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

Project Title:
Operational Awareness Dashboard for ADCIRC Surge Guidance System

Principal Investigator Name/Institution:
Brian Blanton (RENCI)

Other Partners/Institutions:
Lisa Stillwell (RENCI), Phil Owen (RENCI)

Short Project Description ("elevator speech"):

This project will design, develop, and deploy a web-based "operational awareness dashboard" for monitoring ADCIRC Surge Guidance System (ASGS) prediction activities being conducted at several HPC sites. This dashboard will provide a real-time view of ASGS simulations during tropical cyclone events, and will be capable of displaying multiple, concurrent ASGS instances on different HPC resources. This new capability 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 through continued federal support and industry/commercial subscription services.

1. Introduction and project overview:

Recent tropical cyclones (TC) that threatened the eastern United States 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, and DHS/FEMA. 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 of each other, and potentially with 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. At the start of year 4, we proposed to ***develop an operational awareness dashboard (OAD)*** 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. This was achieved during year 4.

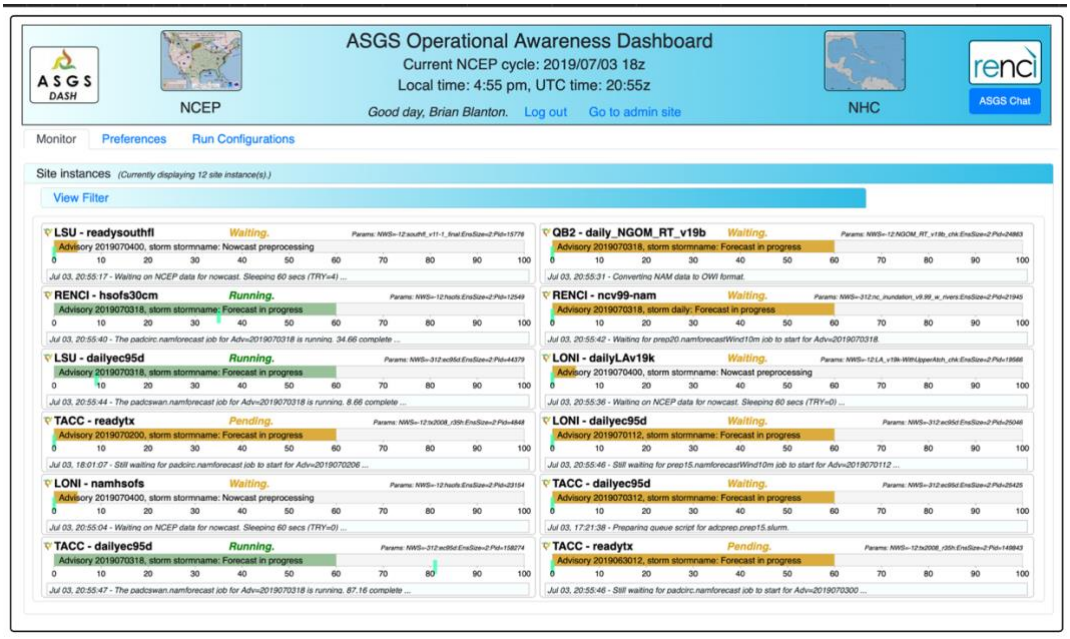
The resulting OAD alerts APS operators to runtime warning and errors that occur, substantially decreasing downtime and facilitating debugging of ASGS input/output and operational issues. This level of awareness has been critical for APS operators as we headed into the 2019 Atlantic hurricane season. This functionality and awareness will be essential to presenting the APS operational activities as robust and reliable to end-users as we position for long-term sustainability through continued federal support and industry/commercial subscription services.

2. Results:

During year 4, the first year of this specific OAD project, we designed, implemented, tested, and deployed the OAD. Development of the infrastructure was rapid, due to the expertise of the project's software engineering personnel (L. Stillwell and P. Owen).

The current version of the OAD website is shown in the figure below. At the time this figure was taken (4:55pm EST on 3 July, 2019), there were 12 different instances of ASGS running on 5 different HPC resources (LSU, LONI, QB2, TACC, and RENCI). Nine of the instances are waiting on upstream information to become available, and three instances are computing forecasts. All of these instances are driven by the daily weather model output from NWS/NCEP. I.e., these are not tropical/hurricane driven simulations because there was no active tropical cyclone threatening the Atlantic/Gulf coast at this time. During an active/threatening tropical event, many of these NWS/NCEP driven instances would be suspended so that the HPC resources could be used for more critical simulations.

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.



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 (that functionality resides with the CERA website), but rather on simulation status information.

4. Transition:

Current APS operators and product communicators include: Jason Fleming (Seahorse Coastal Consulting), Rick Luettich, Brian Blanton, Matt Bilskie (LSU), and Nathan Dill (Ransom Consulting). Carola Kaiser has been using the OAD to better understand the full spectrum of APS activities, and how they might impact CERA. 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.

5. Project Impact:

During tests of the messaging system and web infrastructure, prior to the 2019 Atlantic hurricane season, we got feedback from ASGS operators (i.e., OAD end-users). They all expressed that the OAD definitely provides a systematic view of all of the ASGS activities, enabling operators to more quickly identify and trouble-shoot run-time problems. Although occurring after this reporting period, tropical storm Barry provided a real-time opportunity to qualitatively evaluate the OAD effectiveness. During that event, operators were able to see the overall ASGS situation/activities, and we were able to better anticipate computer resource constraints and bottlenecks and thereby move higher priority simulations to less burdened HPC resources. This significantly increased availability of APS results to the broader end-user community.

6. Unanticipated Problems:

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.

7. Student Involvement and Awards:

No students were involved in this project, because of the need for robustness, on-time delivery, and deep understanding of web technologies.

8. Interactions with education projects:

There have been no interactions with education projects due to the need for robustness, on-time delivery, and deep understanding of web technologies and the functioning of ASGS in real-time operations.

9. Publications:

None to date. We will likely publish a technical report describing the software architecture and implementation, as well as publish the code in GitHub (as a transition element).

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
Implement/configure the RabbitMQ messaging system server	9/1/2018	100	
Develop message data structure/content and "sender" code	9/30/2018	100	
Initial end-user dashboard requirements gathering	9/30/2018	100	
Instrument ASGS with RabbitMQ messaging	11/30/2018	100	
Web dashboard design, development, deployment	1/31/2019	100	
Assess OAD functionality during pre-season ASGS test simulations	3/31/2019	100	
Research Milestone			
Publish message-enabled ASGS to GitHub repository so that other ASGS users can begin to test it.	11/30/2018	100	
Achieve basic functionality for the OAD	2/28/2019	100	
Maintenance and updating of OAD infrastructure. 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,	6/30/2019	100	

existing functionality may be degraded and new features impossible to implement.			

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
Deploy (make available) current OAD proof-of-concept website to ASGS operators and communicators. This involves putting the proof-of-concept website on a public-facing (and password protected) web server so that operators can access, test, and critique the OAD. This activity explicitly names this as a goal/objective/activity/etc./	9/31/2018	100	
Document ASGS messaging implementation and messaging configuration setup for real-time messaging.	12/31/2018	100	
Deploy (make available) revised OAD for 2019 Atlantic hurricane season testing. This revision to OAD is based on the information gathered from the first activity above.	3/31/2019	100	
Transition Milestone			
Successful access by end users to the OAD proof-of-concept website, with initial feedback on OAD interface and information content provided by operators to project team.	9/31/2019	100	
Host a virtual meeting with ASGS operators and communicators to train them on OAD website functionality and information content.	4/15/2019	50	Training / communication has largely taken place via the ASGS2019 Slack channel and related conference calls.

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)**
OAD website	software	5/1/2019	APS/ASGS operators

Table 2: Performance Metrics

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