P 2.49 An Effort to Increase Storm Surge Threat Awareness for the Charleston, SC Area Using a Web-based Visualization Tool and Associated Survey

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1. BACKGROUND

Forecasting storm surge associated with hurricanes has improved over recent years, largely due to improved track forecasting. However, the public's understanding of storm surge and its impacts remains poor (Morrow 2007). Although Lindner et al. (2004) found that the use of pictorial references aided in public understanding of storm surge threats, the National Weather Service (NWS) tropical watch/warning product suite remains chiefly text-based, particularly regarding storm surge. The National Weather Service has been developing experimental hazard graphics during landfalling tropical cyclones, but these graphics give broad-brushed potential impacts and may not be specific enough to cause individuals to take the necessary protective action for life and property.

A study between the College of Charleston and the Charleston, South Carolina NWS office is currently underway to improve basic understanding of the storm surge associated with hurricanes as well as the effectiveness of current NWS tropical advisory products relating to storm surge. Specifically, a web-based interactive surge visualization tool is being developed.

2. METHODOLOGY

Sea, Lake and Overland Surges from Hurricanes (SLOSH) (Jelesnianski et al. 1992) model output has been obtained for various hurricane scenarios (e.g., different intensities and landfall locations) along with historical tidal data and elevation data for roughly 2000 landmarks across the Charleston, South Carolina area. All of this data is linked together using GIS with an interface developed in HTML for interactive display on the web. The online interactive tool will allow users to select a landmark or locally known structure on a clickable map (Fig. 1), and choose a hurricane/tide scenario (e.g., a Category 3 hurricane making landfall just south of Charleston at high tide). The result is an image depicting the approximate forecast height of inundation, including the combined impacts of storm surge and tide (Fig. 2), along with a close up map of the user-selected location (Fig. 3). The interface is dynamic and allows the user to click on different radio buttons to display data for the same location, but with different storm strength, location of landfall, and tidal cycle.

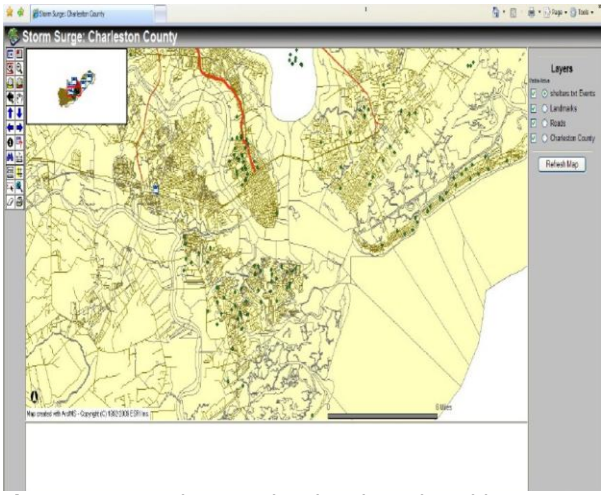

Figure 1. Example map showing the selectable landmark locations (green dots).

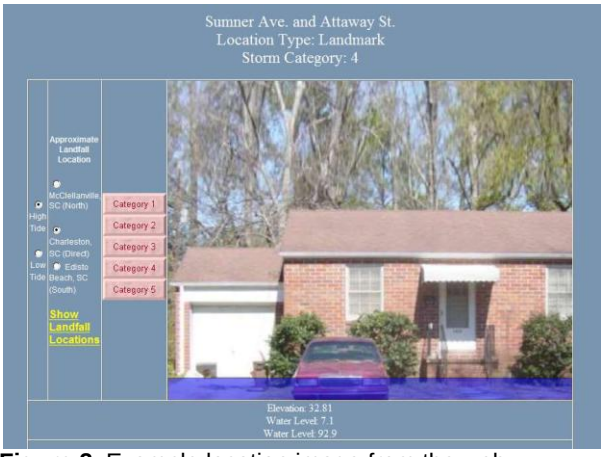

Figure 2. Example location image from the web depicting tide level (high or low), landfall location, storm category, and an approximate level of inundation.

An inset will be displayed (Fig. 4) to show the approximate locations of landfall that are available as choices to the user. Currently there are 3 choices meant to represent the surge impact based on landfall to the south (Edisto Beach), a direct hit (Charleston), and landfall to the north (McClellanville).

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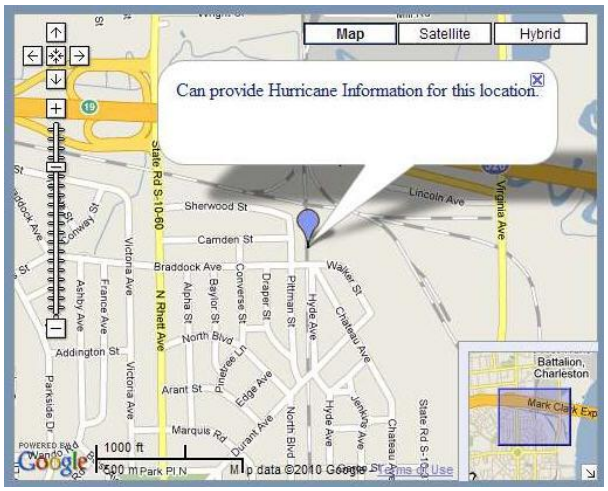

Figure 3. Image showing close-up details of random location chosen.

Figure 4. Image showing approximate landfall locations where **E** represents Edisto Beach, SC, **C** represents Charleston, SC, and **M** represents McClellanville, SC.

3. FUTURE WORK

The collaborative website between the College of Charleston and the National Weather Service Forecast Office is nearing completion. Once completed, the web address for the site will be made available to participants of a survey. The main purposes of the survey will be to determine the effectiveness of this graphical approach compared to standard NWS text-based products and warnings. The survey participants will be asked a general series of questions on their experience with past hurricanes as well as their understanding of hurricane risk and associated terminology (i.e. What does a hurricane warning mean and what action do I take when a warning is in effect?). The participants will then go through a variety of scenarios on the web site and be asked follow-up questions to see if the participants show improvement in their understanding of and appreciation for storm surge and its associated risks.

In addition, the database predictions will be compared to surge depths measured by the passage of an actual hurricane, should one pass during the timeframe of this project. Further, NWS Charleston will investigate whether the output can be incorporated into their product suite during the approach of a tropical cyclone.

Lastly, we eventually plan to adapt the tool to incorporate real-time SLOSH data or other available surge data, including ensemble data, for tropical systems forecasted to affect the Charleston, South Carolina area. We could envision the tool being used to display different scenarios based on different models, or to display confidence percentages of water reaching a certain height (i.e. 10%, 50%, and 90% levels).

4. UNIQUE ASPECTS

There are several unique aspects of this project. First, SLOSH output is converted into pictorial form, which we propose will be more easily understood by the public. Secondly, the interactive nature of the website will allow users to customize NWS storm surge forecasts to very near their particular location. Lastly, the project is different with respect to its educational component. In particular, users can experiment with a variety of hypothetical hurricane impacts based on location of landfall, strength at landfall, and tidal level at landfall. They will see the results in their own neighborhoods, which may lead to better evacuation route decisions, while also appreciating the forecast uncertainty regarding storm track and intensity.

5. CONCLUSIONS

The main goal of this project is to enhance the understanding of storm surge threats associated with hurricanes as well as the uncertainties inherent in providing such forecasts. It is our hypothesis that a better presentation of the risks associated with surge will result in a decrease in death and injury, and perhaps improved decision making with regards to evacuation, insurance, and home building. This type of graphical display may also help to add understanding to those who do not use English as their primary language or may otherwise have more difficulty reading or understanding wordy text-based products. Further, the results of this study should be easily expandable to all coastal areas in the United States threatened by tropical systems.

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