University: College of Charleston

Name of University Researcher Preparing Report: B. Lee Lindner

NWS Office: Charleston South Carolina

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Partners or Cooperative Project: Partners

Project Title: Improved Integration of SLOSH Model Simulations and Local Landmark Data in a Hurricane Surge Visualization Model

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SECTION 1: Summary of Project Objectives and Accomplishments

As detailed in the proposal (which will not be repeated in depth here), this project involves the completion of the interactive Internet-based hurricane surge simulation computer model and the subsequent use of this model to ascertain if it enhances public understanding of the risks associated with hurricane surge. In fall 2010 the university PI and two undergraduate students gathered additional field data to fill in some geographical holes in the model (we didn't want people living in those parts of town to feel they were being ignored). Additionally, the university PI and the undergraduate students have analyzed the data collected and modified existing databases to accommodate the new data. The data collection phase is now complete. Over the past 18 months, the university PI and the graduate students have continued development of the model. Specifically, we found that all of the data gathered last fall had to be reformatted in order to match the data obtained in earlier years, which has been accomplished (this took a surprisingly long period of time!). While the reformatting was taking place, all other tasks were placed on hold, and few funds were spent during those six months. A no-cost extension for an additional year was requested and approved. Over the past year, we have run into multiple technical glitches, including movement of the GIS lab to another building and still later came the changing of web servers at the college. Both of these events required us to reformat the model and update various databases, which again took substantial time. Additionally, we have divorced the model from the GIS lab, which makes the model more robust, easier to access and more user friendly. There are only a few remaining minor modifications that need to be done before the model will be beta tested. Then the model will be connected to the survey, which will be used to ascertain public understanding. Both PIs and both graduate students hereby vow to complete the model on our own dime (the model is too close to completion to warrant any further grant proposals). COMET funding got us almost all the way to the finish line, and for that we are very grateful. We will keep the COMET office informed when the model is completed and published, and we will of course feature the COMET logo prominently as we have on every presentation and publication we have done.

As detailed above, the university PI has been primarily responsible for the work thus far. The NWS PI has been heavily involved in consultations, but the next part of the research is where his responsibility becomes a far greater part of the project.

We are very excited about the impact that this project will have on the field. This project has only been funded by COMET (no other programs have contributed funding) and yet despite the limited funding, we are already seeing tremendous interest in our results (particularly at conferences). For example, we were invited as panelists at the prestigious Interdepartmental Hurricane Conference this past spring, and our work was featured at the conclusion of the conference in a summary of the conference. Numerous high officials at various governmental agencies have lauded our novel approach and are anxious to see the results. In addition, various emergency managers, television broadcast meteorologists, National Hurricane Center meteorologists and others have shown interest in our work. None of this would have been possible without COMET, which definitely is producing an outsize impact relative to the funding level.

Also noteworthy are the two publications in refereed venues that occurred while this current grant was in effect. Both papers discuss the results of research funded by earlier COMET grants, including one COMET grant from over a decade ago (an appropriate venue for publication was not found until recently). The COMET boilerplate acknowledgment is of course present in both publications.

SECTION 2: Direct and Related Project Accomplishments and Findings

Four students participated in this project. Specifically two graduate students (Janet Johnson and Stephen Duke) have worked on GIS and HTML computer programming of the model for the entire term of the project. Two undergraduate students (Austin Garland and Michelle Anderson) did data collection and database manipulation during the first twelve months. Specifically, the undergraduate students gathered additional data points (in addition to the approximately 2000 data points at locations throughout the tri-county area), provided new data for some of the previous data points that were determined to be in error, and reformatted data so that it matched earlier data. Each data point consists of a photograph of a landmark, GPS measurements of exact latitude and longitude, scales within the photograph, general descriptions, time and date. The data collection phase of this project is now completed, and that part of the model is virtually completed.

The primary accomplishment thus far has been the ongoing model development by the graduate students (who received the lion's share of the funding). When this project began, we had developed a new GIS-based hurricane surge model. As we detailed in the proposal, we ran into various technical issues with this new approach. Over the first 6 months we have been removing these technical hurdles, and over the next 6 months data has been reformatted to be consistent. During the past year, we overcame various technical problems, divorced the GIS center from the model and have virtually completed the model, which will soon be beta tested, and evaluated as to its effectiveness with the survey.

The Principal Investigators (both academic and forecasting) have been supervising the overall work, as well as presenting preliminary COMET results at the the 29th AMS conference on hurricanes and tropical meteorology, held in Tucson in 2010, at the NWA annual conference, held in Birmingham, AL, in fall 2011 and at the 66th Interdepartmental Hurricane Conference, held in Charleston, SC in spring 2012 (details on the abstracts are given below). The academic PI has also worked with college webmasters to resolve technical and security issues that were hampering model development (the GIS lab was moved to a new building, which required the solution of new technical and security issues). The academic PI also recruited and managed the students, and was also responsible for the budget. The forecasting PI has also been assisting the students with understanding the hurricane warning suite issued by the local forecasting office and also with answering technical questions regarding hurricane surge modeling.

2.2 Related Accomplishments

Each of the undergraduate students received college credit for their participation in the research. Specifically, Austin Garland was enrolled in an independent study Environmental Studies course, numbered ENVT350 (in other words, a separate course was created for this student, where the academic PI was the instructor and guided the student research during the term). Michelle Anderson and Austin Garland were enrolled in independent study Physics courses, numbered PHYS390 (again, three separate courses were created where the academic PI was the instructor). Each of the students prepared a final report at the end of their course that summarized what they learned and problems they encountered.

Specifically, here are the courses developed for the students involved in this COMET research:

Fall 2010:

PHYS 390 section 001 called "Meteorology Research Techniques", taken by Michelle Anderson for 3 credit hours

PHYS 390 section 004 called "Hurricane", taken by Austin Garland for 2 credit hours

Spring 2011:

ENVT 350 called "Assessing Public Understanding of Hurricanes", taken by Austin Garland for three credits

PHYS 390 called "Hurricane Model Beta testing", taken by Michelle Anderson for 3 credit hours

Additionally, both Robert Bright and Frank Alsheimer have also served as contact points for undergraduate students desiring further research opportunities. A couple of the students actually spent time as volunteers at the NWS office learning about its operations.

SECTION 3: Summary of Benefits

3.1 Operational Partner Perspective

One of the premier benefits for WFO Charleston to date has been the continued interaction with College of Charleston students on the project, as discussed in the section above. This allows the exchange of ideas between the field forecasters and the students during visits to the office as well as volunteer tours of duty. Additionally, one recent contact with a student

resulted in a senior thesis, and another resulted in an additional research project which is now underway with a recently graduated student.

This project has also continued to help the WFO CHS staff become more familiar with GIS-based technologies and associated web delivery systems. These types of projects will become a larger part of WFO CHS operations going forward.

Preliminary concepts on technique and display have already been discussed with the South Carolina Emergency Management community. The availability of additional tools to get the public to evacuate during the threat of hurricane landfall has become even more critical in light of the devastation in storm-surge prone areas from both Hurricane Katrina (2005) and Hurricane Ike (2008). The results of the research will be incorporated into the significant hurricane outreach efforts by the NWS Charleston WFO.

3.2 University Partner Perspective

Many undergraduate and graduate students are getting valuable research experience, as well as a deep understanding of the difficult issues the NWS faces in trying to present the risks associated with hurricanes to the public. Additionally, four College of Charleston special topics research courses have been created as part of the students' educational experience. These courses will appear on the students' transcripts, which will enhance their employment possibilities in the future. NWS personnel also have served as contacts and mentors for the graduate students.

SECTION 4: PRESENTATIONS AND PUBLICATIONS

Three presentations were made of COMET research while this grant was in effect, and two manuscripts describing prior COMET research were accepted for publication while this grant was in effect (appropriate citation of COMET funding was noted in each). Copies of all these publications can be emailed if desired.

Abstracts:

Alsheimer, F., R.J. Bright, B. L. Lindner, J. Johnson and S. Duke, An Effort to Increase Storm Surge Threat Awareness for the Charleston, SC Area Using a Web-based Visualization Tool and Associated Survey, 29th Conference on Hurricanes and Tropical Meteorology, American Meteorological Society, Boston, 2010.

Alsheimer, F., R. Bright and B. L. Lindner, Update to a storm surge visualization product in Charleston, SC, 36th NWA (National Weather Association) annual meeting, Oct. 2011, Birmingham, AL, http://www.nwas.org/meetings/nwa2011/

Lindner, B.L., S. Duke, J. Johnson, A. Garland, F. Alsheimer and R. Bright, Assessing improvement in the public's understanding of the risks due to storm surge through the use of a surge visualization model, 66th Interdepartmental Hurricane Conference proceedings, pp. 87-88, Office of the Federal Coordinator for Meteorological Services and Supporting Research, Silver Spring, MD, 2012.

Papers:

Alsheimer, F. and B. L. Lindner, Synoptic Scale Precursors to High Impact Weather Events in the Georgia and South Carolina Coastal Region, Journal of Coastal Research, 27, 263-275, 2011.

Lindner, B. L. and C. Cockcroft, Public perception of hurricane-related hazards, in Coastal Hazards, part of the Coastal Research Library book series, Springer, the Netherlands, in Press, 2012.

SECTION 5: Summary of Problems Encountered

Numerous computer software and hardware issues were encountered, as detailed above. These appear to finally be completely resolved.