A high-resolution, finite element-based, shallow water equation model is developed to simulate the tides in the South Atlantic Bight. The model is constructed to include all of the estuarine features along the southeastern United States seaboard: coastal inlets, rivers and tidal creeks, sounds and lagoons, intertidal zones including salt marshes and mangrove swamps, and the Atlantic Intracoastal Waterway. The estuaries are represented in the finite element mesh using triangular elements with side lengths on the order of tens of meters. Also incorporated into the model is a spatially distributed bottom friction parameterization, based on the various landcover and benthic characteristics in the domain. The motivation to use this comprehensive representation of the system was inspired by a desire to capably account for the full estuarine tidal physics. In this approach, no calibration is performed and the model is used as a tool to assess the physical processes it describes.

Upon its development, the model is first validated by accurately simulating tidal hydrodynamics in the South Atlantic Bight including the described estuaries. Variants of the model are then constructed by selectively removing estuarine features from the domain. All model representations are subsequently applied in nearly identical simulations: the only differing factor between the simulations being the inland extent of the estuaries described. The solutions are compared with respect to including versus excluding the estuarine features of the domain. Where water surface elevations are shown to be unaffected by the estuarine features of the South Atlantic Bight, tidal velocities exhibit far more sensitivity. This effect is pronounced locally, with regional effects extending offshore. Further analysis is performed on tidal discharges recomposed at inlet cross sections and on tidal energetics diagnosed throughout the domain. It is discovered that the interconnectedness of the hydrodynamics caused by the estuaries plays a role in local and regional tidal circulation in the South Atlantic Bight.

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Approved for distribution by Dr. Scott Hagen, Committee Chair, on October 5, 2009.

The public is welcome to attend.