THE EFFECT OF RIVER BATHYMETRY ON RIVERINE FLOOD SIMULATION

Mariam Khanam and Sagy Cohen

The University of Alabama, Department of Geography, Surface Dynamics Modeling Lab

INTRODUCTION

- Numerical simulation has gained popularity as an effective non-structural flood mitigation measure in past few decades.
- One of the major challenges to deliver precise prediction in hydraulic modeling is an accurate description of river bathymetry and floodplain geometries.
- This study will investigated the impacts of topographic and geometric description of river bed and floodplain on flood inundation simulation.
- The increased availability of high-resolution DEMs (e.g. LiDAR data) offer accurate information about floodplain geometry and topography but (with the exception of blue/green LiDAR surveys) not for the river channels.
- Here we present preliminary results of a study focused on elucidating the effect of detailed river bathymetry inputs on flood simulations in a wide range of river reaches.

METHODOLOGY

- Two different river reaches in Alabama were simulated for a 50-year flood event (Fig. 1):
  - A 90 km reach of the Tombigbee River - from Demopolis lock & dam to Coffeeville lock & dam,
  - A 15 km reach of Black Warrior River from Holt lock & dam to Northport, AL
- A 10 m DEM from NED and sonar-surveyed bathymetry data (by the USACE) were used to create a DEM that incorporate the river bed elevation (bathymetry).

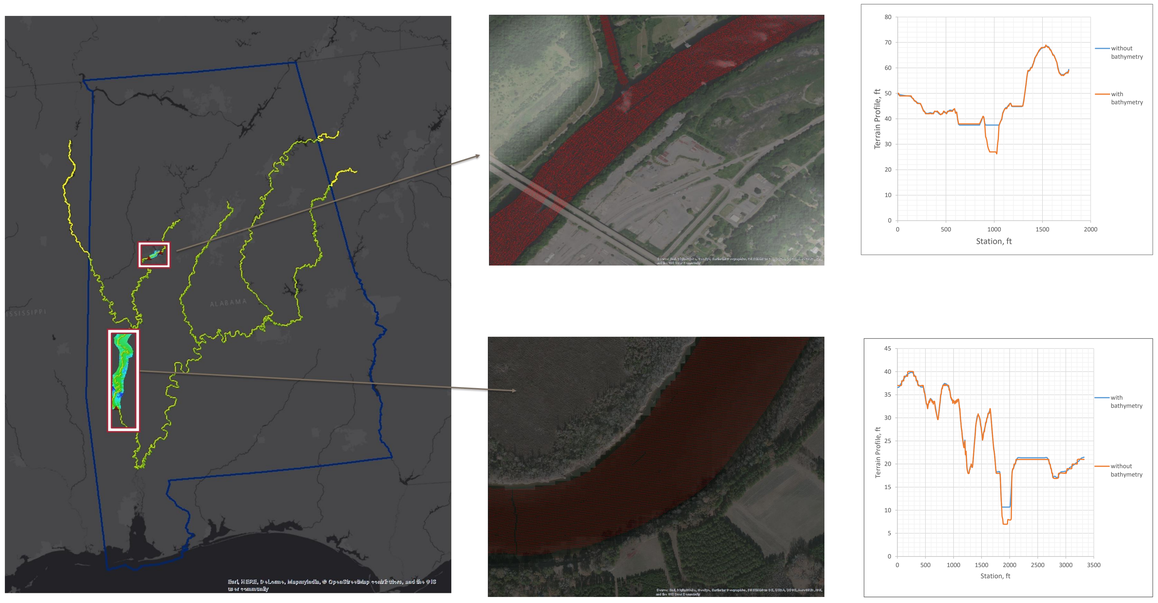

Figure 1: Study area (left), Bathymetry data sample (Middle), Terrain profile variation (right)

- 2D Simulations were initiated using both the original DEM and bathymetry induced DEM.
  - National land cover 2011 data set were used as input for roughness coefficient. Break−lines were induced to enforce the river reach into 2D flow area.
  - Daily mean flow and stage hydrograph of one month including peaks discharge from last 10 years were considered as upstream and downstream boundary conditions consecutively.
  - Both the reaches were simulated over a period of one month similar to the hydrometry data extent and flood maps have been produced for comparison
- Quantitative indices such as inundation area, average inundation width and the F statistics are used to compare inundation maps (Cook & Merwade. 2009). Innundation area was used to the compare and identify the variation in predicted area by the model for each case.

RESULTS

- Depth and flood extents for peak flow produced with and without bathymetry DEM showed quite significant variation in depth value as well as flooded area for both the Black Warrior and Tombigbee river reaches (Fig. 2)and 3.
- For the Black Warrior River, a 17% greater flooded area was predicted by the model without the bathymetry and a 6% increase was predicted for the Tombigbee reach.

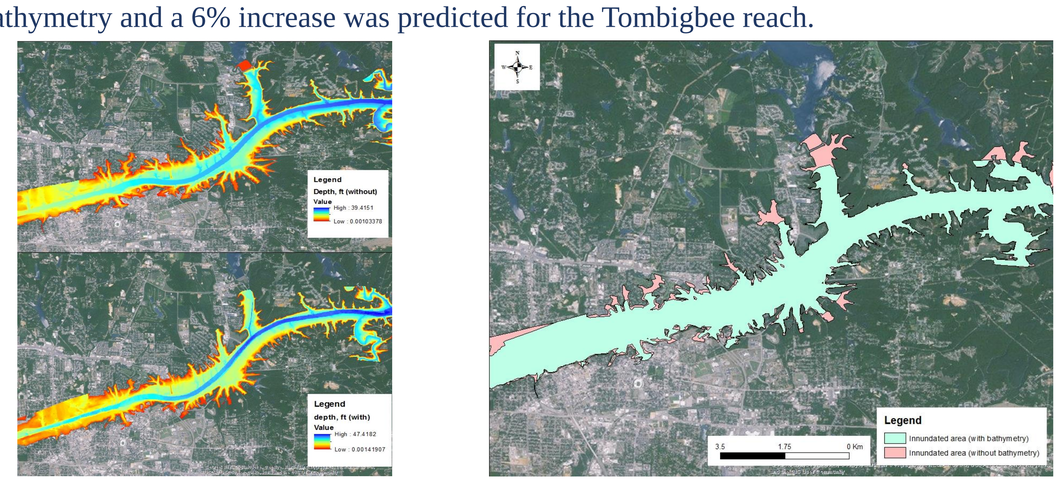

Figure 2: Variation in simulated depth values (left) and inundated area (right) at peak flow for Black Warrior river

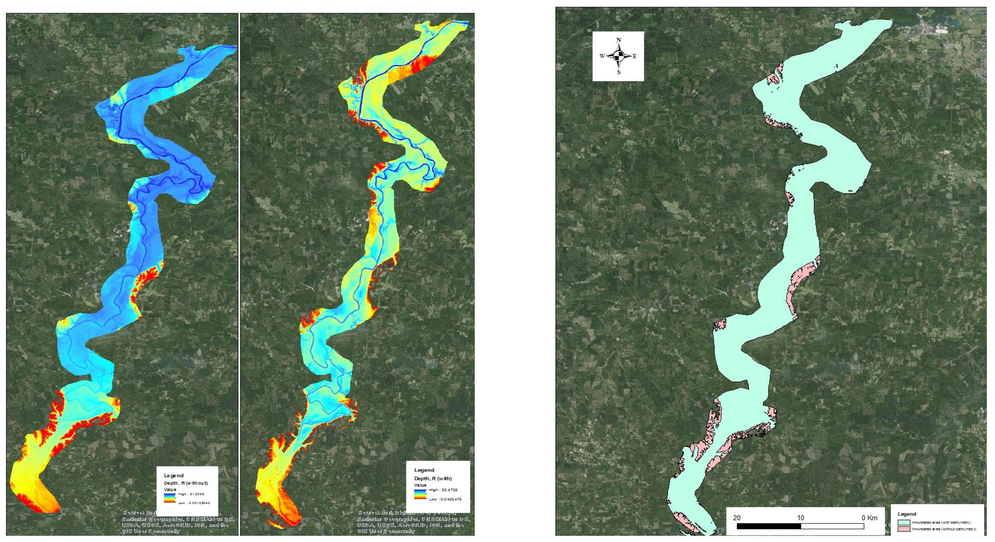

Figure 3: Variation in simulated depth values (left) and inundated area (right) at peak flow for Tombigbee river

CONCLUSION

- The differences in inundation extent can be significant, particularly for flood susceptibility analysis. These initial results support the overarching assertion for this research, that is there may be a significant effect on flood simulation due to varying bathymetry descriptions.
- Flood simulation accuracy is utmost important for first responders and decision makers, in support of flood prediction and mitigation measures.
- The significance of the effect of bathymetry on flood simulation will be tested for river reaches with varying stream order, width and size to asses its importance over fluvial scales .

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