Storm Surge Modeling and Validation

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Abstract:
Coastal communities are home to approximately 40% of the world population. Consequently, loss of property and life has become a major concern when coastal hazards take place. One of the most common, wide-spread hazards is the storm surge, which is the significant and abnormal rise of sea water level caused by storm systems like hurricanes and typhoons. Being able to model and reconstruct these events is considered consequential. The software used was Clawpack (Conservation Law Package), which is a collection of finite volume methods for conservation law problems in linear or non-linear PDE systems. GeoClaw, a variant of the Clawpack, uses the two-dimensional depth-averaged shallow water equation in cooperation with the adaptive mesh refinement (AMR) algorithm to model many kinds of flows and waves over topography data with adjustable resolutions. My work used GeoClaw to simulate four major hurricanes in the 2021 Atlantic Hurricane Season. A rigorous verification and validation process between simulation and observation was performed on all storm systems studied. To reduce data collection time and make data more visualizable, an automated analysis program was developed to assist users in advance of storm surge modeling and validation process. The program was also made compatible with GeoClaw, so that majority of storm specific run-time parameters were selected and filled in automatically.

Keywords: *Modeling & Simulation; Verification & Validation; Finite Volume Method for Hyperbolic PDE; Geophysical Flow; Natural Hazards; Coastal Community*