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Simulating the Storm Surge from a Category 5 Hurricane Making Landfall in Mobile Bay, Alabama

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Resilient Civil Infrastructure Systems (RCIS) Lab

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https://sites.google.com/uah.edu/rcislab/home?authuser=1

Project Description

Background and Motivation: Due to its proximity to the Gulf of Mexico, the Gulf Coast is vulnerable to hurricanes of varying intensities. More than 230 hurricanes have struck the Gulf Coast over the past 150 years. Twenty-four hurricanes have directly struck Alabama during the period, with many more having an effect without a direct hit. A storm surge is water from the ocean that is pushed to the shore as a result of hurricane wind force. Such hurricane-induced storm surge can cause considerable damage to critical infrastructures, such as bridges. For example, a record-high 12-foot storm surge caused by Hurricane Katrina in 2005 hit Mobile Bay, causing considerable damage to bridges and other infrastructure systems. The most intense hurricane to make landfall in Alabama is a Category 3 hurricane. The impact of a Category 5 hurricane making landfall in Mobile Bay, which is not unlikely, has not been investigated in the past.

Goal: The goal of this project is to use the Simulating WAves Nearshore (SWAN) + ADvanced CIRCulation (ADCIRC) storm-surge model to simulate the storm-surge from a hypothetical Category 5 hurricane making landfall in Mobile Bay, Alabama.

Objectives: Specific objectives include: (i) simulating a hypothetical Category 5 hurricane by changing the size (radius of winds), intensity (wind speed), and forward speed of a historical Category 3 hurricane; (ii) collecting and preparing the necessary data (bathymetry, tidal levels, topography, etc.) for simulating the storm surge; (iii) using the Surface-water Modeling System (SMS) software to simulate the storm surge from the hypothetical hurricane.

Outcomes: The outcome of the project will be the hypothetical hurricane-induced storm surge level and speed at various locations along the coastal area of Alabama, especially at locations of critical infrastructure to determine their risk of damage. The outcome will provide the basis for studying the vulnerability of various structures and infrastructure systems in coastal Alabama. By quantifying the vulnerability, decisions can be made on appropriate risk mitigation strategies and prioritize the allocation of resources for the mitigation actions.

Ongoing work: Currently, a Ph.D. student is developing a model for simulating thousands of hurricanes along the gulf coast and the east coast. The student is also developing a method to select representative hurricanes that can be used to study the risk posed by storm surge to infrastructure systems and communities using the SMS software.

Student Duties, Contributions, and Outcomes

Specific Duties: (i) surveying relevant literature for the first two weeks of the program; (ii) collecting data from the National Oceanic and Atmospheric Administration (NOAA) website on Hurricane Ivan (path, wind speed, size, translational speed, etc), which will form the basis of the hypothetical hurricane (2 weeks); (iii) preparing the necessary input files from the data to run the SMS software (1 week); (iv) run the SMS software to simulate the storm surge from the hurricane and determine the surge level and speed at various locations (3 weeks); and (v) write a technical paper to be submitted to *Perpetua* (2 weeks).

Tangible Contributions: (i) the student will produce a map showing the level of storm surge inundation at various locations in coastal Alabama; (ii) the student will prepare a manuscript to be submitted for publication in *Perpetua*.

Specific Outcomes: (i) the student will gain a deeper understanding of the genesis and properties of hurricanes that contribute to their destructiveness; (ii) the student will learn how to use the SMS software to model simple coastal processes; (iii) the student will gain knowledge on the common approach for coastal infrastructure risk assessment.

Student Selection Criteria: This project is open to students at all academic ranks and from any academic discipline.

Faculty Mentorship:

To successfully complete the project, the student needs to gain knowledge of the principles of hurricane formation and its characteristics as well as learn how to use the required software. Dr. Salman will be responsible for ensuring that the student gained the necessary knowledge. This will be achieved through one-to-one discussions with the student twice a week and by providing the student with relevant literature to review. During the meetings, Dr. Salman will also review the progress of the student and answer any questions they might have. Dr. Salman will help the student improve their technical writing by reviewing and providing feedback on the manuscript prepared for *Perpetua*. A Ph.D. student will train the student on the use of the SMS software to prepare the necessary data and run the storm surge simulation. The Ph.D. student, Babak Salarieh, is currently using the software for his research project and will be designated as an adjunct mentor on the project.