losses over more recent time scales. Overall, historical results show narrow and narrowing beaches. There is a great need for maintenance.

URL: http://imina.soest.hawaii.edu/coasts/cgg_main.html

OS71A-0264 0830h POSTER

Clues to Coral Reef Health: Integrating Radiative Transfer Modeling and Hyperspectral Data

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An important contribution to coral reef research is to improve spectral distinction between various health states of coral species in areas subject to harmful anthropogenic activity and climate change. New insights into radiative transfer properties of corals under healthy and stressed conditions can advance understandings of ecological processes on reefs and allow better assessments of the impacts of large-scale bleaching and disease events. Our objective is to examine the spectral and spatial properties of hyperspectral sensors that may be used to remotely sense changes in reef community health. We compare in situ reef environment spectra (healthy coral, stressed coral, dead coral, algae, and sand) with airborne hyperspectral data to identify important spectral characteristics and indices. Additionally, spectral measurements over a range of water depths, relief, and bottom types are compared to help quantify bottom-water column influences. In situ spectra was collected in July and August 2002 at the Long Rock site in the Andros Island, Bahamas coastal zone coral reef. Our primary emphasis is on Acropora palmata (or elkhorn coral), a major reef building coral, which is prevalent in the study area, but is suffering from white band disease. A. palmata is currently being proposed as an endangered species because its populations have severely declined in many areas of the Caribbean. In addition to the A. palmata biotope, we have collected spectra of at least seven other coral biotopes that exist within the study area, each with different coral community composition, density of corals, relief, and size of corals. Coral spectral reflectance is input into a radiative transfer model, CORALMOD (CM1), which is based on a leaf radiative transfer model. In CM1, input coral reflectance measurements produce modeled reflectance through an inversion at each visible wavelength to provide the absorption spectrum. Initially, we have imposed a scattering baseline that is the same regardless of the coral condition and that coral is optically thick and no light is transmitted through coral. Here we will focus on methodology, experimental design, and initial findings of the in situ spectral measurements and preliminary output from the radiative transfer model.

OS71A-0265 0830h POSTER

Shear Stress and Turbulent Mixing in the Bottom Boundary Layer over a Fringing Coral Reef

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A field study was conducted along the fringing coral reefs of Eilat, Israel, The Gulf of Aqaba, Red Sea to assess the role that the characteristic bottom roughness of a reef has on dynamics within turbulent boundary layer flow. Measurements were made at four different sites over both coral and sand bottoms, during both summer- and winter-time conditions. Detailed measurements of near-bottom turbulence were made to estimate both Reynolds stresses and bottom shear stresses. In addition, mean velocity statistics were used in combination with these turbulence statistics to calculate drag coefficients, friction velocities and mixing parameters. Simultaneous measurements of temperature, salinity and velocity enabled the calculation of scalar fluxes. These parameters were compared to measurements made over a sand bottom to infer the effects of reef topography on mass and momentum transport.

Over the reef, the drag coefficient values were three to four times greater than values over the sand bottom (which were typical of rough-wall boundary layers). Normalized mixing rates showed much higher values at the reef sites. Temporal velocity spectra, used to infer turbulence dissipation rates, showed that production and dissipation were not in balance over the reef sites but were so over the sandy site. This suggests that the transport of turbulent kinetic energy is significant, and that non-equilibrium boundary layer dynamics, similar to characteristics found in plant canopies, are in effect. These results offer important insight into the basic functioning of the reef ecosystem.

OS71A-0266 0830h POSTER

Wave and Tidally Driven Flow and Sediment Flux Across a Fringing Coral Reef: Southern Molokai, Hawaii

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The fringing coral reef off the south coast of Molokai, Hawaii is currently being studied as part of a U.S. Geological Survey (USGS) multi-disciplinary project that focuses on geologic and oceanographic processes that affect coral reef systems. For this investigation, four instrument packages were deployed across the fringing coral reef during the summer of 2001 to understand the processes governing fine-grained terrestrial sediment suspension on the shallow reef flat and its advection across the reef crest and onto the deeper fore reef. The time-series measurements suggest the following conceptual model of water and fine-grained sediment transport across the reef: Relatively cool, clear water flows up onto the reef flat during flooding tides. At high tide, more deep-water wave energy is able to propagate onto the reef flat and larger trade wind-driven waves can develop on the water depth-limited reef flat (h = 1 m), thereby increasing sediment suspension. Wind-driven surface currents and wave breaking at the reef crest cause setup of water on the reef flat, further increasing the water depth and enhancing the development of depth-limited waves and sediment suspension. As the tide ebbs, the water and associated suspended sediment on the reef flat drains off of the reef flat and is advected offshore and to the west by alongshore tidal currents. Observations on the fore reef show relatively high turbidity throughout the water column during the ebb tide. It therefore appears that high suspended sediment concentrations on the deeper fore reef, where active coral growth is at a maximum, are dynamically linked to processes on the muddy, shallow reef flat.

OS71A-0267 0830h POSTER

Flow and Sediment Suspension on a Coral Reef in West Maui

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A field experiment to investigate the role of flow and suspended sediment in reef health in Maui was initiated in December 2001. This study uses an instrumented tripod (Reef Probe) to measure waves, currents, tides, salinity, water temperature, and sediment suspension. The Reef Probe has an upward-looking Acoustic Doppler Current Profiler to measure flow in the water column and an Acoustic Doppler Velocimeter to measure boundary layer flow (approximately 20 cm above the bed). Suspended sediment concentration is measured at two levels (approximately 20 and 100 cm above the bed) using OBS sensors. The Reef Probe is being deployed in a sand channel at 10-m depth approximately 650 m offshore of western Maui. The site was chosen for the study because of its degraded reef. The Reef Probe will collect data for a period of one year to document seasonal variations in hydrodynamics and suspended sediment. Reef Probe data will be compared to wind speed and direction, deep-water wave conditions, local rainfall, and other environmental parameters. Initial analyses of data from the first three deployments (December 2001 to July 2002) showed a surprising result. Net flow was towards the north (upwind), not to the south (downwind) as commonly believed. This indicates that wind forcing, primarily from the tradewinds, is not generating flows in the direction expected. Possible explanations for this are net flows are forced by an asymmetry in tidal currents, which are primarily oriented alonghore (NNE-SSW), or a longer period northward current associated with an Island Trapped Wave. The implications of a net flow to the north are significant to reef health. It was thought that a net flow to the south controlled dispersal of coral during spawning and advection of fine sediment and pollutants. The present distribution and health of coral in West Maui was interpreted with the assumption that a coral, sediment, or pollution source to the north affected an area to its south. The finding that net flow is to the north, if it persists for the entire year of data collection, will require development of new conceptual models for coral health on Maui.

OS71A-0268 0830h POSTER

A Siliciclastic-Infilled Sedimentary Basin Within a Large Carbonate Platform, Tampa Bay, Florida

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A seismic stratigraphic framework based on over 800 km of seismic reflection data collected within the Tampa Bay estuary and approximately 200 boreholes in and around the estuary shows three separate subsurface regions. In the north-central portion of the bay there is an irregular east-west oriented subsurface trough in the Miocene limestone that reaches depths of 30 m below the seafloor (mbsf). This trough contains steeply dipping clinoforms that indicate it has been filled from the south and east and borehole data show that these clinoforms are siliciclastic sediments. South of the trough in the center of Tampa Bay there is a broad carbonate bedrock high. This area is characterized by less than two meters of siliciclastic sediment cover as well as small-scale shallow karst features (10's m in width and up to 10 m in relief). In the southern portion of the Bay the seismic reflection data shows the Miocene limestone has large-scale warping as well as larger-scale karst features (100's m in width and 30+ m in relief) creating another deep basin (up to 40 mbsf) that has been filled by siliciclastics from the south and the east.

The sedimentary basin underlying the modern estuary reveals that accommodation space can form within the center of large carbonate platforms and that this accommodation space may be filled by remobilized siliciclastics. Based upon the age of the underlying limestones, and recent work in south Florida by others, we propose that the Tampa Basin was filled during multiple Late Neogene and Quaternary sea-level fluctuations. Additionally, we speculate that the observed multiple buried sinkholes, and sag-and-warp deformation indicate spatially selective subsurface collapse probably initiated by deep-seated dissolution produced by karst processes. Overlying stratigraphic units subsided as a result of solution collapse, creating a surficial topographic low. This surficial basin may have controlled subsequent non-marine, estuarine and even open marine sedimentation during the Late Neogene and Quaternary sea-level cycles.

OS71A-0269 0830h POSTER

Alongshore polarization of currents over the inner shelf off Huntington Beach

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A project aimed to gain more insight about the persistent high levels of indicator bacteria in the surf zone off Huntington Beach was carried out in summer 2001. As part of this extensive survey, temporal variation of temperature was obtained from a mooring array of thermistor chains and water velocity was obtained from bottom mounted ADCPs deployed both nearshore (water depths of 5-10 m) and offshore stations (water depths of 15-70 m). The estimation of the velocity field in a cross-shore section is essential to understand the water exchange processes between onshore and shelf areas. These results display differences between the

nearshore and offshore in the observed temperature and velocity fields. A strong alongshore polarization of the nearshore stations was observed at all frequencies. However, diurnal and semidiurnal currents were less polarized than subtidal currents. These results are discussed in terms of their importance in cross-shore transport over the inner shelf and in nearshore waters.

OS71B MCC: Hall D Sunday 0830h

Coastal Geology of the Carolinas: Linking the Shelf and Shore II Posters *(joint with T)*

Presiding: **W C Schwab,** U.S. Geological Survey**; P T Gayes,** Coastal Carolina University

OS71B-0270 0830h POSTER

Relationship of Offshore Sediment Distribution to Short-Term Shoreline Change Using High Resolution Shoreface Mapping Techniques

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Real time kinematic GPS (RTK-GPS), bathymetric, and side-scan sonar data were integrated to analyze short-term shoreline change, from December 2001 to August 2002, in relation to offshore sediment distribution. Local beach behavior, induced by erosional and depositional events, can be identified by longshore trends in shoreline position variability. Those trends can be identified with high-resolution spatial data. Accurate shoreface morphology is measured through comprehensive high-resolution surveys incorporating shore-parallel and -perpendicular beach profiles, providing 3D maps of the shoreface. The Mean-High-Water (MHW) contour was extrapolated from these maps to obtain a reliable evaluation of shoreline change. This study presents preliminary results of shoreline position along the Grand Strand of South Carolina, and the spatial correlation of shoreline change to the inner shelf sediment distribution. Maps of maximum change in the shoreline position shows 3 distinct patterns in shoreline variability. The southern portion of the study area (low-change area) is characterized by a relatively minor change in shoreline position, with an average shift of 5.5 meters. Shoreline change increases gradually from the south to the north in the mid-section (transitional area). The variability reaches a maximum average of 7.25 meters, in the northern-most section (high-change area). Low variability trends in the southern portion of the low-change area correlate spatially with offshore presence of hardbottom morphology, while high variability trends correlate with low-backscatter, sandy morphology. These preliminary results suggest that the offshore geologic framework and shoreline variability are closely related. Further studies will focus on the influence of geologic framework on shoreface morphology.

URL: http://www.coastal.edu/cmws/berm/

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Geologic Framework and Surficial Sediment Mapping Within South Carolinas Long Bay, From Little River to Winyah Bay

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High-resolution seismic reflection profiles, sidescan-sonar imagery and interferometric swath-bathymetry, groundtruthed with surficial sediment samples and vibracores, allow for a detailed interpretation of the shallow geologic framework within South Carolinas Long Bay. This mapping provides a better understanding of the areas nearshore geology by identifying structural and stratigraphic controls that influence the location of paleochannel incisions and distribution and thickness of surficial sediment bodies.

The study area lies on the southwest flank of the Cape Fear Arch (CFA) or Mid-Carolina Platform High. The CFA accounts for the regional southerly dip and localized folding within lithified Cretaceous and Tertiary continental shelf strata that comprise the sedimentary base of the study area. Uplift of the CFA is also primarily responsible for the observed sediment starvation of this inner shelf region, because of massive diversion of post-Cretaceous fluvial sediment input away from its axis into the bounding Southeast Georgia and Albemarle embayments. The dipping and folded strata that underlie the area are incised by paleochannels that are progressively larger and more frequent to the southwest, where they display characteristics of integrated drainage networks. These features are the products of fluvial incision during multiple lowstands in sea level. In many areas, differential resistance to erosion of the underlying shelf strata appears to influence both the location and depth of paleochannel incision. Nested fill geometries within the paleochannels indicate that their stratigraphic histories are complex and likely include repeated periods of abandonment and reoccupation. Differential erosion of paleochannel fill and continental shelf strata produce a well-defined unconformity. This surface is mapped throughout the area and considered to represent the last marine transgression. Coarse clastic and biogenic surficial sediments (sand, gravel, and shell hash) are observed to directly overlie this unconformity. Differentially eroded strata beneath this unconformity crop out at the sea floor, where sediment cover is thin, to form low-relief hardgrounds. Surficial sediments are patchy and thin northeast of the inferred offshore contact between Tertiary and Cretaceous strata. The thickest accumulations of surficial sediment within the area are either inlet-related shoals, associated with the retreat paths of tidal deltas, or shoreface-attached and -detached sand ridges that trend oblique to the shoreline.

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Distribution and Architecture of Channels Preserved on Continental Shelves: A Comparison of the Carolinas and the U.S. East Coast

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Many channels are preserved on the Carolinas continental shelf, and they are widely distributed with a marked variability in form. Preserved channels are largely believed to be excavated by rivers during sea-level low stands, however, they also can be created and modified by processes (e.g., waves and tides) active during high-stand, falling, and rising sea-level conditions. Today, the Carolinas continental shelf receives water and sediment from several moderately sized rivers, and these same rivers have carved a network of channels on the shelf. This research synthesizes and compares high-resolution seismic-reflection data collected along the Carolinas and U.S. East Coast continental shelf to emphasize that several factors are instrumental in determining the architecture and distribution of preserved channels. Processes active in carving, altering, and preserving channels are considered to result from three general controls (sea level, climate and tectonics). Dominant processes include river discharge (water and sediment), tectonic changes, sea-level position, tidal range and wave climate. Naturally, these processes exhibit spatial and temporal variability.

There are two critical concerns when investigating subaqueous channels: (1) the seismic system has a dramatic influence on the imaging quality, and (2) the survey path and assumed sound speed significantly affects the channel geometry. Taking these into consideration, distribution and attributes (e.g., width, depth) of channels on the continental shelf is determined. A classification system and measurement protocol developed for the various parameters is employed in the analysis of data from throughout the U.S. East Coast, compiled from several sources.

Several important insights are gained from the examination of the various seismic datasets. Tidal inlets appear to be commonly preserved with the widespread occurrence of narrow channels (hundreds of meters wide) with steep sidewalls ($> 15^\circ$). Incised valley networks seaward of large river mouths (e.g., Pee Dee, Delaware) are hundreds of meters to kilometers wide and tens of meters deep, and the underlying lithology apparently has a notable impact on their preserved channel morphology. Large surface channels are only evident in the New York Bight (i.e., Hudson and Block Island Shelf Valleys), perhaps reflecting large water and sediment discharge during the late Pleistocene.

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Investigation of the Geologic Framework of the Grand Strand Coast in South Carolina

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The Grand Strand consists of a continuous 100 km arcuate shoreline extending from Winyah Bay to Little River, South Carolina. This coastal segment of South Carolina is dominated by mainland beaches, which are attached to eroding Pleistocene headlands. Pleistocene and Holocene age deposits generally form a relatively thin veneer of unconsolidated sediments that overlie early Tertiary or late Cretaceous sedimentary units. These older indurated to semi-consolidated deposits are exposed as "hardgrounds" in the immediate shoreface zone. Wave erosion of Quaternary deposits and the underlying older strata provides a varied sand source for this sediment-starved coastal segment. Therefore, knowledge of the geologic framework of the lower coastal plain and the inner continental shelf is extremely important in understanding long and short-term coastal changes that affect this region.

Sixteen borings drilled to a maximum depth of sixty feet, as well as 150 additional data points derived from geophysical well logs and existing core data, have been utilized to characterize the near-surface stratigraphy and define the Holocene unconformity beneath the Grand Strand. Pleistocene and Holocene sediments analyzed from these borings suggest deposition in beach ridge/spit, tidal inlet, back barrier, nearshore marine and fluvial/deltaic paleoenvironments. To the south, these younger sediments overlie an erosional surface incised into fine-grained shelfal sand, silt, and clay strata of the Paleocene Black Mingo Group, whereas to the north, these deposits unconformably overlie sandy mudstones and siltstones of the late Cretaceous Peedee Formation. Coast-parallel and perpendicular seismic surveys confirm the presence of buried fluvial channels that were incised into these older stratigraphic units by ancestral Piedmont rivers during Pleistocene sea level low stands.

The identification of nearshore morphological features, coupled with the sedimentological characteristics and thickness of modern shelfal deposits, are important criteria in defining both the sediment budget and sediment transport processes affecting this coastal segment. Through further integration of land-based data and offshore geophysical surveys, a comprehensive model of the geologic framework is being developed to better understand both the geologic evolution and the modern day processes that influence the Grand Strand coastline.