Modeling Coastal Erosion due to Waves and Overwash

Bradley Johnson[1] and Alison Grzegorzewski[1]
[1]U.S. Army Engineer Research and Development Center
, Coastal and Hydraulics Laboratory,
3909 Halls Ferry Road, Vicksburg, MS 39180, USA
Bradley.D.Johnson@usace.army.mil, Alison.S.Grzegorzewski@usace.army.mil

Following the destructive hurricanes of the past decade, The Mississippi Coastal Improvement Program is focused on methods to reduce the impact of powerful coastal storms. One approach to storm protection includes a proposal to replenish Ship Island with a significant volume of sand, increasing the island footprint and closing the channel between the east and west halves of the island. A defensible numerical model prediction of morphological response and sand fate would be invaluable in determining volumes and nearshore placement of sand. The US Army Corps of Engineers MOdeling Relevant PHysics Of Systems (MORPHOS) project is developing a new 2D-H nearshore morphology model. This effort presents an application of the model to the Ship Island case using Hurricane Katrina. With a pre- and post storm bathymetry and topography, this numerical investigation provides the opportunity to assess the new model with a focus on wave-induced erosion and the the overwash process

The large and destructive Hurricane Katrina crossed the Mississippi Sound on August 29, 2005 with the center tracking 50 km to the west of Ship Island. The island was nearly inundated with a storm surge and subject to large storm waves and pressure-driven currents. Recent numerical model studies indicate that the wind and wave driven surge was in excess of 5 m above the expected water levels (IPET 2008). The sustained hurricane force winds generated wave heights in deep water of more than 15 m and current magnitudes through Camille cut at the storm peak are in excess of 2.5 m/s. Pronounced morphological changes are evident in the measured data, with several meters of lowering on the Gulf side of the island and deepening and widening of the Camille cut.

The cross-shore transport model CSHORE has been under development for the past several years, approaching a practical and accurate code that predicts beach profile evolution over the nearshore region, and a full description of the model development is available in Kobayashi *et al.* 2009. The majority of the effort has been in the new and physically defensible sediment transport algorithms for a nearshore breaking wave environment. The model accounts for wave and current interaction, bedload and suspended load, wave-related sediment transport. In a departure from conventional models that directly or indirectly relate transport to bottom shear, the new model includes the effect of energy dissipation due to wave breaking. The one-dimensional model was developed for cases with long straight coasts, and this simplification is appropriate the developmental phase, but is inappropriate for most practical applications such as Ship Island. Recognizing the importance of the current component of transport, the previous formulations are generalized to include strong currents in this effort. Currents in this new model are predicted with the continuous Galerkin finite element model ADCIRC, subject to an additional projection step to ensure mass conservation. The bed position is evolved with an explicit time integration of the sand conservation statement acting on a finite element.

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