1. MOTIVATION

- North Carolina Emergency Management (NCEM) relies on storm surge forecasts from computer models for decision-making during a storm.
- Prediction of the extent of coastal flooding may be limited by resolution of the model grid, because topography can be smoothed out and small-scale features such as roadways and small channels are not represented.

2. METHODOLOGY

- "Enhancing resolution" of ADCIRC using a high-resolution Digital Elevation Model (DEM) makes use of Python scripts and the Geographic Resources Analysis Support System (GRASS), an open-source GIS application.
- The DEM used covers 32 coastal North Carolina counties at 50-foot resolution, totaling more than 430 million grid cells.
- Initial tests were performed on a small sub-region of Carteret County, NC, before moving onto the entire county and then the entire coast of North Carolina.
- The general steps are:
  1) Interpolate ADCIRC points to a raster at 50-foot resolution (Figure 3b).
  2) Expand ADCIRC raster outward only where the water levels are greater than the ground elevation.
  3) Remove isolated (not hydraulically-connected) cells (Figure 3c).
  4) Convert the new "grown" raster to polygon format for distribution.

3. RESULTS IN CARTERET COUNTY, NC

- Figures 4 and 5 show before and after the enhanced resolution on the county scale.
- Analyzing a Carteret County building dataset for a Hurricane Matthew Hindcast:
  - Before enhancement: 2,435 buildings are predicted to be flooded.
  - After enhancement: 3,886 buildings are predicted to be flooded.
  - This is a 60 percent increase.

4. STATE LEVEL RESULTS

- For all of coastal North Carolina, we get similar results:
  - Low-lying floodplains (darker grey colors) that should be flooded are now flooded (Figure 7).
  - The boundary of the flooding is more defined, characteristic of the high-resolution DEM.

5. SPEED AND REAL-TIME FORECASTING

- To speed up interpolation step:
  - Text file containing precomputed Inverse-Distance Weights was created for each ADCIRC mesh.
  - Code was parallelized for running on up to 16 processors.
  - The program now takes 13-15 minutes to process ADCIRC results for a tropical storm using the latest North Carolina mesh.
- A script is running the following process continuously during hurricane season:
  1) Latest ADCIRC forecast is detected
  2) Simulation output is downloaded
  3) Enhanced resolution script is submitted
  4) Final result is e-mailed to NCEM

6. CONCLUSIONS AND FUTURE WORK

- A post-processing tool has been developed that improves accuracy of ADCIRC storm surge forecasts using a high-resolution DEM.
- Current work is considering how neglecting the physics of inundation impacts the accuracy of the resulting enhanced surface.
  - This involves running ADCIRC with 50-ft grid resolution over land and comparing to the results of the enhanced resolution technique described here.
  - Preliminary results indicate that predicted flooding is strongly dependent on the source of the elevation data.
  - Results may also depend on the land-use type and slope of topography.
- Future work could involve incorporation of simple physical processes such as mass conservation and frictional dissipation, as well as application to other coastal regions.