Research Summary

South Carolina Department of Transportation | Office of Materials and Research

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Research Administration

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This final report is available online at:

http://www.scdot.scltap.org/projects/completed/

Lumber and Little Pee Dee Watersheds for SC Flood IMPACT

In recent years, South Carolina has experienced large and small scale flood events. At the time of these events, there was no easy access to predicted inundation mapping for flooding. This Research Grant developed and quality-controlled flood inundation libraries that contain 10 flood frequency scenarios for both the Little Pee Dee and the Lumber Hydrologic Unit Code (HUC 8) Watersheds. The information produced augments the SC Flood IMPACT website and assists in providing state and local officials, as well as the public, with a reliable and accessible resource to communicate flood hazards and identify areas at risk of flooding. An example of a 2,000 year storm event (or 0.05% annual exceedance probability) is shown in the figure below.

0.05% Annual Exceedance Probability Flood Map in the Little Pee Dee Watershed

Problem

The State of South Carolina has recently experienced severe storm events resulting in devastating floods. Specifically, the flooding that resulted from Hurricane Matthew in 2016 highlighted the need to produce inundation maps to be used by multiple government agencies and partners for emergency response. As part of SCDNR's inundation mapping efforts for Hurricane Florence, the two-dimensional (2D) hydraulic modeling approach was identified as an efficient and effective method for delivering inundation mapping for large magnitude events.

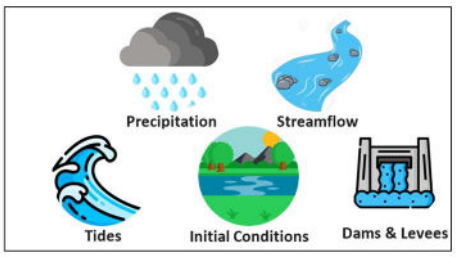
The previous extreme weather events have emphasized several critical needs for the State, including:

- Increase public awareness of flood hazards by identifying areas that may experience flooding,
- Provide a publicly available flood alert system, and

- The need for more resilient mitigation planning and emergency management.

Research

SC Flood IMPACT (Inundation and Mapping for Action) analyzes major factors that contribute to flooding such as precipitation, streamflow, tidal influence, initial model conditions, and dam releases. From each of these factors, the website continuously analyzes data multiple times each day. The end goal is for the website to choose an event from the library to display. By default, a flooding scenario from the library will not display until an event is triggered. Events are triggered using precipitation data produced by the European Centre for Medium-Range Weather Forecasts (ECMWF) and Southeast River Forecast Center (SERFC) gauge information. The forecast is updated every three hours.



SC Flood IMPACT Input Components

All 2D models were created using Hydrologic Engineering Center - River Analysis System (HEC-RAS). HEC-RAS is a software program that models the hydraulics of water flow through natural rivers and other channels. It is designed to perform one-dimensional (1D) and 2D hydraulic calculations. The software allows simulating flow in natural or artificial channels to calculate the water level for performing flood studies and determining the areas that are likely to flood. Various input data was inserted into the model such as Light Detection and Ranging (LiDAR), soil and land use data, and precipitation data.

The models were evaluated using established data sets, methodologies, and acceptable tolerances. This includes utilizing flood data from the Federal Emergency Management Agency (FEMA), historical events, high water marks, and photographs. Historical gauge data was analyzed to ensure that timing, magnitude, and volume of the riverine flows were reasonable.

SC Flood IMPACT is a unique project which paved the way for an innovative approach to predicting flood events. As a result, many specialized procedures were developed and utilized. These alternative procedures were explored and investigated to ensure that the most-informed path was taken.

Two key findings:

- 2D Modeling is a viable approach for creating flood inundation raster libraries, and
- There are numerous data sources that must be considered when creating an inundation raster library.

Results

The funding for this research project provided for the creation of 10 flood frequency scenarios for both the Little Pee Dee and the Lumber Hydrologic Unit Code (HUC 8) Watersheds in the form of flood inundation libraries. The library information was produced in the form of depth rasters. The depth rasters were loaded into the SC Flood IMPACT website library repository.

The repository is programed to display the appropriate depth raster that corresponds to the forecasted event. The website will automatically update as the forecast is refined and once the rainfall event has ended, the site updates based on precipitation data and gauge information.

Value & Benefit

SC Flood IMPACT is the proposed solution to address critical needs as the State will benefit greatly from instantaneous forecasts, accessible flood information, and an alert system. This website provides state and local officials, as well as the public, with a reliable and accessible resource to communicate flood hazards and identify areas at risk of flooding.

One of the main benefits of using rain-on-grid 2D modeling is that it identifies all areas that are at risk of flooding, as opposed to 1D modeling which focuses only on a single stream. As a result, SC Flood IMPACT differentiates itself in this regard compared to similar websites that only display flooding within a mile upstream or downstream of a stream that has a U.S. Geological Survey (USGS) gauge.

For SCDOT, additional benefits could include:

- Inundation scenarios that will identify areas that are at risk for flooding prior to the storm arriving,
- Ability to create and distribute maps of areas forecasted to flood, and
- Utilize potential flood impacts to determine where to stage resources.

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