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Effect of storms on inner-shelf sediment transport in Long Bay, South Carolina

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Long Bay is a sediment-starved, arcuate embayment located along the eastern coast of South Carolina, USA. This region has a strong history of tourism and coastal activities. Rates and pathways of sediment transport are important because they determine the availability of sediments for beach renourishment, seafloor habitat, and affect navigation. Sediment transport in this region is strongly influenced by local storm activity where wave bottom orbital motions resuspend sediment and the winds, waves, and tides create coastal circulation patterns that transport the sediment.

To investigate oceanographic dynamics in this region, instruments were deployed from October 2003 to April 2004 at eight sites offshore of Myrtle Beach, SC to measure sea level, surface waves, currents, salinity, temperature, suspended sediment concentrations, and bed forms. These measurements, in conjunction with meteorological data from other sources, were used to identify the effects of storms on circulation and sediment transport on the inner shelf.

Analysis of the observational data identifies three predominant types of storms: 1) cold fronts, 2) warm fronts and 3) tropical storms. The passage of a cold front is accompanied by a rapid change in wind direction from primarily northeastward to southwestward, a warm front is characterized with the opposite wind response, and

tropical storms typically drive southward winds. Each type of storm has an identifiable response of circulation and sediment transport dynamics. During cold fronts more sediment is suspended when the winds are northeastward because of the larger fetch, creating a net sediment flux to the northeast. Likewise, even though a warm front has an opposite sequence of wind patterns, the net sediment flux is also to the northeast due to the larger fetch during winds to the northeast. Tropical storms create a sustained net sediment flux to the southwest. The duration, magnitude, and frequency of storm types will dictate the long term sediment flux of the region.

We model these storm patterns with the ROMS-SWAN-Sed coupled ocean circulation-surface wave-sediment transport modeling system that includes dynamic wave-current coupling, three dimensional radiation stress terms, enhanced bottom stress due to wave bottom boundary layers, and suspended and bedload transport due to combined wave and currents. Model results identify a more complete spatial variation of circulation and sediment transport on the inner shelf in response to the different storm patterns.