Modeling Tropical Cyclone Impact on Barrier Island Morphology and Infrastructure Under Different Sea-Level Scenarios

Global warming and climate change have severe consequences for the global population living within low-elevation coastal zones, particularly on barrier islands. Along with sea-level rise, storm systems are forecasted to intensify, further threatening these vulnerable populations. In order to evaluate and prepare for these impacts, a coupled 2D-Horizontal morphodynamic and hydrodynamic XBeach numerical model is used to forecast the morphological impact of future climatic scenarios on the barrier island of Palm Beach, Florida. A high resolution digital elevation model is used and incorporates LiDAR elevation data, land use data and a non-erodible layer to represent the heavy development of the island. Initial boundary conditions are set to reflect oceanographic observations during Hurricane Matthew (2016). The model uses this initial result for calibration and is compared to measured values of erosion from a post-Matthew LiDAR survey conducted by the US Geological Survey. After a strong morphological representation of the event is compiled, the initial conditions of this model are then altered to reflect two future variables: (1) local sea-level rise and (2) increases in storm intensity. In order to evaluate the individual impact of each of these components, individual models are run for each parameter, as well as a third model consisting of an aggregate of both. Model output shows that increases in the local sea-level by the expected RCP 4.5 2100 value of 65 cm and setting storm intensity to measured historical Category 5 conditions, significantly enhances erosion along the entire swash zone.