INFLUENCE OF COASTAL AND NEARSHORE MORPHOLOGY ON SEDIMENTATION AND INNER SHELF CIRCULATION

By

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ABSTRACT

This dissertation addresses the mechanisms which enable the development ofcross-shore flows and cross-shore sediment transport. Understanding the processes that contribute to the development of these phenomena are important in understanding how sediments and other materials such as pollutants, larvae, and nutrients can be exchanged between the shore and deeper regions of the continental shelf. These phenomena are explored in four independent but also inter-related parts.

In the first part, the role of along and cross-shore currents were evaluated with respect to the sediment transport processes that contributed to the maintenance of sorted bedforms on the inner shelf of Wrightsville Beach, North Carolina. Here benthic boundary layer model results are used to show that differences in bed roughness between the coarse areas of the seabed within the coarse regions of the sorted bedforms and the finer areas of the inner shelf are more pronounced during increasingly energetic wave and current conditions.

The second chapter examines the spatial variability of near-bed flows over the inner shelf of Long Bay, South Carolina, a concave embayment stretching between Cape Fear and Cape Romain. In this case spatial variations in alongshore currents were noted during southwestward winds (downwelling favorable) which occur often with the passage of low pressure systems in late-fall through early spring. At these times flows within 1 km of the shore opposed the wind and currents farther offshore. Analysis of the depth-averaged, alongshore momentum balance illustrated that the alongshore pressure gradient approached or exceeded the magnitude of the alongshore wind stress at the same time that the nearshore alongshore current opposed the wind stress and alongshore currents farther offshore.

In the third part of this work, nearly six months of oceanographic observations were used to examine the development of vertical density gradients and their effect on the development of cross-shore transport over the inner shelf of Long Bay. Here, vertical density gradients were observed mainly during periods of northward wind (upwelling favorable). At these times a two-

layered flow pattern was observed where near-surface flows were directed mainly alongshore with the wind but also exhibited a small offshore flow component. At the same time, near-bed flows, which were weaker, were directed onshore compensating for the offshore transport in the surface layer in a manner qualitatively consistent with Ekman circulation over the continental shelf.

Lastly, the role of tidal semi-diurnal tidal oscillations in sea-surface and current variability were evaluated over the inner shelf of Long Bay. The results show that tidal oscillations account for approximately 90 percent of the sea-surface variability and 30-45 percent of the total current variability. M_2 sea-surface amplitudes and alongshore-current amplitudes decrease with increasing distance from the coast while the cross-shore current amplitudes decrease seaward in agreement with Poincare wave theory.