COASTAL RESILIENCE CENTER
A U.S. Department of Homeland Security Center of Excellence

Development of an optimized tide and hurricane storm surge model for the west coast of FL for use with the ADCIRC Prediction System

Principal Investigator: Scott C. Hagen
Louisiana State University
Director: LSU Center for Coastal Resiliency
Professor: Department of Civil & Environmental Engineering / Center for Computation & Technology
shagen@lsu.edu

Co-Principal Investigator: Matthew V. Bilskie
Louisiana State University
Research Scientist: LSU Center for Coastal Resiliency
mbilsk3@lsu.edu

Co-Principal Investigator: Stephen C. Medeiros
Embry-Riddle Aeronautical University
Assistant Professor: Department of Civil Engineering
medeiros@erau.edu

Outline

- Summary Years 1-4 Activities

- Year 5 Research Activities

- End Users

- Transition of Project Outcomes

- Realized and Anticipated Impacts

- Summary

Felix Santiago-Collazo (PhD Student, LSU) using RTK-GPS survey equipment.

Year 1
1/1/2016 - 6/30/2016

- Developed mesh decimation approach
- Delineated the active floodplain

Year 2
7/1/2016 - 6/30/2017

- Tested mesh decimation approach
- Streamline lidar based surface roughness parameterization
- Successful SUMREX in August 2016 (Felix Santiago-Collazo)

Year 3
7/1/2017 - 6/30/2018

- Finished NGOM-RT and tested for the 2017 hurricane season (Hurricanes Irma & Nate)
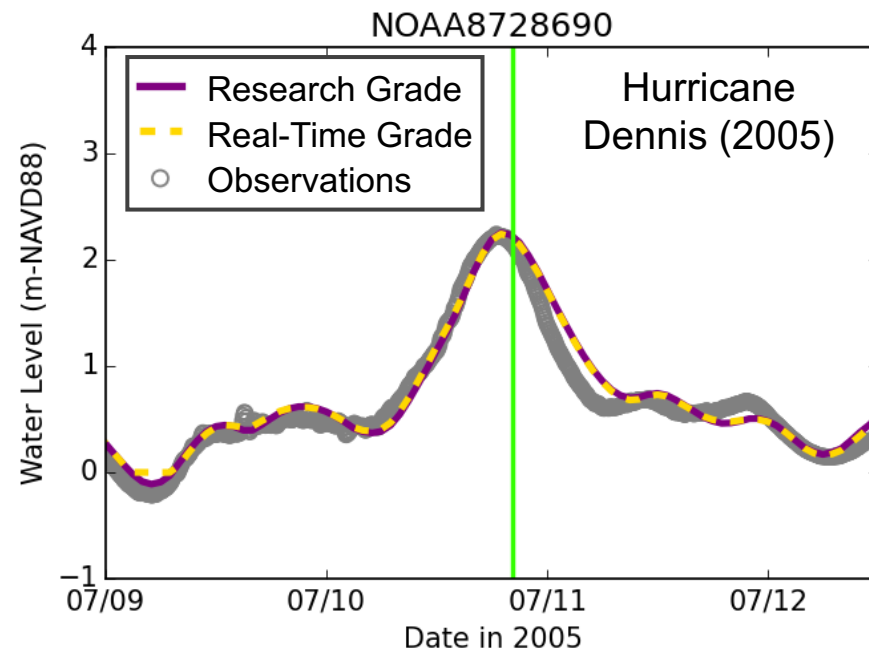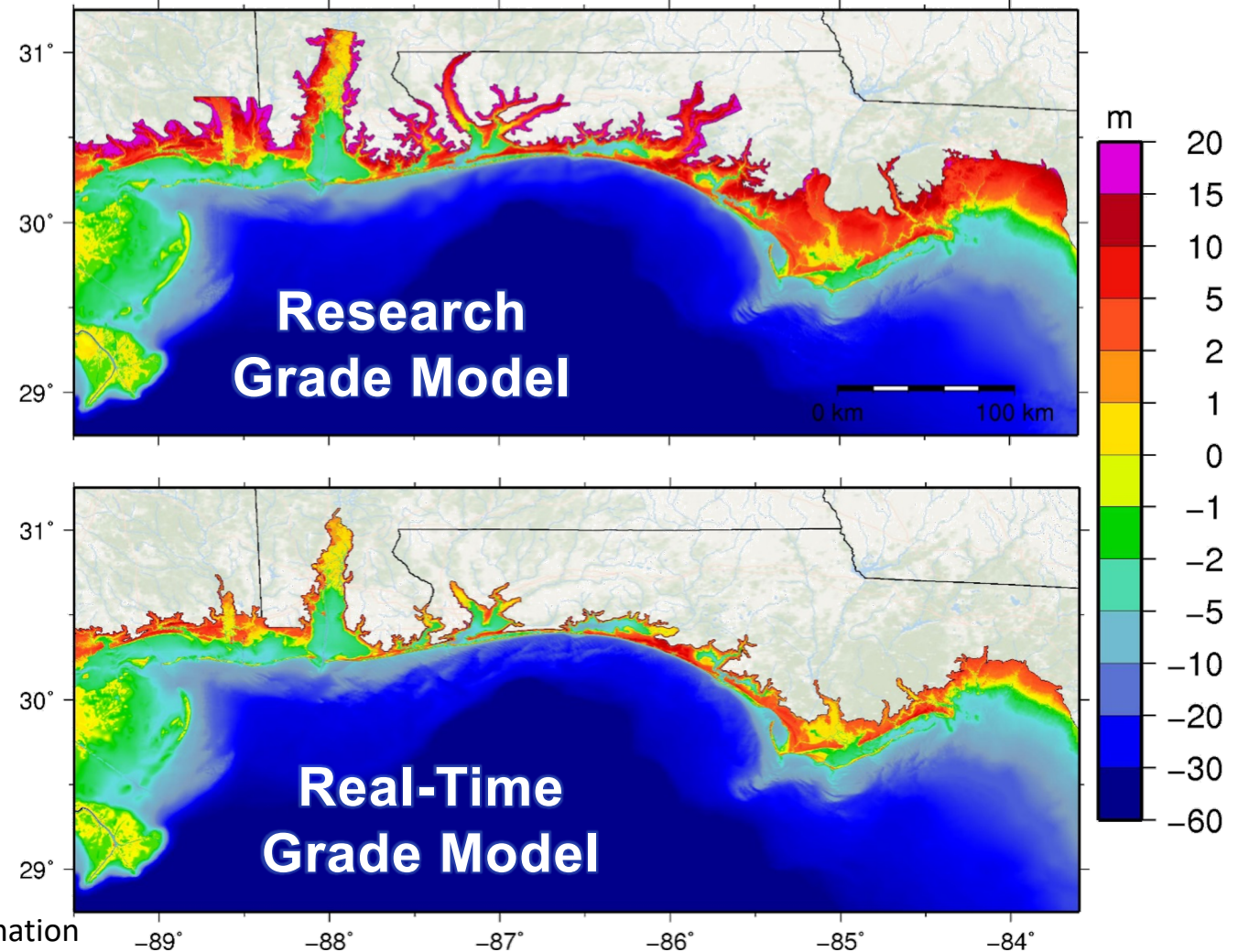- Successful SUMREX in July 2017 (Sabrina Welch & Diego Delgado)

Year 4
7/1/2018 - 6/30/2019

- Official deployment of NGOM-RT for the 2018 hurricane season
  - Alberto, Gordon, and Michael
- Pivoted to Michael hindcast for surf rough comparison paper w/ 2017-2018 lidar

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Years 1-3 Project Overview
Optimize a research grade mesh to reduce wall-clock simulation time

Mesh Topography / Bathymetry

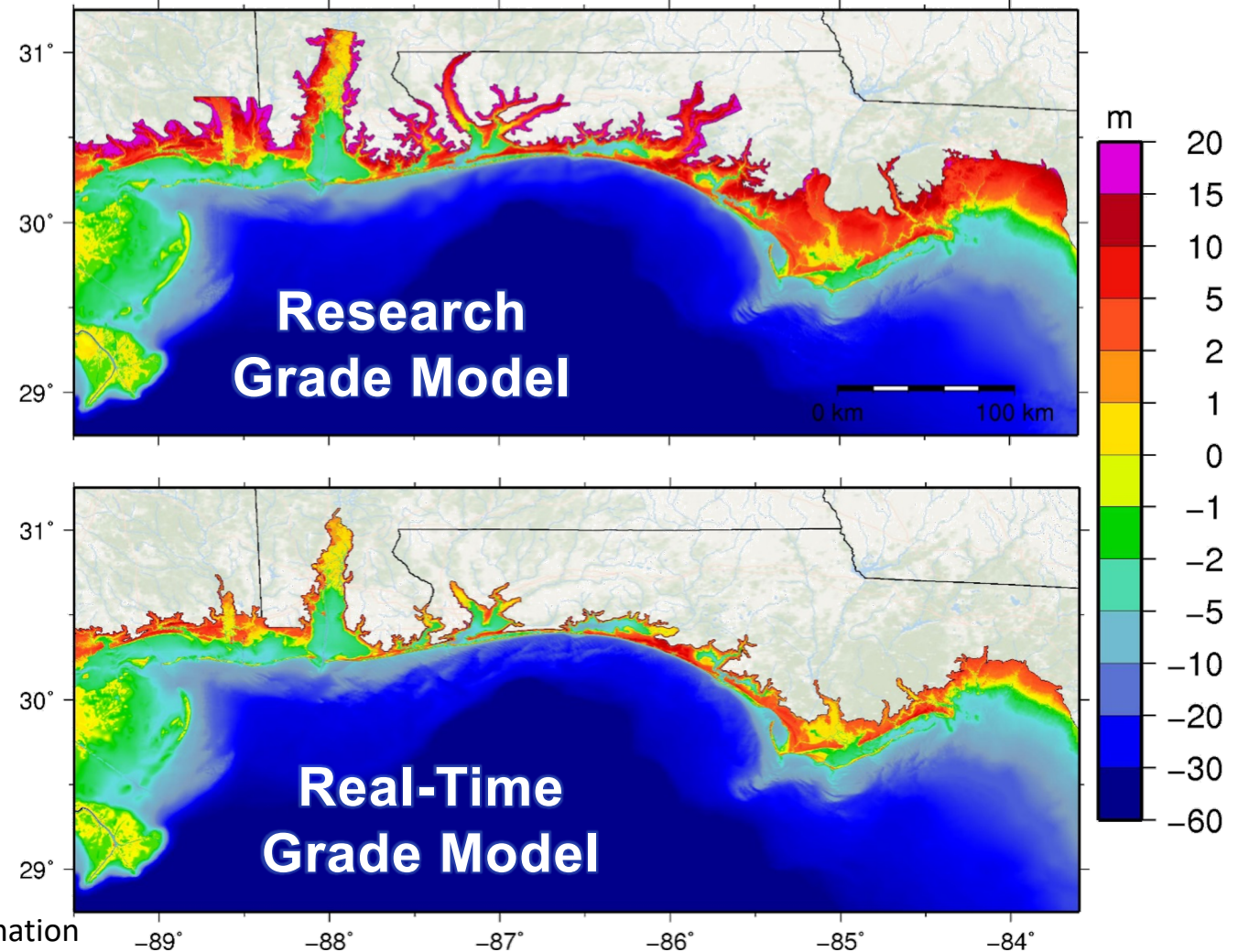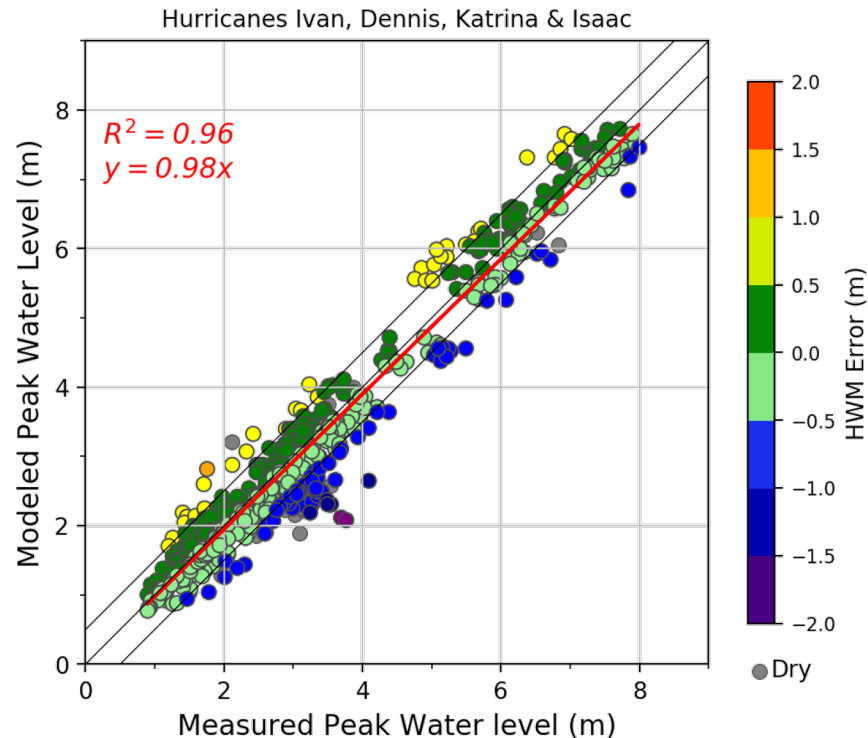Research Grade Model

Real-Time Grade Model

Bilskie, Hagen & Medeiros (2020), Unstructured finite element mesh decimation for real-time Hurricane storm surge forecasting, *Coastal Engineering*, 156, 103622. https://doi.org/10.1016/j.coastaleng.2019.103622.

Mesh Topography / Bathymetry

Years 1-3 Project Overview

Optimize a research grade mesh to reduce wall-clock simulation time

Hurricanes Ivan, Dennis, Katrina & Isaac

$R^2 = 0.96$
$y = 0.98x$
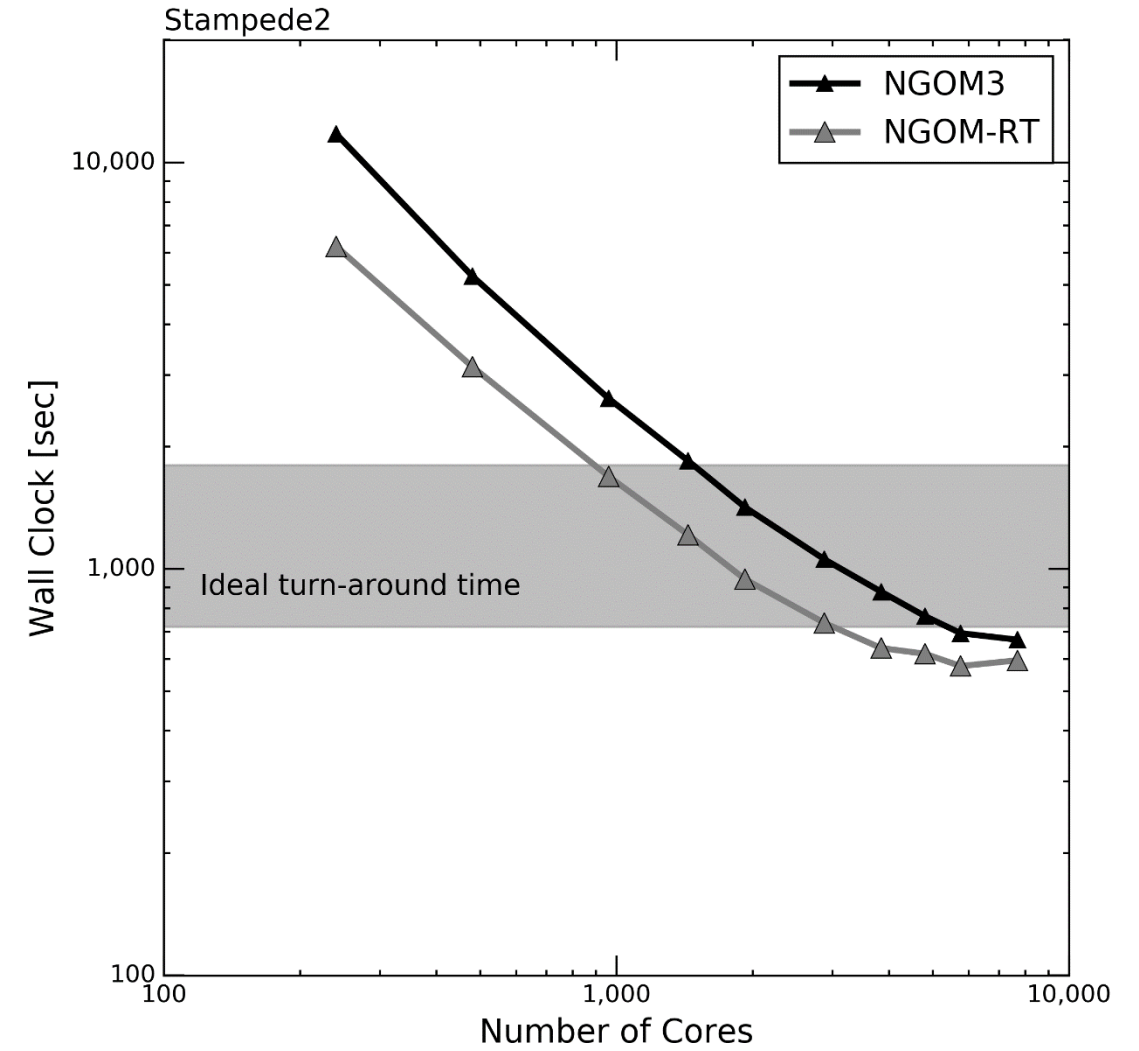

Research Grade Model

Real-Time Grade Model

Bilskie, Hagen & Medeiros (2020), Unstructured finite element mesh decimation for real-time Hurricane storm surge forecasting, *Coastal Engineering*, 156, 103622. https://doi.org/10.1016/j.coastaleng.2019.103622.

Run-Time Comparison (ADCIRC+SWAN)

Years 1-3 Project Overview

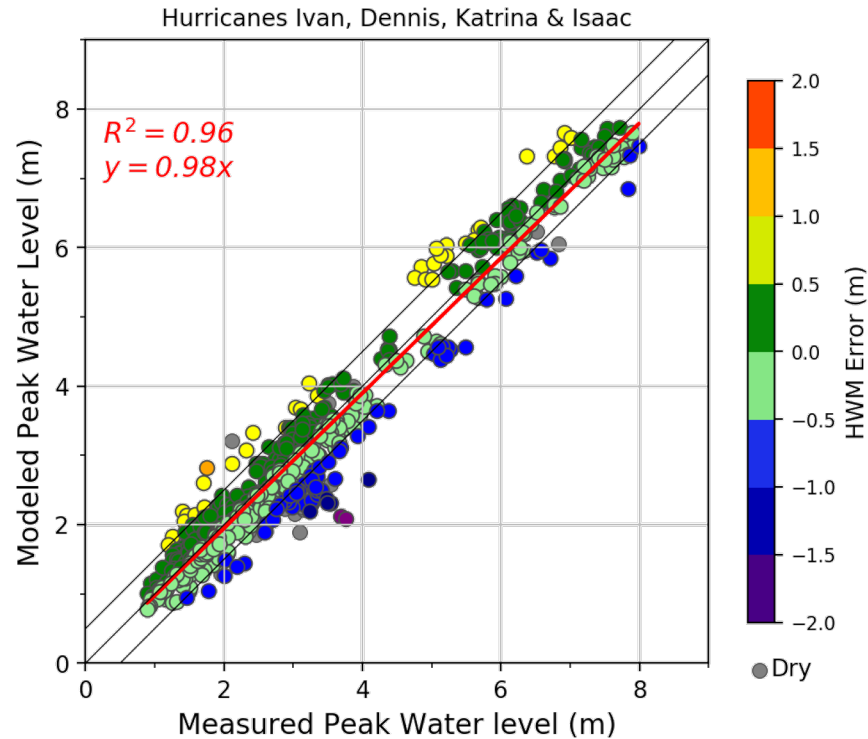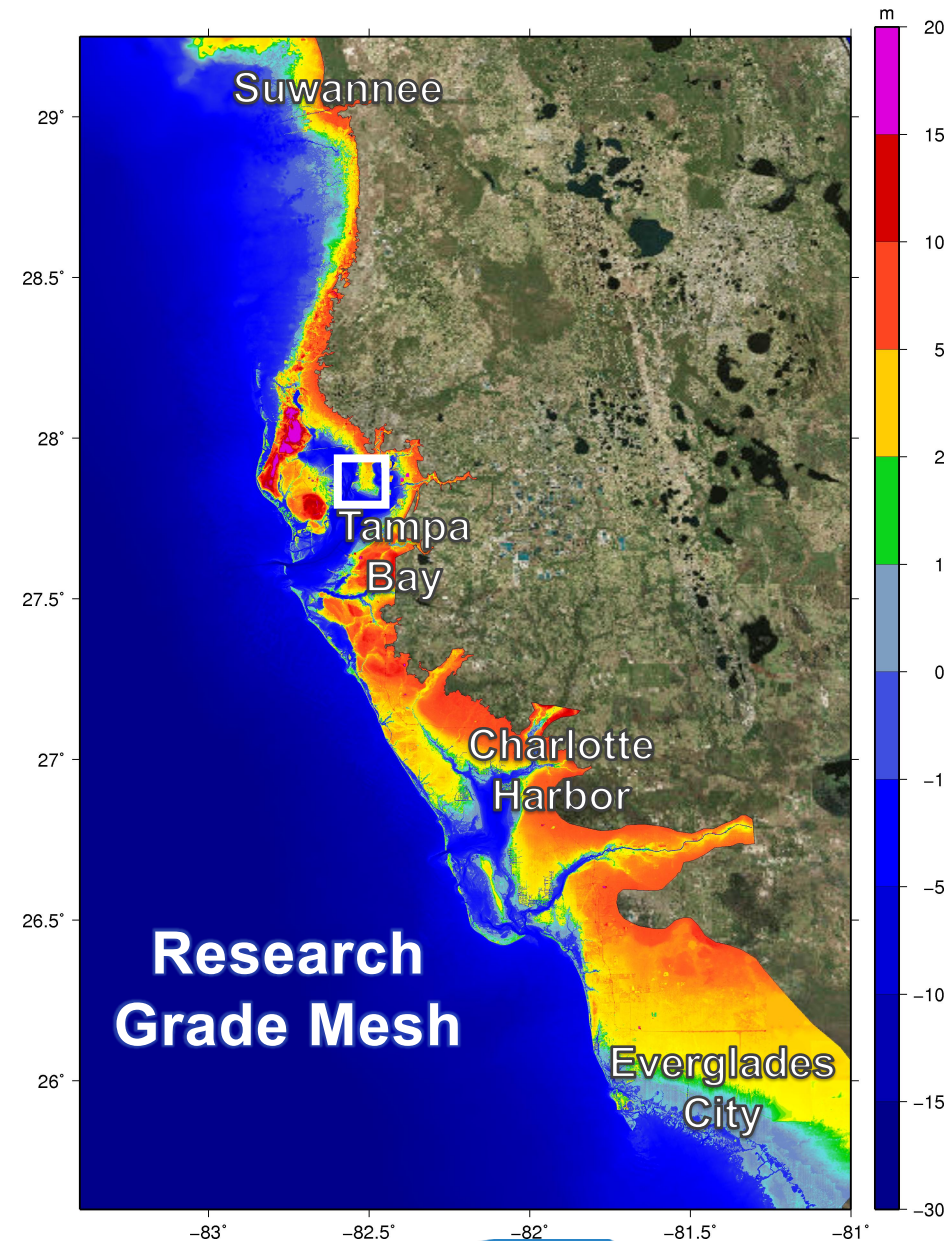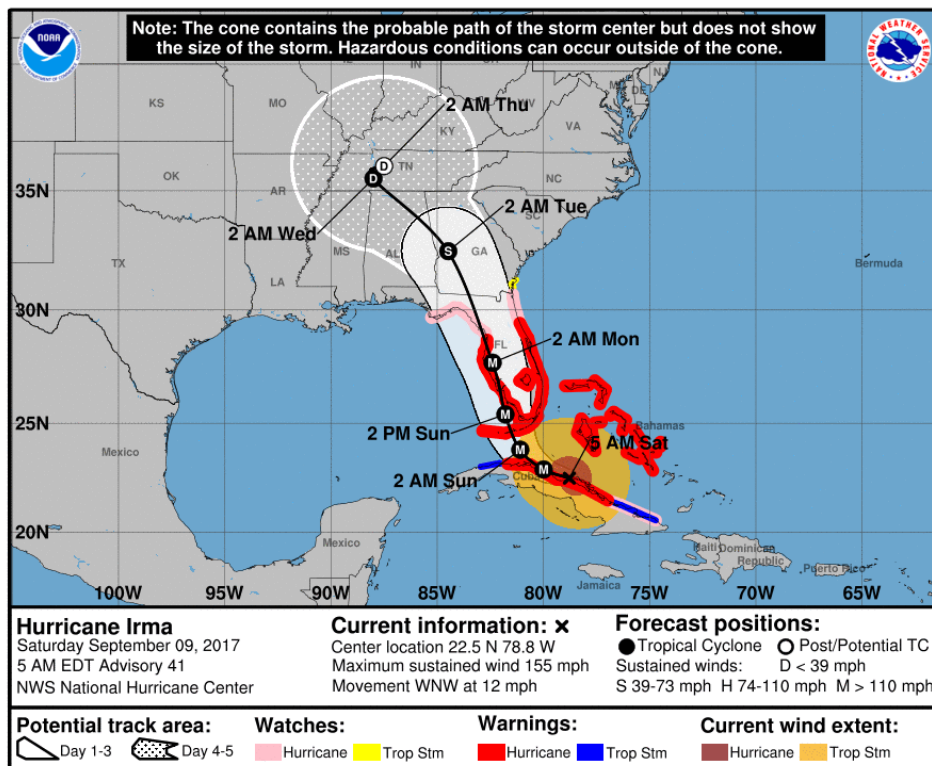Optimize a research grade mesh to reduce wall-clock simulation time

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Years 4-5 Project Overview

Optimize the FEMA ADCIRC meshes of west Florida to reduce wall-clock simulation time

Research Grade Mesh

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MacDill Air Force Base

Research-Grade · **Decimated Mesh** · **Real-Time Mesh**

Finite Element Mesh

19,283 nodes · 4,283 nodes · 5,999 nodes

Topography/Bathymetry

69% Reduction!
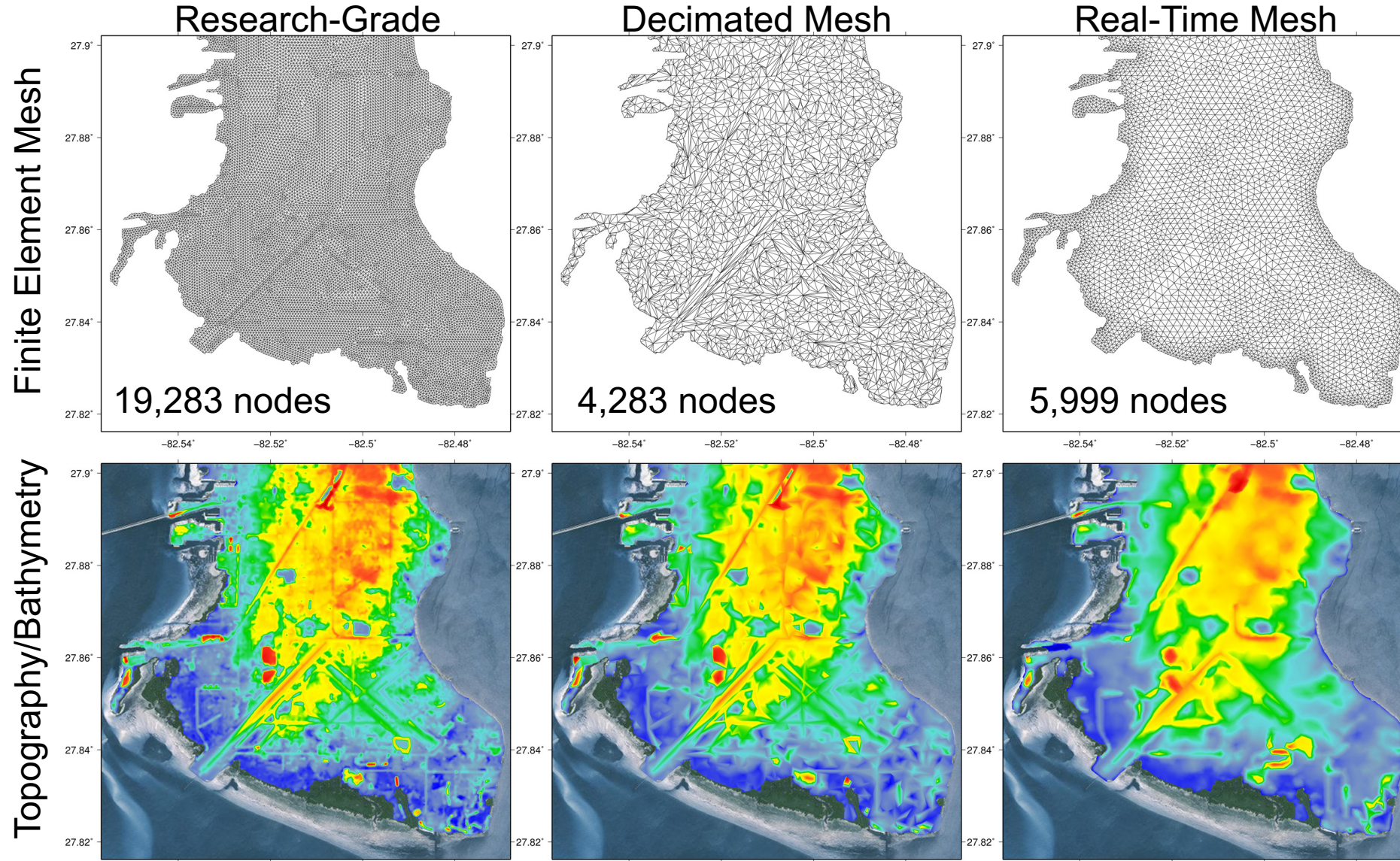
Surface Roughness Parameter Technique Comparison

Bay County

~17.6 Billion Points (~500 GB)

Gulf County

~13.7 Billion Points (~400 GB)

Franklin County

~27 Billion Points (~750 GB)
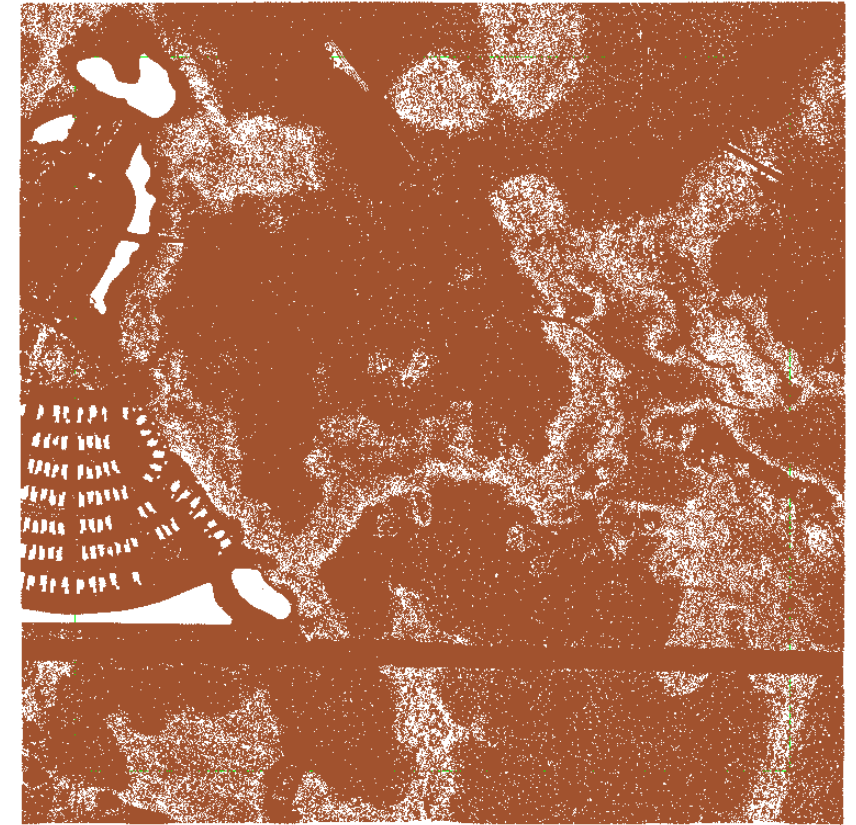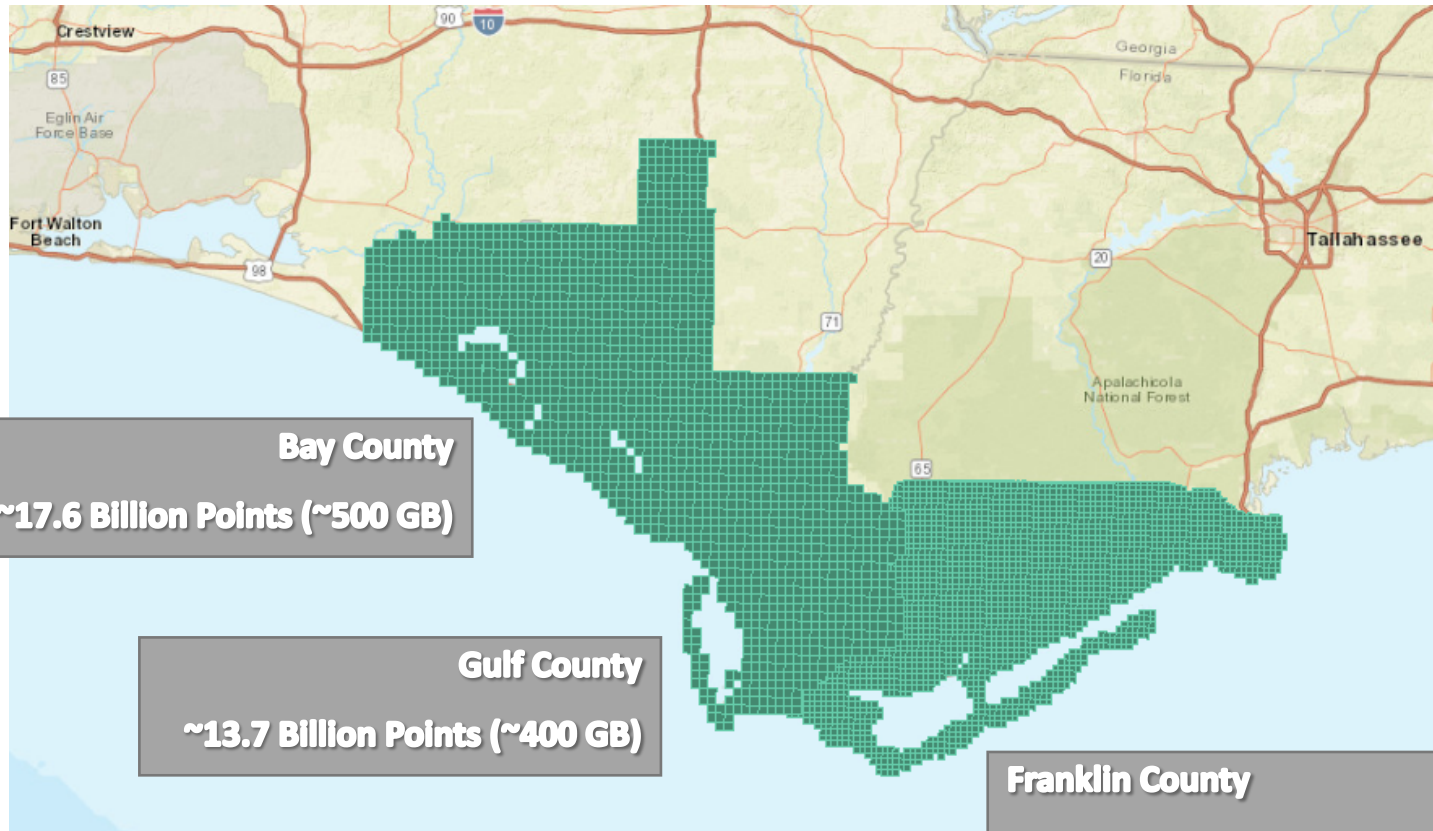
Major Research Activities - Updated

October 2018
- Obtain FEMA ADCIRC meshes for the FL west coast

March 2019
- Initial optimization of the FEMA ADCIRC meshes
- Submission of manuscript on Hurricane Michael forecast errors

January 2020
- Mesh decimation routine paper published in *Coastal Engineering*

April 2020
- Finalize FL west coast ADCIRC mesh
- Compute SR parameters for Bay, Gulf, & Franklin counties

June 2020
- Deploy FL west coast mesh to the APS
- Hurricane Michael manuscript re-submission to AMS W&F
- Run SR comparison simulations and write manuscript

End User:
NOAA Northern Gulf of Mexico Sentinel Site Cooperative (NGOMSSC)

Contacts:

INTERACTIONS:
- Dr. Hagen is in regular contact with.

OUTCOME:
- Output from NGOM_RT was shared with the NGOMSSC throughout the 2019 hurricane season.

ACTION ITEM:
- Coordinate with in June 2020 to further cultivate NGOMSSC as a distribution channel for NGOM_RT forecasts to NGOM coastal stakeholders.

End User:
Federal Emergency Management Agency (FEMA) Region IV

Contact:

INTERACTIONS:
- Drs. Hagen and Bilskie have been in regular contact with

OUTCOME:
- Florida West Coast FEMA mesh was obtained in October 2018, integration and mesh decimation process underway

ACTION ITEM:
- Brief annually regarding status of model development and CERA integration prior to hurricane season.

End User:

South Florida Water Management District (SFWMD)

Contacts:

INTERACTIONS:
- Conducted a webinar on CERA interface for SFWMD staff (5 participants) on 12 July 2019

OUTCOMES:
- SFWMD provided API schema for adding their gages into schema.
- Interested in doing their own modeling, perhaps with CRC models / tools

ACTION ITEM:
- Follow up with before June 2020 to reassess SFWMD needs and update on CRC progress

End User:

Florida Department of Transportation (FDOT)

Contact: (District 5 Maintenance Engineer)

INTERACTIONS:

- Initiated contact with in October 2018
- Dr. Medeiros held a 90 minute workshop in the FDOT District 5 EOC (DeLand, FL) for employees with EM responsibility from maintenance, structures, and safety groups on 18 June 2019 (5 participants)

ACTION ITEMS:

- Follow-up with Mr. Hatfield regarding geospatial products that can be accessed using FDOT's existing tools via API or map service prior to June 2020
- Add to distribution list for pre-storm CERA reminders.

End User:

Florida Department of Transportation (FDOT)

Contact: (Secretary of the FDOT) &
(Interim Secretary of District 5)

INTERACTIONS:
- Presented coastal resilience research efforts on Thursday 13 February 2020 at ERAU MicaPlex, including CRC efforts to develop a real time capable mesh for FL West Coast.

ACTION ITEMS:
- Follow-up with regarding CRC efforts to produce actionable storm surge guidance prior to June 2020.
- Add both to distribution list for pre-storm CERA reminders.

End User:

State of Florida

Contact: former State Chief Resilience Officer,
now Homeland Security Advisor in Trump Administration

INTERACTIONS:
- Presented coastal resilience research efforts on 27 August 2019 at ERAU College of Engineering
- Followed up with at UCF Sustainability conference mixer at Orlando City Hall

ACTION ITEMS:
- Re-establish relationship with state office once replacement is installed

Transition of Project Outcomes

| June 2019 | • CERA Tutorial tested by undergraduate research assistant |
August 2019	• CERA Tutorial presented to 10 end users
August 2019	• Enhanced custom hydrograph output for CPRA
March 2020	• Models tangibly incorporate local domain knowledge
June 2020	• Publication on SR parameterization – usable tool for modelers

Realized & Anticipated Impacts
Hurricane Michael (2018)
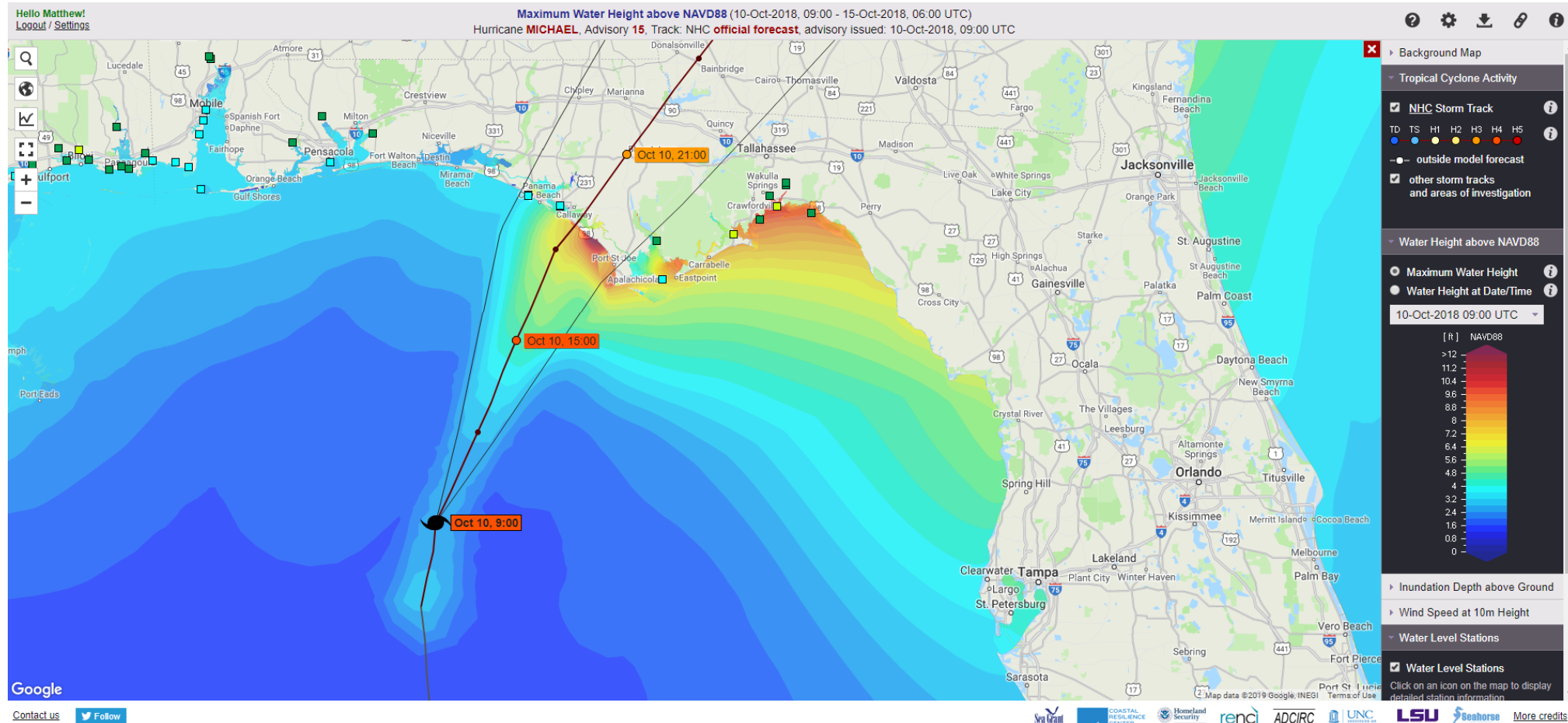
Realized & Anticipated Impacts

Using the NGOMSSC distribution channels, those most affected by coastal hazards are informed about ASGS and CERA

Coastal resource managers and stakeholders are informed about surge guidance methodology and advances in model development

Accurate, local surge forecasts enable NGOMSSC, SFWMD, & FDOT personnel to secure assets prior to event and guide assessment efforts after

Coastal hazards community (DHS, NOAA, Local Government, and University partners) receive talented & trained personnel via research assistantships under the Research and Education PIs

State of Florida Cabinet level exposure for APS and CERA

Publications

Accepted peer-review articles

2016   S. Tahsin, S.C. Medeiros, A. Singh. "Resilience of coastal wetlands to extreme hydrologic events in Apalachicola Bay," *Geophysical Research Letters*, Vol. 43, https://doi.org/10.1002/2016GL069594.

2017   S. Tahsin, S.C. Medeiros, A. Singh, M. Hooshyar, "Optical Cloud Pixel Recovery via Machine Learning," *Remote Sensing*, Vol. 9 (6), https://doi.org/10.3390/rs9060527.

2020   M.V. Bilskie, S.C. Hagen, S.C. Medeiros, "Unstructured finite element mesh decimation for real-time Hurricane storm surge forecasting," *Coastal Engineering*, 156, 103622. https://doi.org/10.1016/j.coastaleng.2019.103622.

Manuscripts in Progress

M.V. Bilskie, T.G. Asher, J.G. Fleming, S.C. Hagen, C. Kaiser, R.A. Luettich, R. Twilley, P. Miller, "Real-Time Storm Surge Predictions during Hurricane Michael", *Weather & Forecasting*.

S.C. Medeiros, S.C. White, M.V. Bilskie, S.C. Hagen, "Influence of surface roughness parameterization technique on local water levels and velocities during Hurricane Michael" (Working Title), *Coastal Engineering / TBD*

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Professor & Louisiana Sea Grant Laborde Chair:
Department of Civil & Environmental Engineering /
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shagen@lsu.edu

Co-Principal Investigator: Matthew V. Bilskie
Research Scientist: LSU Center for Coastal Resiliency
mbilsk3@lsu.edu

EMBRY-RIDDLE Aeronautical University
DAYTONA BEACH, FLORIDA

Co-Principal Investigator: Stephen C. Medeiros
Assistant Professor: Department of Civil Engineering
medeiros@erau.edu