Global to Channel Scale High Resolution Comprehensive Spectrum Modeling of Coastal Flooding

Extreme sea levels associated with storm surges and high tides can have devastating impacts on coastal populations. Furthermore, slowing of global currents systems is driving increased frequency of low level so called nuisance flooding as the geostrophic pull of water from many coasts decreases. Accurate coastal flooding forecast systems should therefore incorporate the entire energy spectrum of processes including tidal, wind and atmospheric pressure driven, wind waves, and baroclinically driven processes. We have made advances in the use of a globally forced unstructured mesh storm tide models (2 km to 25 km resolution) that incorporate seamless local high-resolution regions (minimum resolution of 30 m). The system incorporates downscaled temperature and salinity information from a three dimensional coarse grid HYCOM model to force baroclinic pressure gradients terms and internal tide dissipation terms in the fine mesh implementation of a 2D ADCIRC model. This coupled system functions as a heterogeneous internal mode – external mode coupling often used in 3D ocean models but each system operates at its own optimal scales for the processes being modeled. This heterogeneity allows for efficient operation of each model while optimally extracting the full spectrum of processes. We have demonstrated that this methodology improves the fit between the measured and modeled long term energy spectrum. Optimized automated mesh generation are designed for global coverage with elements sizes varying from 25 km down to 30 m.