Development and application of a Coupled-Ocean-Atmosphere-Wave-Sediment Transport (COAWST) Modeling System

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Understanding the processes responsible for coastal change is important for managing both our natural and economic coastal resources. The current scientific understanding of coastal processes suggests that examining coastal systems at sub-regional to regional scales can lead to significant insight into how the coastal zone evolves. In the coastal zone, storms are one of the primary driving forces resulting in coastal change. Here we utilize a numerical modeling approach to investigate the dynamics of coastal storm impacts.

We use a newly developed Coupled Ocean – Atmosphere – Wave – Sediment Transport (COAWST) Modeling System that is based on the Model Coupling Toolkit to exchange prognostic variables between the ocean model ROMS, atmosphere model WRF, wave model SWAN, and the Community Sediment Transport Modeling System (CSTMS) sediment routines. The models exchange fields of sea surface temperature, ocean currents, water levels, bathymetry, wave heights, lengths, periods, bottom orbital velocities, and atmosphere radiation fluxes, winds, atmospheric pressure, relative humidity, precipitation, and evaporation. Data fields are exchanged using regridded flux conservative sparse matrix interpolation with weights from SCRIP.

We describe the modeling components and the model field exchange methods. As part of the system, the wave and ocean models are run with cascading, refined, spatial grids to provide increased resolution at selected regions within a larger, coarser-scale coastal modeling system. The modeling system is applied to the U.S. East coast to simulate impact from Hurricane Isabel. Results identify that hurricane intensity is extremely sensitive to sea surface temperature. Intensity is reduced when coupled to the ocean model although the coupling provides a more realistic simulation of the sea surface

temperature. Coupling of the ocean to the atmosphere also results in decreased boundary layer stress and coupling of the waves to the atmosphere results in increased bottom stress. Wave results are sensitive to both ocean and atmospheric coupling due to wave-current interactions with the ocean and wave-growth from the atmosphere wind stress. Sediment resuspension at regional scale during the hurricane is controlled by shelf width and wave propagation during hurricane approach. Also presented will be some of the challenges faced to develop the modeling system.