**Efficient Computations of Flooding Scenarios for the Coast of Maine**

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In 2012, Hurricane Sandy wrought loss of life and damage in the billions of dollars to the Eastern seaboard. Despite flood mitigation actions and policies, communities were unprepared as flood hazard maps did not accurately predict Sandy's storm surge. These deprecated flood maps derived from flooding models that relied heavily upon historical data to produce flood zone grids (FZG). Since the devastation of Hurricane Sandy, the NOAA has developed a protocol that allows flood scenario models to account for rising sea levels produced by climate changes and global warming. Geospatial LiDAR data produced digital elevation models (DEM) are used in the NOAA protocol along with the FZG from historical data to allow simulation of terrain flooding and storm surges with a given sea level rise. Coastal flooding modelers enter the very large data sets of the DEM and FZG into an ArcGIS mapping platform and then manually bring the data sets through the sequence of steps prescribed by the NOAA protocol. A slow, laborious, process hampers current coastal flooding forecasting methods utilizing ArcGIS. This research aims to provide more efficient modeling of flooding scenarios by algorithm development utilizing FZG and DEM LiDAR geospatial data sets to automate the NOAA protocol sequence computations.

DEM LiDAR data provides the elevation with respect to vertical datum and flooding is identified when a point in the grid's elevation is below the elevation of the ocean. Algorithm development utilizes graph traversal breath-first search to find the coast and places the points in a queue. Then while the queue is not empty, a point is removed from the queue and its neighbors are evaluated to determine if they are flooded. If they are flooded, then they are added to the queue and marked as flooded. In addition, flooding is also identified when a point in the grid's elevation is reachable by the ocean. This requires determination of the height of storm waves at grid elevation data points reachable by flooding. Various interpolation methods were explored to develop an algorithm to identify storm surge points for the flood zone grids and two selected. The interpolation methods employed for the flood zones grid are inverse distance weighted (IDW) and nearest neighbor (NN). These methods assign each point in the grid a particular flood zone value based on their distance to the original flood zone. Using the interpolated flood zones, the algorithm is then able to model flooding with storm waves and provides ability to input variables unlike ArcGIS. This research developed algorithms to produce flood grids that allow manipulation by a selected sea level. The algorithms also predict storm wave height and produce flood grids that simulate inundation moving from the coastline to areas inland.

Outputs from the newly developed algorithms compared to results produced through ArcGIS showed comparative relative accuracy through visual inspection of produced flood grids. Running with 2-meter LiDAR data, results mimicked ArcGIS, but were produced within seconds rather than the longer time required by utilizing ArcGIS. When implemented for selected Maine coastal areas, the program produced flooded grids and storm wave heights for Southport (15 million points) in 0.7 seconds, Bremen (13 million points) in 0.2 seconds, and Lincoln County (1 billion points in 6.5GB) in 80 seconds. This new algorithm demonstrates drastic time reduction for output over the days needed to utilize ArcGIS.

Overall, the program is able to produce results in a fraction of the time required by ArcGIS geospatial platform with increased facility to manipulate variables. Provided as a free and open source, the drastic reduction in time required for computation will aid coastline management flooding mitigation and policy decisions.

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