BLANTON, UNC-CH
DHS COASTAL RESILIENCE CENTER
ADCIRC PROJECT
YEAR 5 PROGRESS REPORT
July 1, 2019 – June 30, 2020 (Updated 12/15/2020)

I. INTRODUCTION

Project Title: Operational Awareness Dashboard for ADCIRC Surge Guidance System

Principal Investigator Name/Institution: Brian Blanton, UNC-CH (RENCI)

Additional Research Participants/Partners:
Lisa Stillwell (RENCI)
Phil Owen (RENCI)

Short Project Description:

This project is developing a web-based *operational awareness dashboard* (OAD) for monitoring ADCIRC Surge Guidance System (ASGS) prediction activities being conducted at several HPC sites. This dashboard provides a real-time view of ASGS simulations during tropical cyclone events, and displays multiple, concurrent ASGS instances on different HPC resources. This continuation of CRC Y4 activities will elevate ADCIRC/ASGS prediction activities to a new level of robustness, reliability, confidence and availability by showing all ASGS activities in one web-based application. This new capability also advances ASGS/ADCIRC operational activities as we position for long-term sustainability beyond the lifespan of the CRC.

II. PROJECT NARRATIVE

1. Project overview: Recent tropical cyclones (TC) that threatened the eastern US and Gulf of Mexico coasts have demonstrated that storm surge and wave predictions from the ADCIRC Prediction System (APS) have substantial demand and value to end-users, such as emergency managers, the US Coast Guard, NOAA, DHS/FEMA, and companies. To meet this demand, the core APS operations community (DHS/CRC, RENCI, UT, NCSU, Seahorse Coastal Consulting, etc) relies on high performance computing (HPC) assets to compute and deliver real-time storm surge guidance information to end-users. While the primary APS components, ADCIRC and ASGS, have proven to be robust, efficient, and accurate, it remains challenging for APS operators to have an awareness of the entire suite of activities and simulations being conducted during a TC event, since each ASGS instance is run independently and with several different human operators. This presents a significant challenge when it is critical for operators and real-time guidance experts to know what is being computed, in what stage is any given simulation, and (particularly) when updated results can be expected.

   To summarize the previous work and progress on this project, we proposed at the start of year 4 to ***develop an operational awareness dashboard*** that monitors multiple, concurrent

ASGS instances on different HPC resources and provides a real-time, web-based visualization of the ASGS workflow, progress, and status. We designed, implemented, tested, and deployed the OAD, using modern and production-ready software components to send/receive internet-based messages and display status information in a webpage. Development of the infrastructure was rapid, due to the expertise of the project's software engineering personnel (L. Stillwell and P. Owen).

The resulting OAD (see example in Figure 1) alerts APS operators to runtime warning and errors that occur, substantially decreasing downtime and facilitating debugging of ASGS input/output and operational issues. The OAD also shows important information in the top-level banner. From left to right, the NCEP inset graphic shows the continental-scale synoptic weather (clicking on the thumbnail brings up a larger version); the current NCEP cycle date/time and local time, and the current tropical situation from NHC. This level of awareness has been critical for APS operators as we headed into the 2019 Atlantic hurricane season.

2. Results: During year 5, we continued to refine the OAD's user-facing layout, and in particular reorganized the main way in which the information is presented. We based these changes on feedback of the first (Y4) version during the 2019 hurricane season, which includes the first part of this reporting period. The improved layout is shown in Figure 1. This layout is easier to read and will (in the next project year) be more configurable by operators. This screen capture was taken during the third named storm of the 2020 Atlantic hurricane season, Tropical Storm Cristobal. The OAD shows that 10 different ASGS/ADCIRC configurations were operating, on three different HPC platforms (TACC, RENCI, and LSU (Queenbee)), and in various stages of completion (Step and % complete columns).

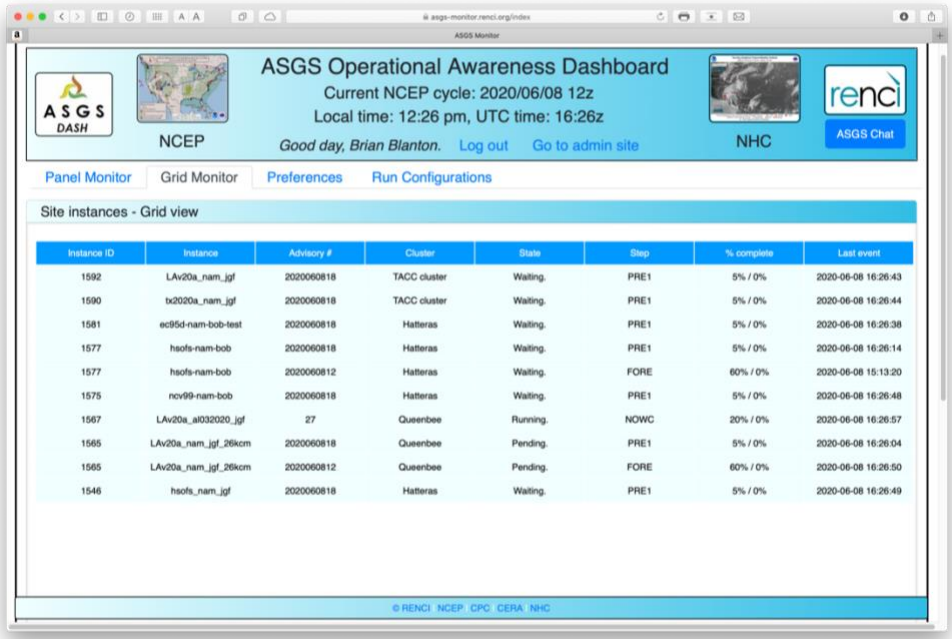

Figure 1 (above): Grid/table information layout implemented in Y5 of the OAD project.

3. End users: End users of the APS OAD are the APS operators and those communicating directly with end-users. As noted above, the OAD does not provide the actual APS prediction/simulation output, but rather on simulation status information. Current APS operators and product communicators include Jason Fleming (Seahorse Coastal Consulting), Rick Luettich, Brian Blanton, Matt Bilskie (LSU), Nathan Dill (Ransom Consulting), and This group of users must maintain an "operational awareness" of all concurrent ASGS computing activities in a fast and easily understandable format, in order to optimally communicate hazard information to their respective end-users and "clients", anticipate delivery of new information, and react to system warnings and errors that delay product computation and delivery.

4. Transition: Transition of the project outcome (the OAD itself) is done through the website that hosts the OAD, https://asgs-monitor.renci.org/index. All APS operators have an account on this website and can view all currently running ASGS instances.

5. Project Impact: The primary impact of the OAD is through the operators that are running the ASGS/ADCIRC system on multiple HPC sites, with different ASGS/ADCIRC configurations, and potentially for different but concurrent tropical events. It provides a unified view of all ASGS instances, thus facilitating more effective communication between operators maintaining and running the systems. This impacts the broader end-users that the operators increasing the timeliness and robustness of operations.

6. Unanticipated Problems: Other than typical software development issues, there have been no unanticipated problems, due to the expertise of the software development/engineering personnel on the project. The design, implementation, and maintenance of the OAD has been efficient, streamlined, and rapid. No students were involved in this project, because of the need for robustness, on-time delivery, and deep understanding of web technologies.
7. Student Involvement and Awards: None

8. Interactions with CRC education projects: None

III. RESEARCH ACTIVITIES AND TRANSITION MILESTONES

1. Year 5 Research Activities and Milestone Achievements:

Year 5 Research Activities and Milestones: Status as of 6/30/2020			
Research Activity	Proposed Completion Date	% Complete	Explanation of why activity/milestone was not completed
Incorporate design changes into OAD	7/1/2019	100	
Update OAD user interface as needed	12/31/2019	100	
Assess OAD functionality during 2019 ASGS season	3/31/2020	100	
Research Milestone			
Deploy year 2 version of OAD	5/1/2020	100	
Maintenance and updating of the OAD system. This includes addressing software bugs and failures and updating the required software components on the computers that host the RabbitMQ messaging system, the message database, and the website itself. Any substantial software update will be documented. Without maintenance of the software system, existing functionality may be degraded and new features impossible to implement.	6/30/2020	100	

2. **Year 5 Transition Activities and Milestone Achievements**:

Year 5 Transition Activities and Milestones: Status as of 6/30/2020			
Transition Activity	Proposed Completion Date	% Complete	Explanation of why activity/milestone was not completed
Delivery of updated OAD, with functionality improvements based on end-user participation in the design process and previous testing and evaluation.	3/01/2020	100	
Maintenance and updating of the OAD system. This includes addressing software bugs and	6/30/2020	100	

failures and updating the required software components on the computers that host the RabbitMQ messaging system, the message database, and the website itself. Any substantial software update will be documented. Without maintenance of the software system, existing functionality may be degraded and new features impossible to implement.			
Transition Milestone			
Host a virtual meeting with ASGS operators and communicators to train them on new features and functionality of the OAD website.	6/15/2020	100	This has been accomplished through a series of shorter Zoom/Slack meetings where capabilities were demonstrated, user questioned answered, and suggestions for improvements were recorded.

3. **Research Project Product Delivery.**

Table: Research Project Product Delivery

Product Name and Function	**Brief Product Description, including type** (e.g., software, algorithm, guidance document, knowledge product)	**Date Delivered** (or projected date of delivery)	**Recipient or End User(s)**
OAD website	software	3/01/2020	APS/ASGS operators

IV. PUBLICATIONS AND METRICS

1. Publications: N/A

2. Performance Metrics

BLANTON PERFORMANCE METRICS

Metric	Year 1 (1/1/16 – 6/30/16)	Year 2 (7/1/16 – 6/30/17)	Year 3 (7/1/17-6/30/18)	Year 4 (7/1/18-6/30/19)	Year 5 (7/1/19-6/30/20)
HS-related internships (number)	0	0	0	0	0
Undergraduates provided tuition/fee support (number)	0	0	0	0	0
Undergraduate students provided stipends (number)	0	0	0	0	0
Graduate students provided tuition/fee support (number)	1	1	1	0	0
Graduate students provided stipends (number)	1	1	1	0	0
Undergraduates who received HS-related degrees (number)	0	0	0	0	0
Graduate students who received HS-related degrees (number)	0	0	1	0	0
Graduates who obtained HS-related employment (number)	0	0	0	0	0
SUMREX program students hosted (number)	0	1	0	0	0
Lectures/presentations/seminars at Center partners (number)	1	0	1	0	0
DHS MSI Summer Research Teams hosted (number)	1	0	0	0	0
Journal articles submitted (number)	0	0	0	0	0
Journal articles published (number)	0	0	0	0	0
Conference presentations made (number)	2	2	2	0	0
Other presentations, interviews, etc. (number)	0	2	4	0	0
Patent applications filed (number)	0	0	0	0	0
Patents awarded (number)	0	0	0	0	0
Trademarks/copyrights filed (number)	0	0	0	0	0
Requests for assistance/advice from DHS agencies (number)	0	0	0	0	0
Requests for assistance/advice from other agencies or governments (number)	0	0	0	0	0
Dollar amount of external funding	0	0	$935,000	0	0
Total milestones for reporting period (number)	7	7	5	5	8
Accomplished fully (number)	2	2	5	4	8
Accomplished partially (number)	3	3	0	1	0
Not accomplished (number)	2	2	0	0	1