**Benthic Boundary Layer Processes: Bedform Evolution and Bottom Turbulence**

by

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## ABSTRACT

Bedform roughness, caused by ripples on the seabed, plays an important role in controlling sediment dynamics in the nearshore region. In this dissertation, the temporal and spatial evolution of ripples from two field sites located in the South Atlantic Bight, offshore Long Bay, SC and Georgia are used to relate wave-induced ripple geometry (wavelength and orientation) to near bed directional wave velocities. 2-D spectral analysis techniques were developed to automate detection of ripple wavelength, direction, and irregularity. This analysis showed that magnitude, direction, and duration of wave forcing controls ripple geometry and irregularity. During highly energetic events, ripple geometry changes rapidly and the ripples align with the main wave direction. During periods of low energy conditions, close to the critical conditions for initiation of sediment motion, ripple evolution occurs at a much slower rate often leading to irregularities such as terminations and bifurcations along the ripple crest. Under constantly changing wave direction, the rippled bed becomes highly disorganized.

Equilibrium ripples were found to occur only when either strong wave forcing was present or the forcing remained constant for a long duration. These equilibrium ripples, when combined to a database of existing published ripple measurements, were found to have a wavelength that scales with the wave orbital semi-excursion and sediment grain diameter. Ripple steepness was found to remain relatively constant and it only slightly increased for shorter ripple wavelengths. These findings allowed for the development of a new equilibrium ripple predictor suitable for application in a wide range of wave and sediment conditions.

In order to describe the temporal variability between equilibrium states, a 2-D time-variable ripple prediction model developed. This new model allowed for the prediction of ripple wavelength, height, and orientation. Since ripple irregularity is associated with directionality, the new model also predicts the irregularity of the rippled seabed and second order ripples (i.e. cross-ripples). This model was tested against existing time-dependent models and found to improve predictions of wavelength, height, and orientation, especially for relict ripples.

Turbulence was measured via the eddy correlation and inertial dissipation methods from which drag coefficients were calculated. The data reveal a trend of decreasing drag for increasing ripple irregularity and increasing ripple height. In similar fashion, suspended sediment concentrations were calculated from ABS systems and it was found that convective sediment resuspension extended to greater elevation above the seabed when ripples were more regular.