A Regional Storm Surge and Inundation Model Testbed for SECOORA:

A Community Approach to Advance Coastal Hazard Science

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2. Project Summary

A. Project Name: A Regional Storm Surge and Inundation Model Testbed for SECOORA

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D. Brief Project Summary: A Regional Storm Surge and Inundation Model Testbed (RSSIMT) is proposed to facilitate the transition from research and development (R&D) to operations by federal/state/county agencies of storm surge and coastal inundation models developed or in use by academic institutions. This Testbed will validate, compare, and integrate existing R&D storm surge and inundation modeling activities in the SECOORA region and explore ways to provide potential enhancements to existing hazard maps for emergency management and planning. Having experienced the highest number of hurricanes in the U.S., the SECOORA region (NC, SC, GA, and FL) has four leading academic storm surge modeling groups: UF (P. Sheng), UNC (R. Lueptich), USF (R. Weisberg), and NCSU (L. Xie). These research groups use a variety of models (ADCIRC, CH3D-SSMS, FVCOM, and CMEPS) and approaches in developing their products. Each model with its own attributes has been applied to different coasts, although with somewhat different foci. For example, some of these modeling activities have focused on the modeling of surge in large open water regions, while others have focused on high resolution inundation within the watersheds. Some groups have included wave effects while others have not. The diversity in these activities reflects the typical culture in the coastal ocean community where group work independently with its sponsor with little coordination with other groups. While all credible in their own right, the diversity of the models and modeling applications and the lack of inter-academic institution coordination have not been conducive for use by government agencies, e.g., National Weather Service (NWS), Federal Emergency Management Agency (FEMA), and State/County Depts. of Emergency Management. Whereas these agencies are interested in learning about the latest models, further progress requires a better quantitative understanding of the merits and limitations of the various storm surge models and how to best apply them. Using a community-based approach, we will conduct an objective and comprehensive validation and comparative study of four leading academic storm surge and inundation models with the goals of enhancing the U.S. storm surge and inundation modeling capabilities, establish a common standard for storm surge and inundation modeling, bridge the gap between the leading academic storm surge modelers and the operational agencies, and further improve inundation maps, e.g. surge atlas and Flood Insurance Rate Maps (FIRMs), for emergency management and planning.

Major objects of this project are to: (1) Produce an interoperable Testbed for comparing storm surge models, building upon the existing modeling and cyberinfrastructure expertise in the SECOORA region, in coordination with federal agencies (FEMA and NOAA) and State Emergency Managers; (2) Establish a panel of experts and users to enable objective scientific model validation and comparison; (3) Objectively and critically compare the results from four storm surge models with SLOSH using past hurricane data in the SECOORA region to arrive at matrix of model quality and performance standards as well as data needs; (4) Produce inundation maps using different models for comparison with those currently produced by federal agencies; (5) Provide results of model-data/model-model comparison in relation to the inundation maps to facilitate potential improvements in these maps or enabling new products by federal agencies and Emergency Managers through a web portal; and (6) Nurture synergistic collaborations with other regional and national activities including Southeastern Coastal Ocean Observing and Prediction (SCOOP) Program, the NWS-NIST Storm Surge Testbed being planned, and SURAgird.
Year 1: (1) Establish a panel of experts and users from NWS/NHC, NOS, NIST, FEMA, USACE, USGS, and State/County Emergency Managers, to produce a set of objective protocols and criteria for model-data and model-model comparisons; (2) Produce an updated inventory of storm surge, wave, and inundation modeling activities in the SECOORA region, including major academic institutions, federal and state agencies, and private industries; (3) Identify the major products (e.g., SLOSH surge atlas, FIRMs, and inundation maps) produced by NWS and FEMA and used by Emergency Managers in the SECOORA region, and together determine possible enhancements needed for these products; (4) Develop a common data framework, and design realistic test problems with archived field and analytic data, for model-data comparison and inter-comparison of storm surge and inundation models while leveraging current advances in DMAC and MMI including those made by the SCOOP, SEACOOS, and SECOORA; (5) Develop a set of common model quality and performance standards that should be met by all surge, wave, and inundation models to be used in the region; and (6) Select a number of past hurricanes for model validation and inter-comparison, gather and store data in a Storm Archive, as part of a virtual computing “Grid” which will leverage and build upon SCOOP’s virtual Grid.

Year 2: (1) Conduct simulations of selected hurricanes; (2) Compare model results to data and with each other in terms of a number of model variables and skill assessment methods and to determine if these models meet existing federal standards; (3) Determine the sensitivity of models’ skills to model attributes, coefficients, and input data; (4) Using the four storm surge models and SLOSH, produce and compare a surge atlas for a coastal region in FL and NC, following the method used to produce SLOSH surge atlas; (5) Determine the sensitivity of surge atlas to various model attributes and input data; (6) Improve the storm surge and inundation models if necessary; and (7) Working with NWS and Emergency Managers, recommend ways to potentially enhance the SLOSH surge atlas pr produce ensemble surge atlas.

Year 3: (1) Conduct ensemble model runs for a coastal region in FL and NC, following the FEMA method for producing FIRM for 100-yr storm; (2) Provide the results from four storm surge models to FEMA to produce FIRMs for inter-comparison and comparison with the FEMA FIRM; (3) Identify the sensitivity of FIRMs to various model features and input data; (4) Working with FEMA, identify ways to enhance their FIRMs; (5) Using the four models, produce real-time inundation maps for a coastal region during a hurricane, and compare them with the corresponding SLOSH surge atlas; and (6) Using the model comparison results, develop “best practice” guidelines for optimal application of storm surge models.

This project will establish a strong partnership between the storm surge and inundation modeling community, the responsible federal agencies, State/County Emergency Management Departments, SECOORA and SCOOP (see letters of support). We will engage users frequently, including a kick-off and annual meeting at the end of each year, and produce a status report bi-annually. There will also be email notification when major milestone is completed. The project will improve the storm surge and inundation models as well as hazard maps for emergency management and planning in SECOORA and adjacent regions. A Virtual Grid, which will be part of the broader SURAgrid, will be established to implement the Testbed to enable easy and flexible sharing of computer resources, models, and data, as well as dissemination of model results. The regional Testbed can be integrated with other regional or national activities, e.g., SCOOP and the planned NIST-NWS Testbed, to produce a National Testbed after this project.