

**LUETTICH, UNC-CH
DHS COASTAL RESILIENCE CENTER
RESEARCH PROJECT
YEAR 4 PROGRESS REPORT
July 1, 2018 – June 30, 2019**

Project Title:

ADCIRC Prediction System Development Coordination and Improved Connectivity with Hydrologic Models

Principal Investigator Name/Institution:

Rick Luettich, Professor, University of North Carolina at Chapel Hill

Other Research Partners/Institutions:

Brian Blanton, Jason Fleming, Casey Dietrich, Clint Dawson, Scott Hagen, Isaac Ginis, Don Resio

Short Project Description (“elevator speech”):

A substantial portion of the Coastal Resilience Center’s research portfolio involves the development and application of new capabilities for the ADCIRC Prediction System (APS) which is comprised of ADCIRC, the ADCIRC Surge Guidance System (ASGS) and the Coastal Emergency Risks Assessment (CERA) web portal. Included in these activities is the development of:

- higher resolution regional grids for the US East and Gulf coasts that integrate with our current national scale Hurricane Surge on demand Forecast System (HSOFS) grid (with Dietrich, Dawson, Hagen, Ginis);
- software to efficiently track and manage multiple ADCIRC runs across different computer platforms including “the cloud” (with Blanton, Fleming);
- additional improvements in the wind model that is included in ADCIRC (with Ginis);
- better coupling to hydrology models that track the movement of fresh water across the land, into streams and rivers until it interacts with coastal waters (with Resio, Ginis, Huang); and
- continued operation and maintenance of the ASGS and CERA to provide access to ADCIRC predicted water levels and flooding during major storm events and water velocities 24x7x365 for US Coast Guard search and rescue operations (with Blanton, Fleming and Kaiser).

This proposed project will contribute to and coordinate the suite of projects providing enhancements to the APS to increase the accuracy and power of this system; provide interpretation of APS results during major storm surge events to maximize the value of these results for end users; and develop improved documentation and testing via an updated website, wiki and test cases to better enable its use by the broader ADCIRC user community.

1. Introduction and project overview:

Significant development work has been and continues to be done to enhance the ADCIRC modeling system. This project is designed to direct and integrate this work for the benefit of ADCIRC-based forecasting system that comprises the ADCIRC Prediction System (APS). In addition, this project supports the expansion of ADCIRC information and documentation available to the user community and the development of improved couplings between inland and coastal flooding.

2. Results:

Results are further detailed in the milestone tables below. Preeminent results include extensive forecasting efforts for 2018 hurricanes Florence and Michael (and 2019 hurricane Barry), progress toward enhancing the APS capabilities, the growth of a group of individuals who are capable of operating the APS and cloud-based high-performance computing to execute the APS. Especially successful was the development of the ASGS monitoring portal by Blanton.

Substantial transition progress was accomplished as documented below.

3. End users:

USCG information consumption

Louisiana Coastal Protection and Restoration Authority identify information desired for future events.

4. Transition:

- Wrote the APS business plan scope of work
- Organized APS planning workshop at LSU
- Attended NOAA sponsored Coastal Coupling Community of Practice (CCCoP) Workshop at the National Water Center, agree to join the CCCoP steering committee
- multiple times daily communications with potential end users during 2018 hurricanes
- led design of ADCIRC Wikipedia and ADCIRC wiki, new ADCIRC branding activities
- worked on manuscript for bias correction
- communication with other CRC ADCIRC project PIs regarding efforts to support APS.

5. Project Impact:

This project is intended to provide significant progress in the development and implementation of the ADCIRC Prediction System (APS). Evidence of the success was the extensive use of the APS during hurricanes Florence and Michael in the fall of 2018 and the considerable impact it had during hurricane Barry in 2019. In the latter case our APS results were extensively used to assist decision making by the U.S. Army Corps of Engineers and the State of Louisiana.

6. Unanticipated Problems:

This project built from past CRC work, principally coordination and transition of important findings into the operational ADCIRC Prediction System and also initiated new research in coastal – inland model coupling. The former work was successfully accomplished during the project year. The latter was not initiated due to the delayed funding and the resulting inability to hire a post-doctoral associated to perform this work. It will be reinitiated during Year 5.

7. Student Involvement and Awards:

Research

PhD Student Jie Gao was supported by other funds but worked on research directly related to this project over her time as a UNC graduate student. She completed her dissertation and was awarded a PhD in December 2018.

PhD Student Taylor Asher received primary support for his work on storm surge uncertainty from other sources. However, he received partial support from this project for his work on the bias correction, the ADCIRC Wikipedia page and the ADCIRC wiki.

Student Demographics

Jie Gao – Asian, foreign national, graduate

Taylor Asher – US, graduate

Degrees Attained

none

Student Awards

Taylor Asher – ADCIRC User meeting, most significant male contributor of 2018-19

8. Interactions with education projects:

n/a

9. Publications:

Gao, J., 2018. On the Surface Wind Stress for Storm Surge Modeling, PhD Dissertation UNC Chapel Hill, 12/2018.

Asher, T.G, Luettich, R.A. Jr., Fleming, J.G, Blanton, B.O., in review, Dynamic Water Level Correction in Storm Surge Models Using Data Assimilation, Ocean Modelling

10. Year 4 Research Activities and Milestone Achievements:

Year 4 Research Activities and Milestones: Status as of 6/30/2019

Reporting Period 7/1/2018 – 6/30/2019			
Research Activity	Proposed Completion Date	% Complete	Explanation of why activity/milestone was not completed
Evaluate feasibility of using URI HBL wind model improvements in APS	06/2019	0	Funding not available to hire necessary personnel. Will be pursued in Year 5
Test new approach for representing rivers to link ADCIRC with hydrology models	06/2019	0	Funding not available to hire necessary personnel. Will be pursued in Year 5.
Research Milestone			
Presentation of findings from research activities at ADCIRC Week	06/2019	100	Presented keynote talk on the ADCIRC Prediction System at the ADCIRC Users group meeting

11. Year 4 Transition Activities and Milestone Achievements:

Year 4 Transition Activities and Milestones: Status as of 6/30/2019

Reporting Period 7/1/2018 – 6/30/2019			
Transition Activity	Proposed Completion Date	% Complete	Explanation of why activity/milestone was not completed
Process to include dynamic offset capability into ASGS using the recently developed data assimilation scheme to account for un-modeled processes such as antecedent meteorology, large-scale ocean currents (e.g., the Gulf Stream) and other factors that can introduce bias into ADCIRC water levels	06/2019	50	Review of a manuscript covering the dynamic offset capability provided suggestions for improving the methodology. We have been investigating this prior to full implementation in ADCIRC. In the meantime we have implemented an interim capability that was used extensively during 2018

			hurricanes Florence and Michael.
Transfer of high resolution regional grids being developed by Dietrich, Ginis, Hagen projects into APS to provide more accurate storm surge results than possible with the HSOFS grid.	06/2019	20	One grid has been transferred, the Northern Gulf of Mexico (NGOM) grid developed by Hagen. This was used extensively during 2018 Hurricane Michael.
Test capabilities of ADCIRC run monitoring portal	06/2019	100	ADCIRC run monitoring portal has been thoroughly evaluated with many improvements recommended and implemented during the project performance period. The portal performed without a hitch and proved INVALUABLE during Hurricane Barry. Based on the recent experience we expect to continue to recommend enhancements for the porta.
Revise ADCIRC website and update ADCIRC online documentation at adcirc.org to provide more a more current look and feel and easier access to content for the benefit of the ADCIRC user community.	06/2019	50	Efforts have been focused on developing a Wikipedia page for ADCIRC (targeted at broad audiences) and an ADCIRC wiki (wiki.adcirc.org) to provide more user friendly ADCIRC documentation and community input. Both have been created, substantially populated with information and will continue to be expanded in Year 5.
Transition Milestone			
Dynamic offset capability included in ASGS	06/2019	50	Interim version implemented. Working on improvements to methodology prior to full inclusion

Version 1 of high resolution grids included in APS	06/2019	20	One grid included, waiting on the delivery of other grids from partners.
Version 1 of ADCIRC / ASGS run monitoring portal is operational	06/2019	100	Fully achieved and highly successful! (Technical work accomplished by Blanton's project.)
Version 1 of revised ADCIRC website and documentation available online	06/2019	100	Wikipedia page and ADCIRC wiki online and populated.

12. Tables:

Table 1: Research Project Product Delivery

Product Name	Product Type (e.g., software, guidance document, knowledge product)	Delivery Date	Recipient or End User(s)
ADCIRC Wikipedia page	Online information	6/30/2019	
ADCIRC wiki	Online documentation	6/30/2019	
ASGS run portal	Software	6/30/2019	ADCIRC Prediction System team

Table 2: Performance Metrics
(N/A)