NC STATE UNIVERSITY

~~Connecting Coastal Infrastructure to Predictions of Storm Surge and Flooding~~

How Can We Speed Up Our Coastal Flooding Models?

JC Dietrich[1],
R Cyriac[1], A Thomas[1], A Gharagozlou[1], N Tull[1]

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NSF Workshop on the Future of Coastal and Estuarine Modeling
Raleigh NC, 18–21 June 2018

GULF OF MEXICO RESEARCH INITIATIVE
Sea Grant North Carolina
ncds THE NATIONAL CONSORTIUM for DATA SCIENCE
COASTAL RESILIENCE CENTER
A U.S. Department of Homeland Security Center of Excellence
NSF

North Carolina State University

Assistant Professor, Civil Engineering

Mann Hall, built 1964

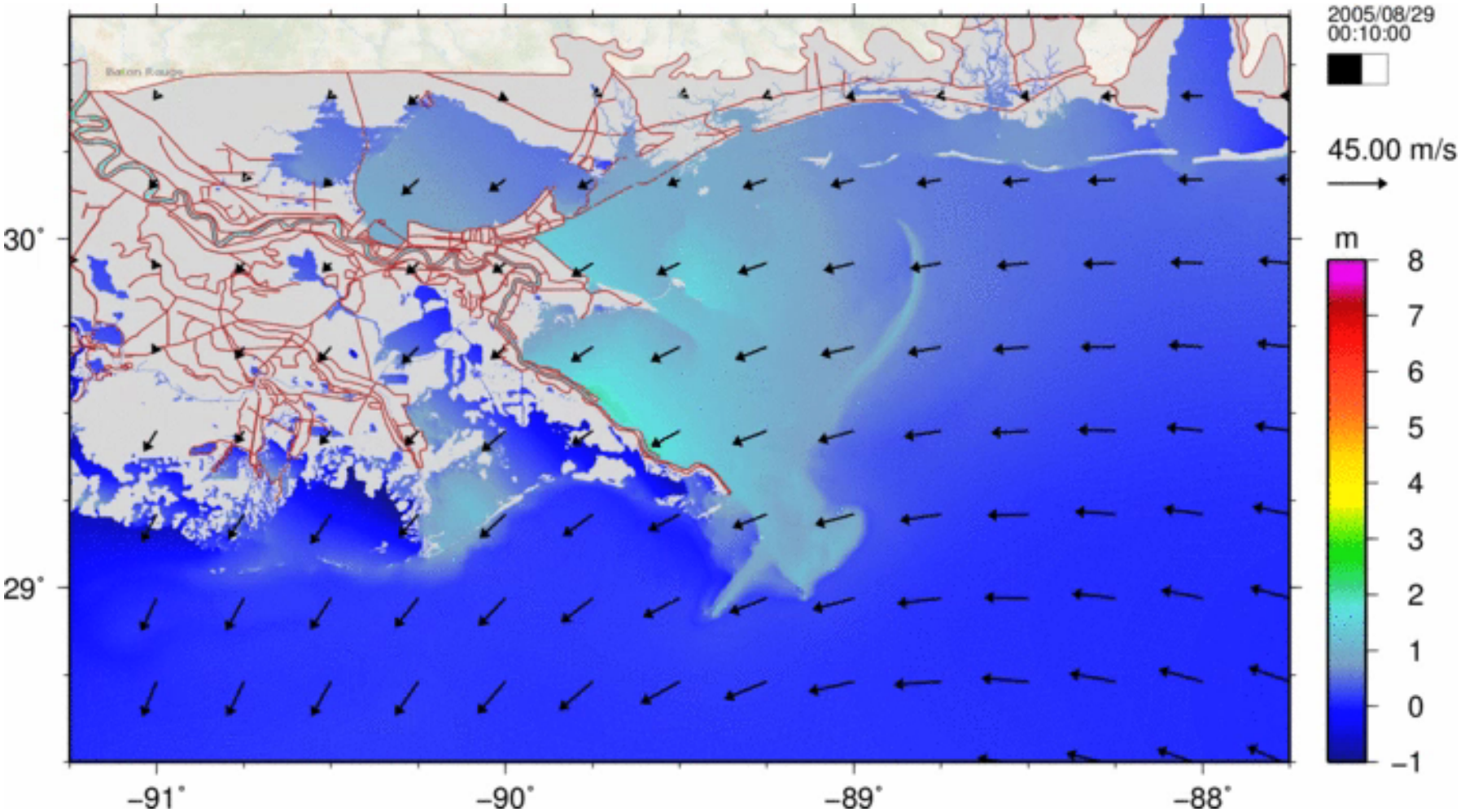
North Carolina State University

Assistant Professor, Civil Engineering

Fitts-Woolard Hall, to be completed 2020

ADCIRC (ADvanced CIRCulation)

Member, Development Group



S Bunya, JC Dietrich, *et al.* (2010). A High-Resolution Coupled Riverine Flow, Tide, Wind, Wind Wave and Storm Surge Model for Southern Louisiana and Mississippi: Part I – Model Development and Validation. *Monthly Weather Review*, 138(2), 345-377.

JC Dietrich, *et al.* (2010). A High-Resolution Coupled Riverine Flow, Tide, Wind, Wind Wave and Storm Surge Model for Southern Louisiana and Mississippi: Part II – Synoptic Description and Analysis of Hurricanes Katrina and Rita. *Monthly Weather Review*, 138(2), 378-404.

Summaries of Ongoing Projects

1. Choctawhatchee River Plume at Destin Inlet
2. Erosion on Hatteras Island during Isabel

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   - Domain Decomposition in ADCIRC
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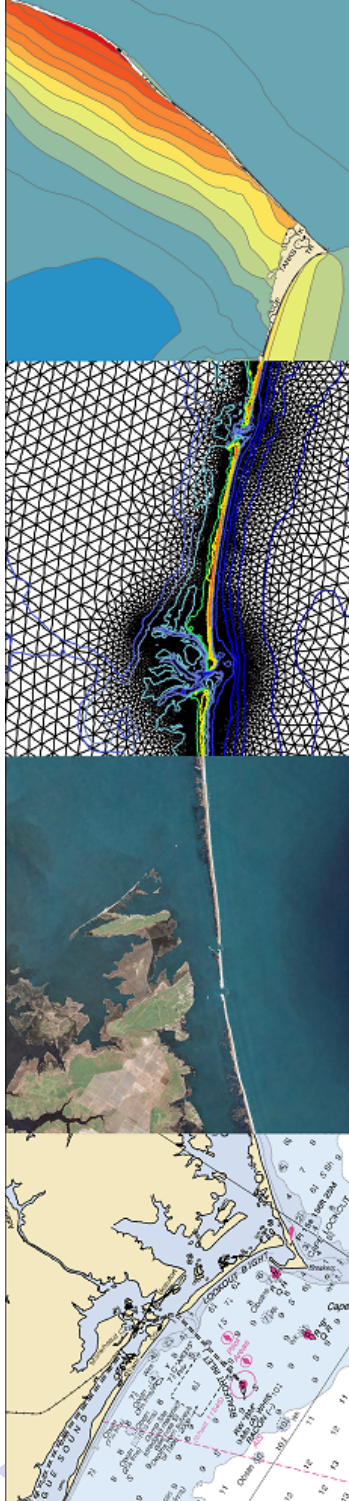
   - Variations in Caernarvon Marsh during Isaac

Summary and Discussion



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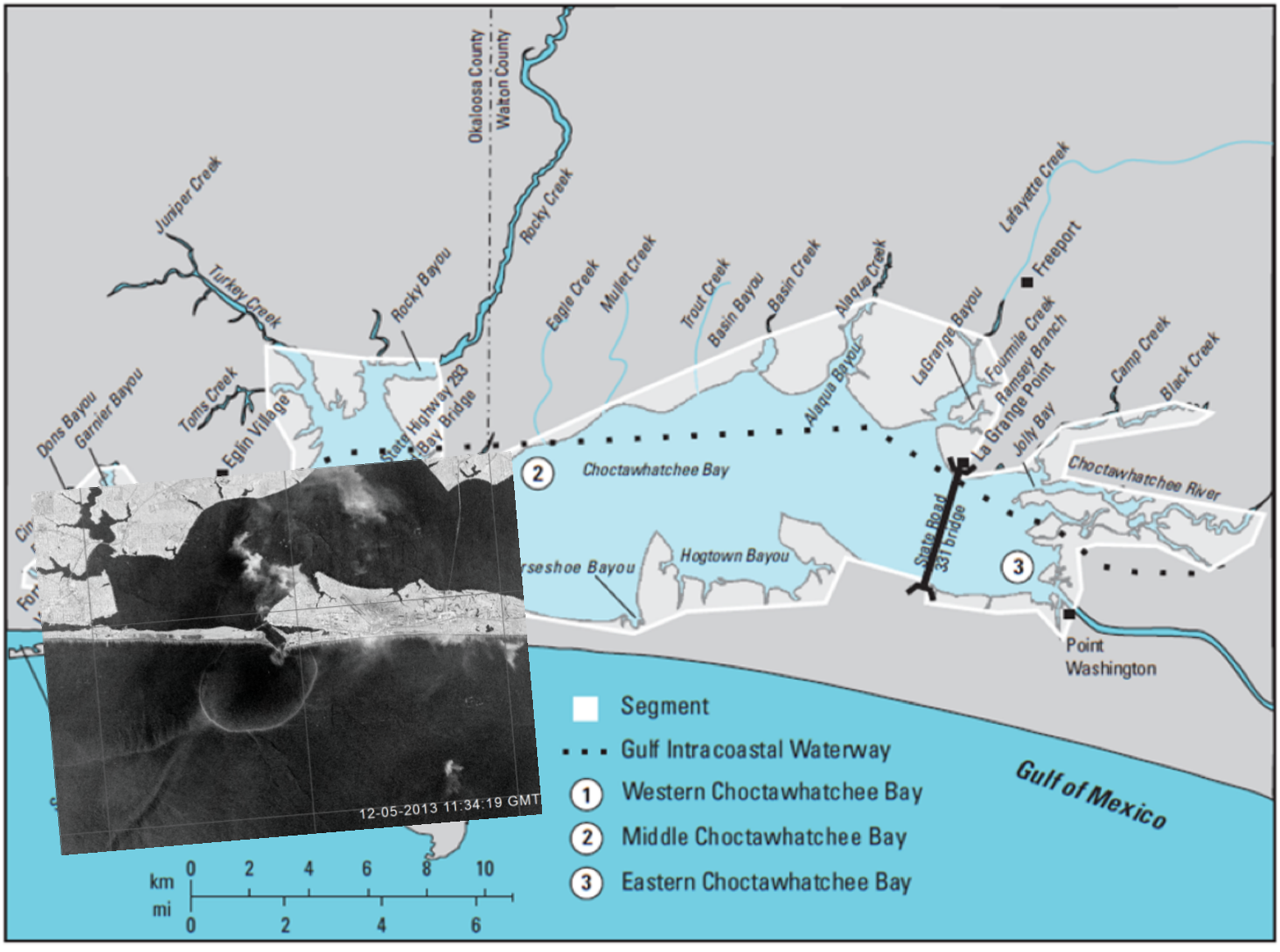

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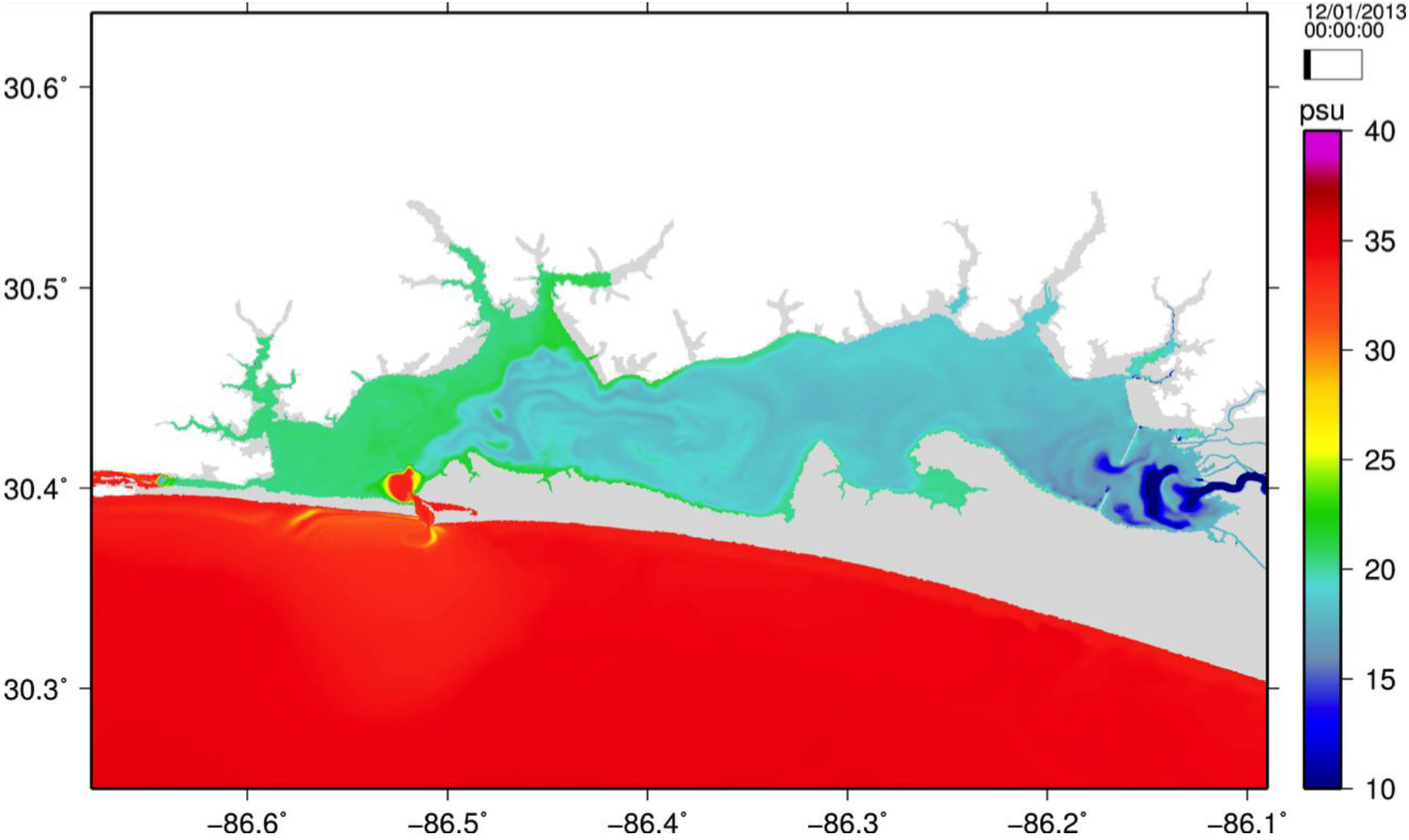

R Cyriac*, JC Dietrich, A Fathi, CN Dawson, CA Blain, KM Dresback, *et al.* (2018), *Continental Shelf Research*, in preparation.

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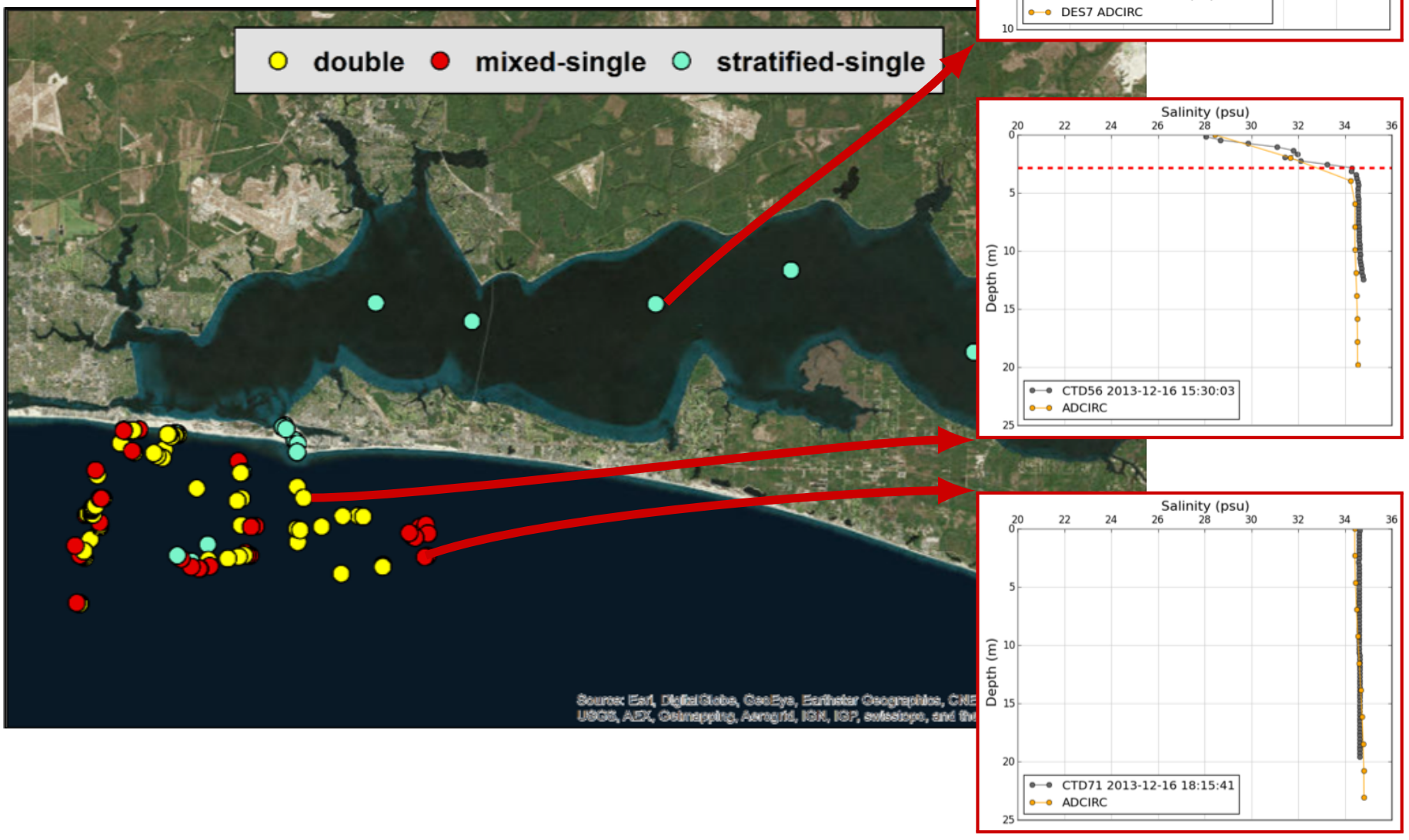

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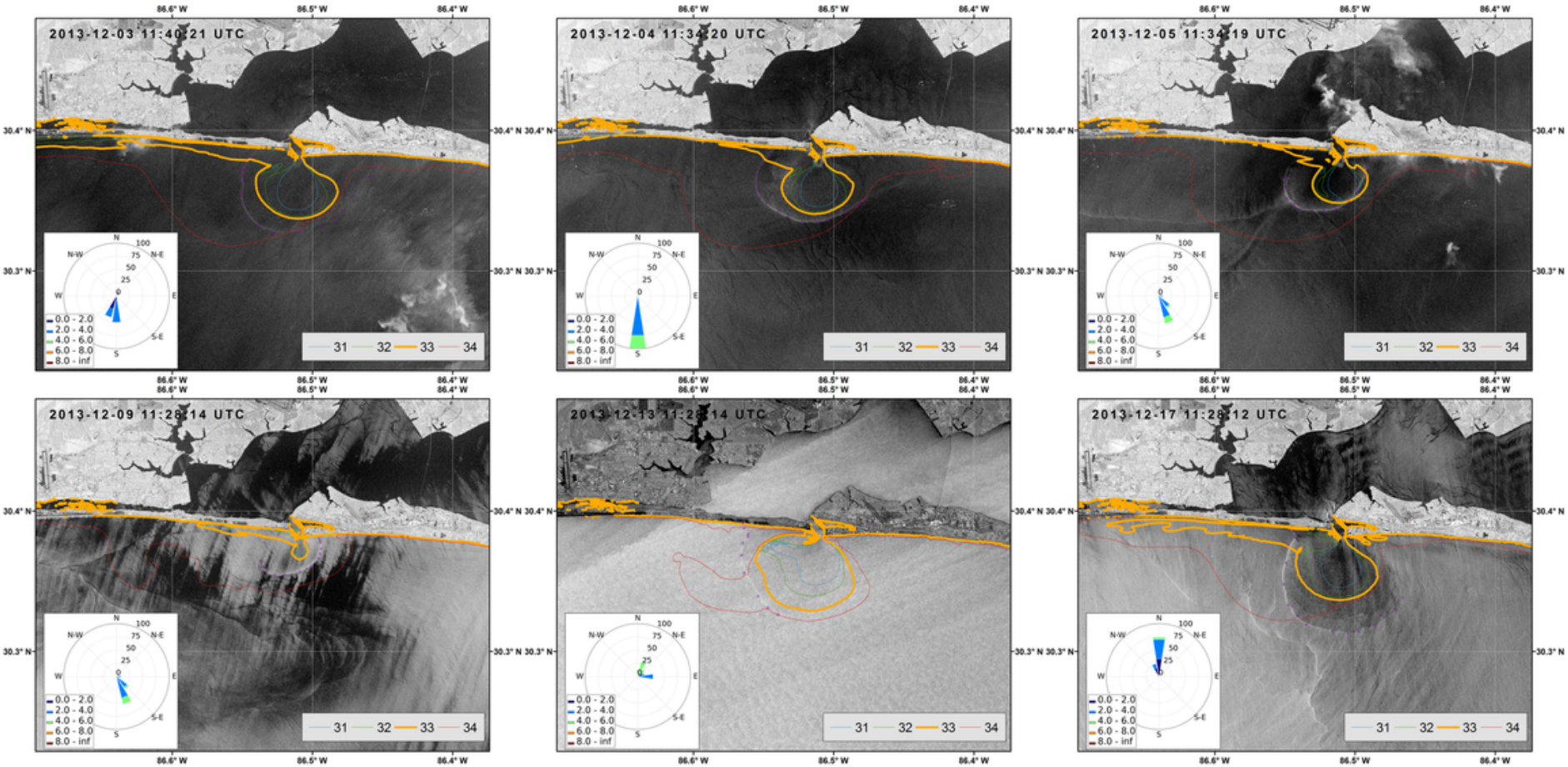

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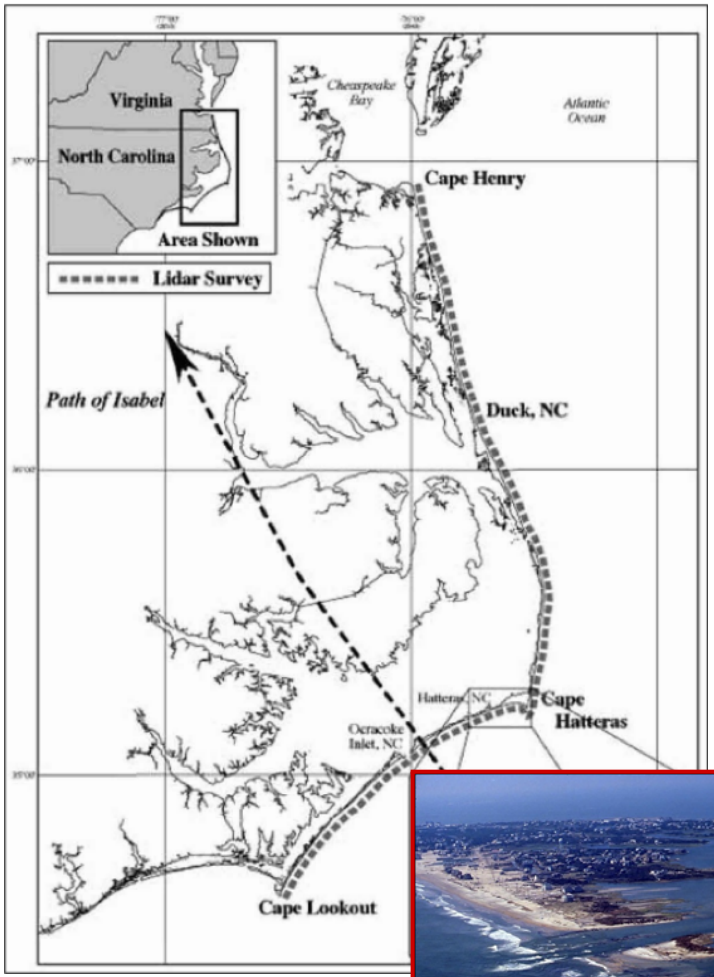

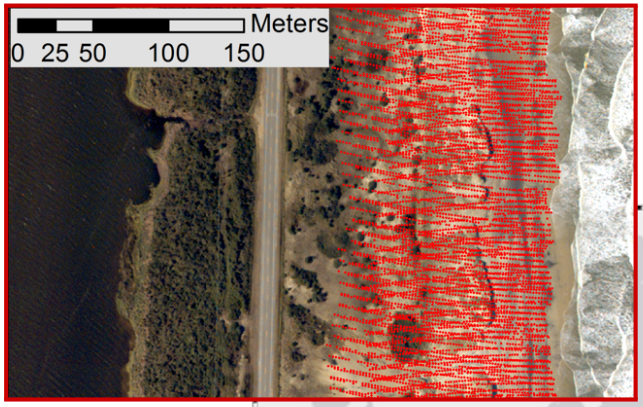

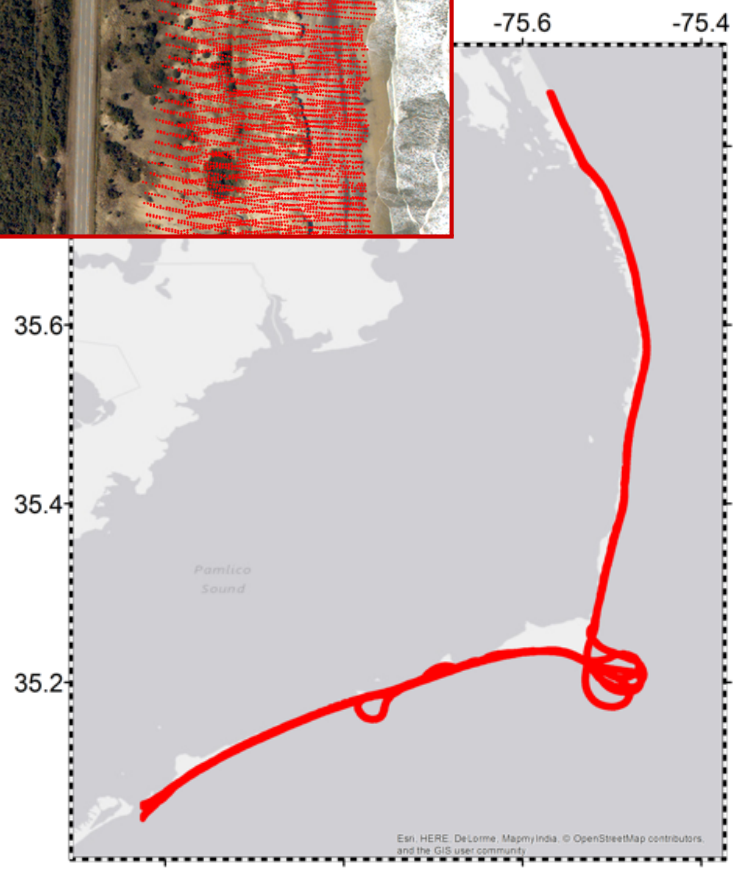

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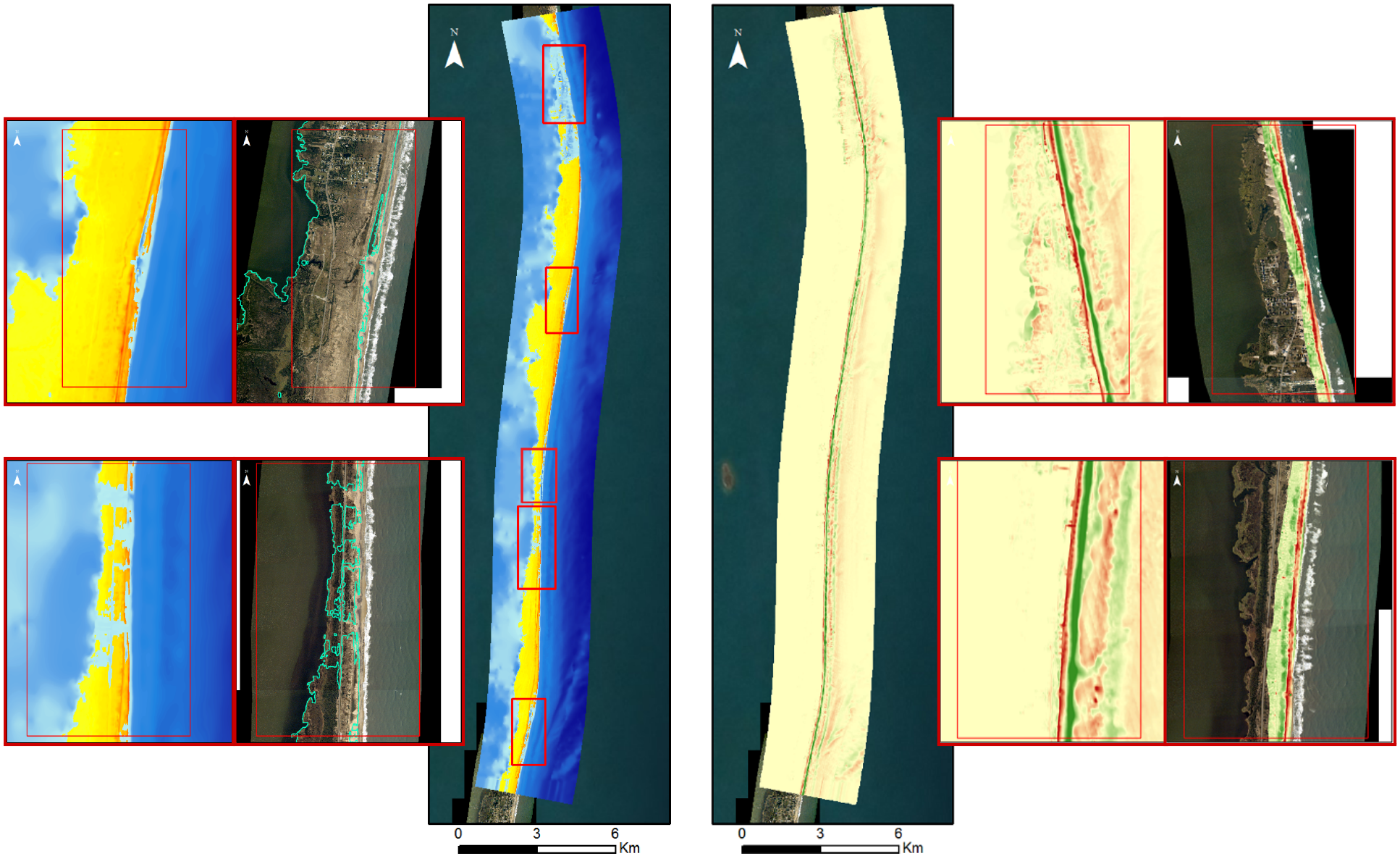

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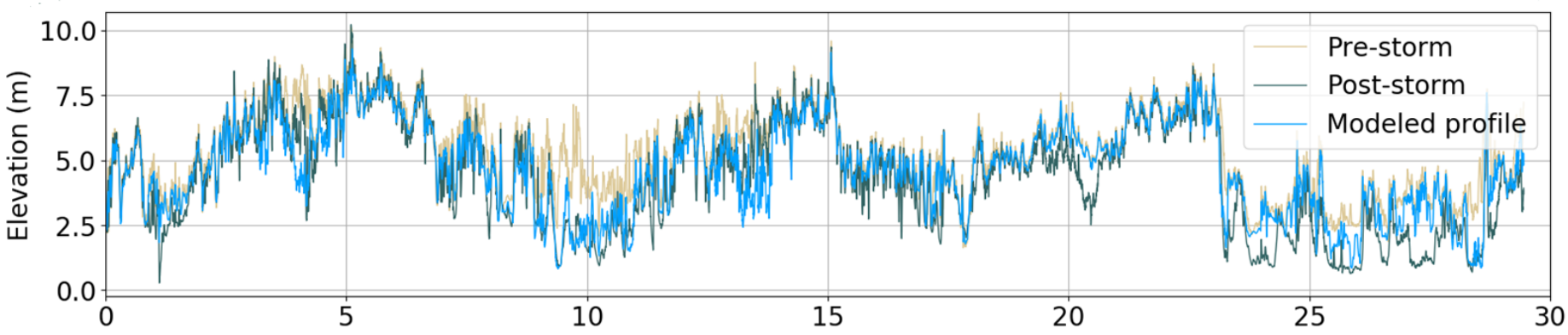

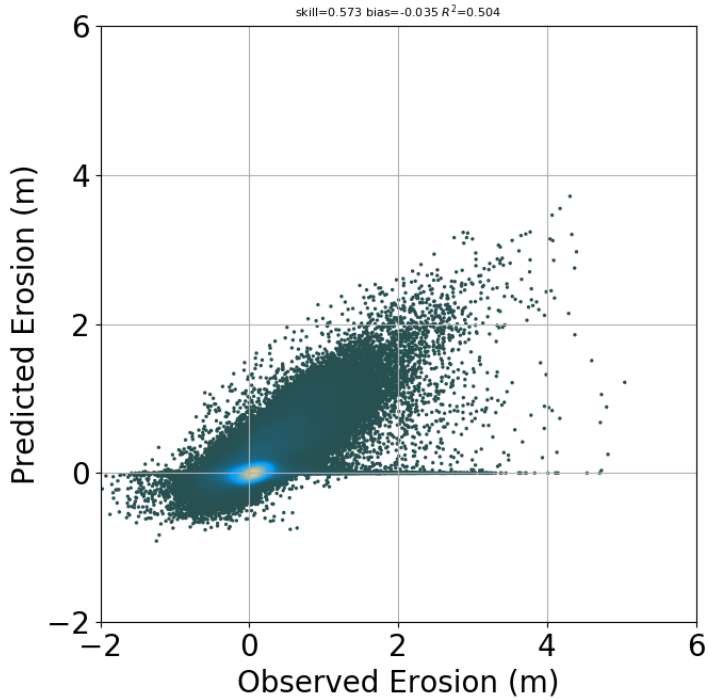

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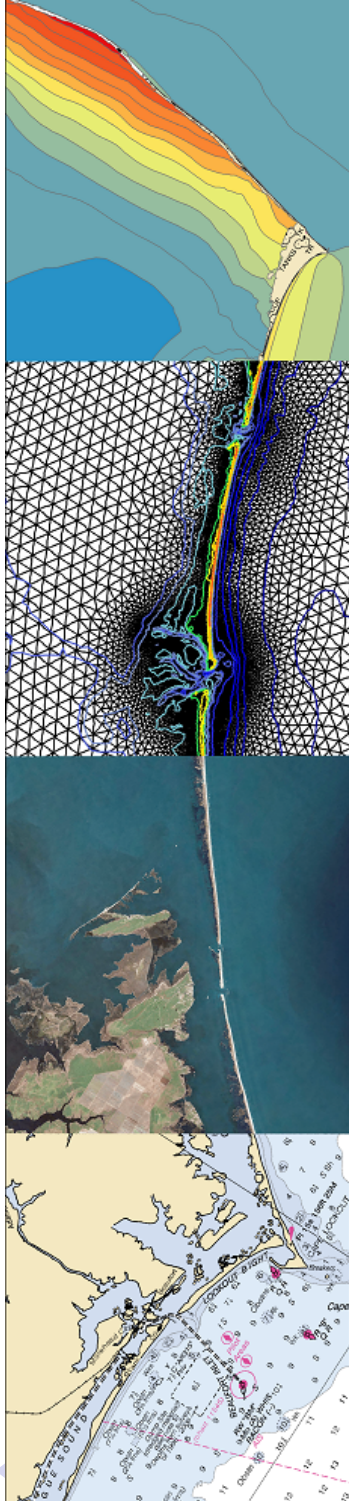
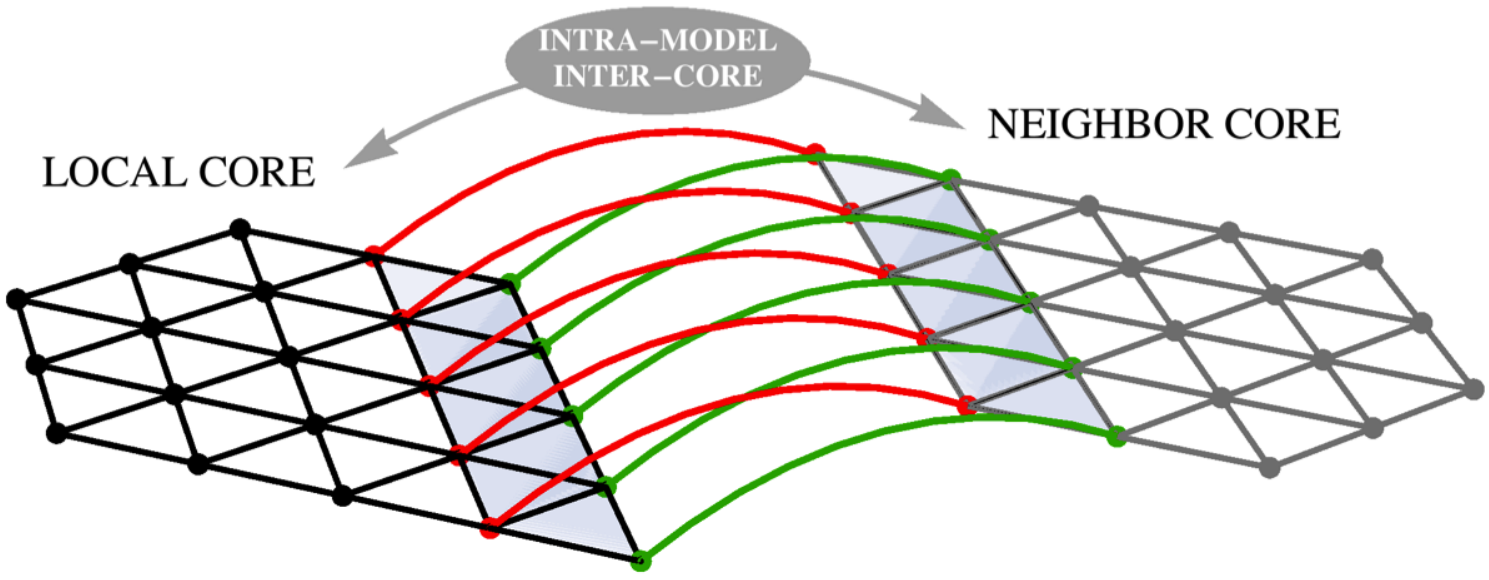


3. Dynamic Load Balancing

Domain Decomposition in ADCIRC



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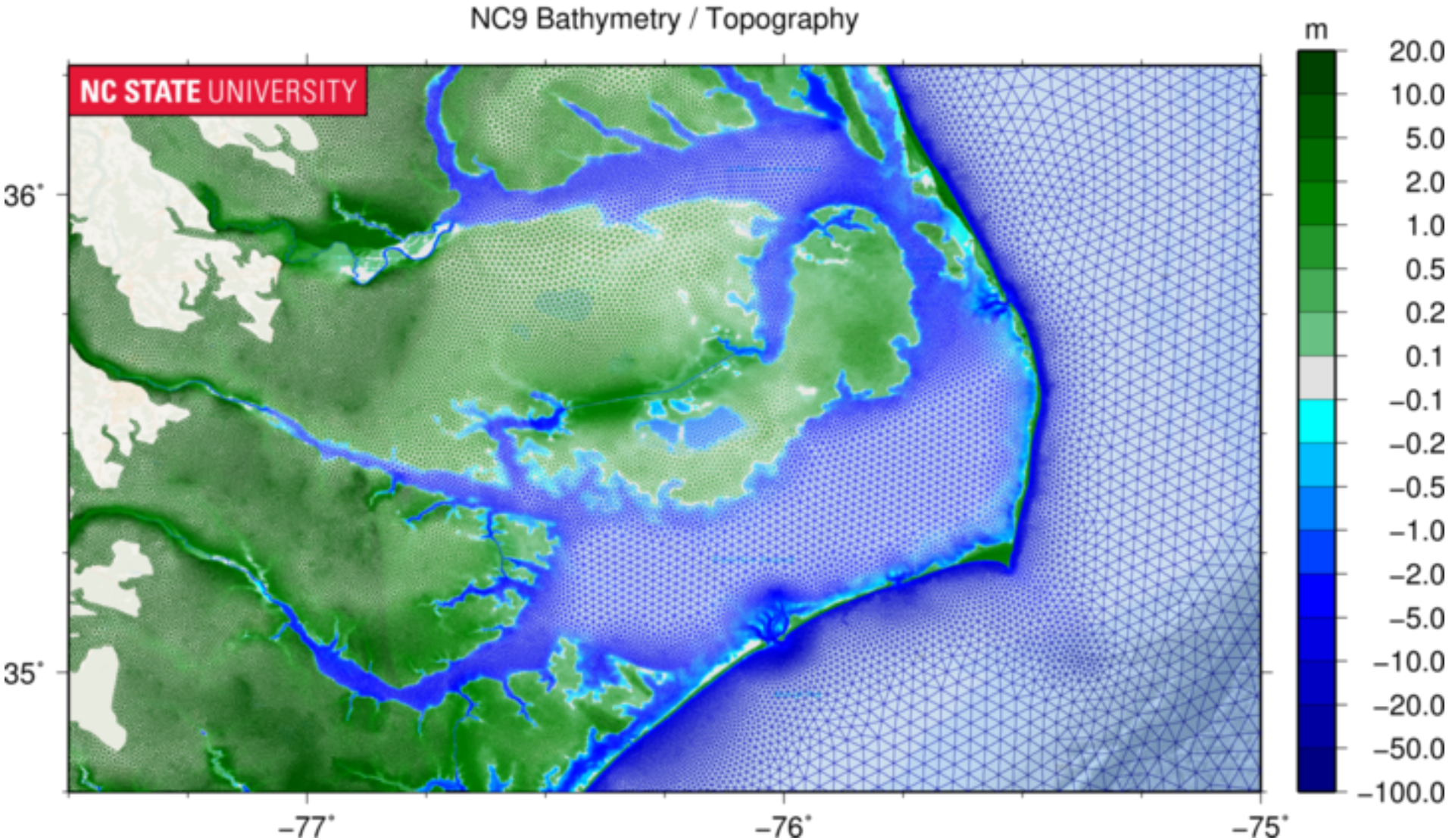

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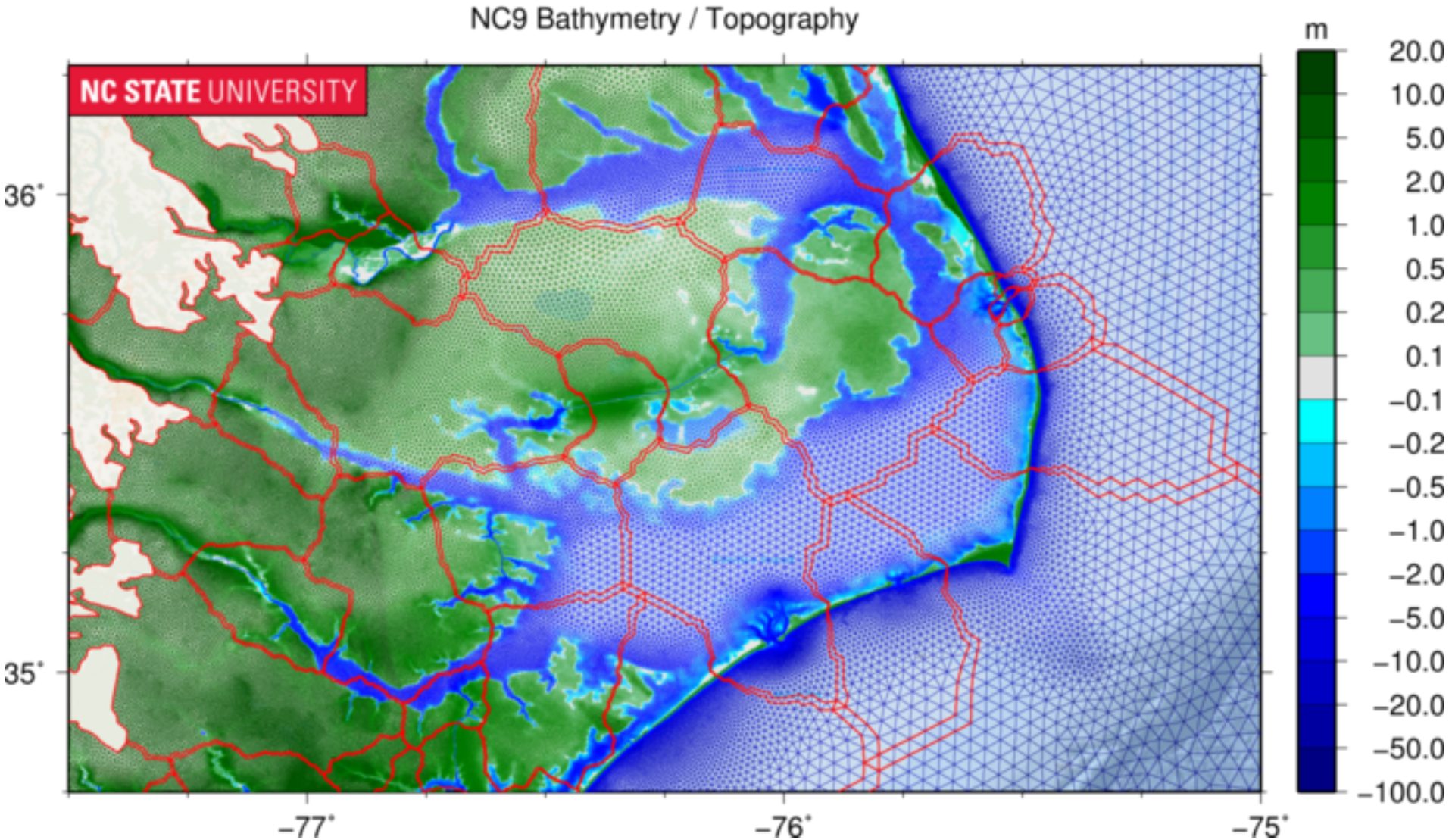

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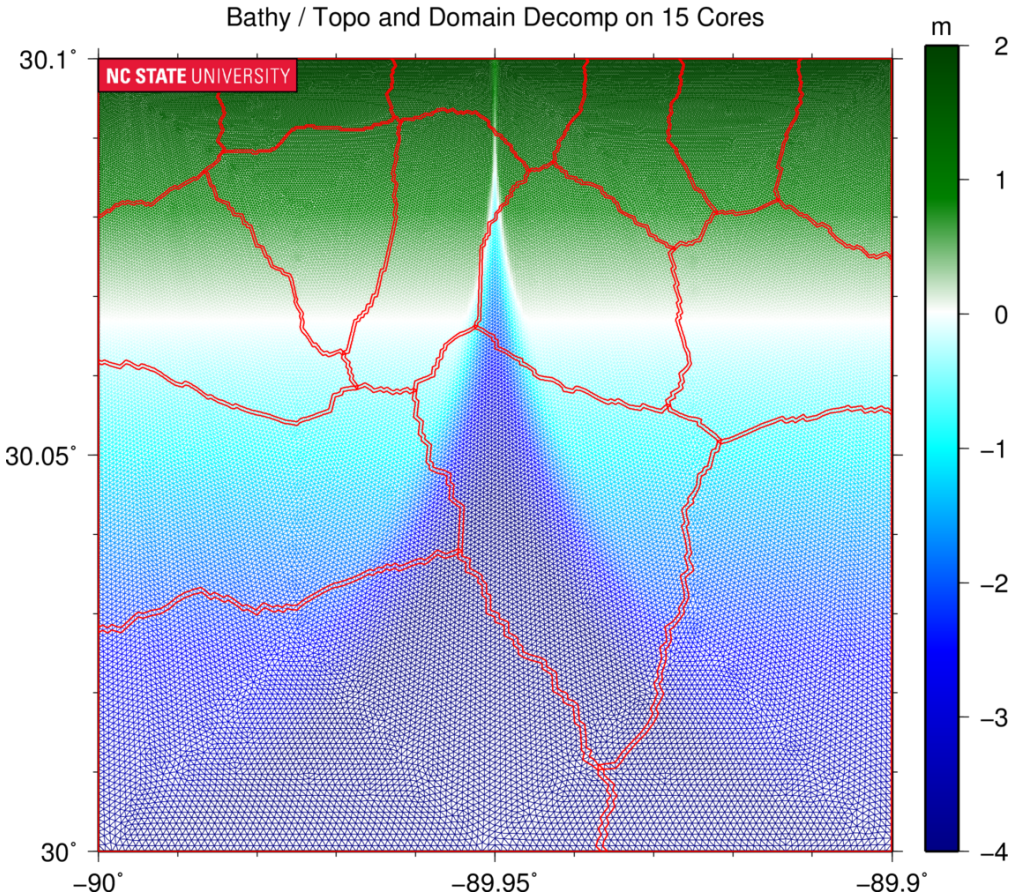
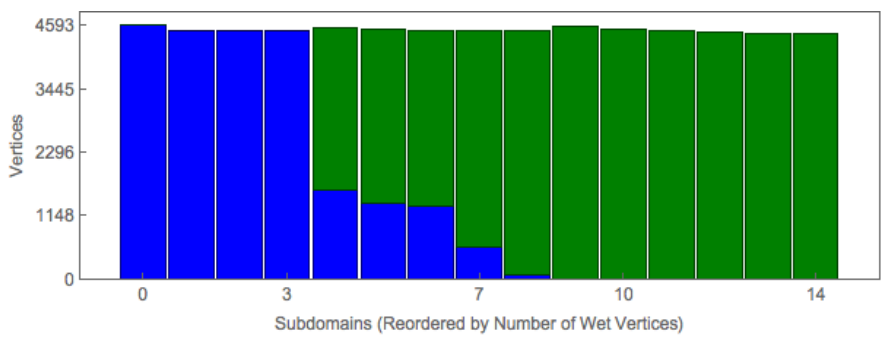
Example on Ideal Channel





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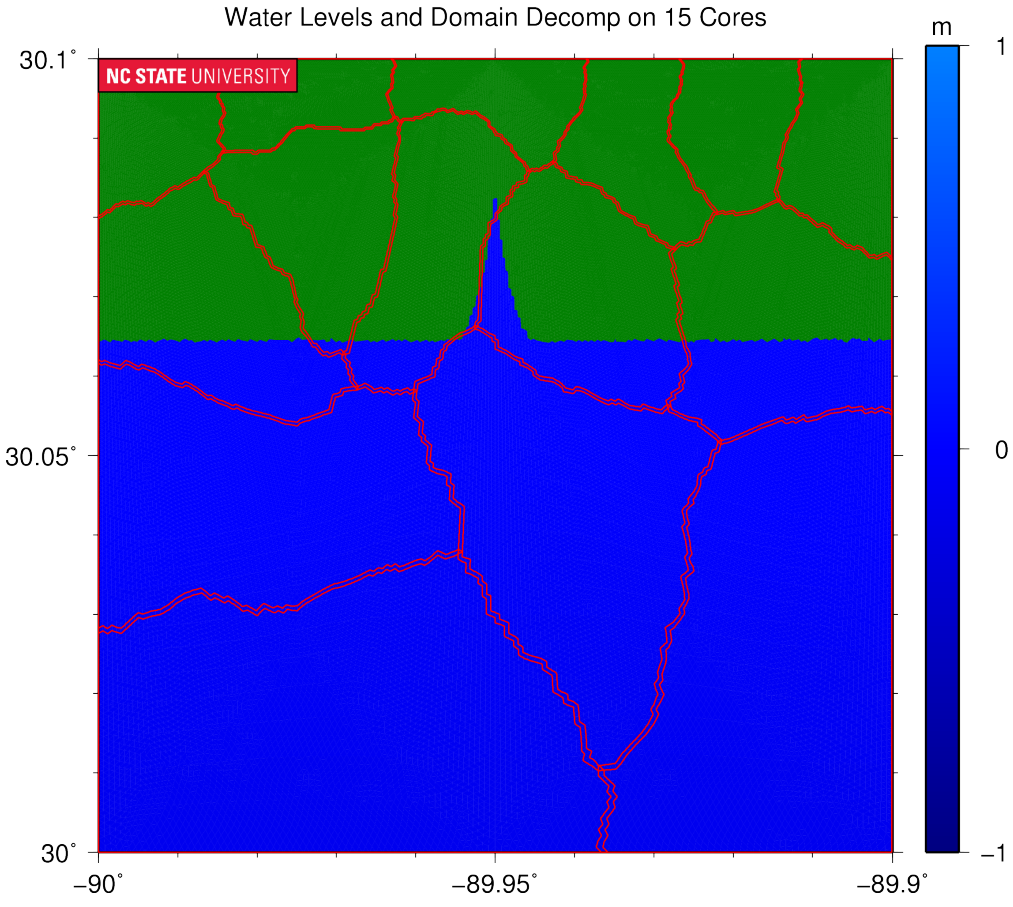

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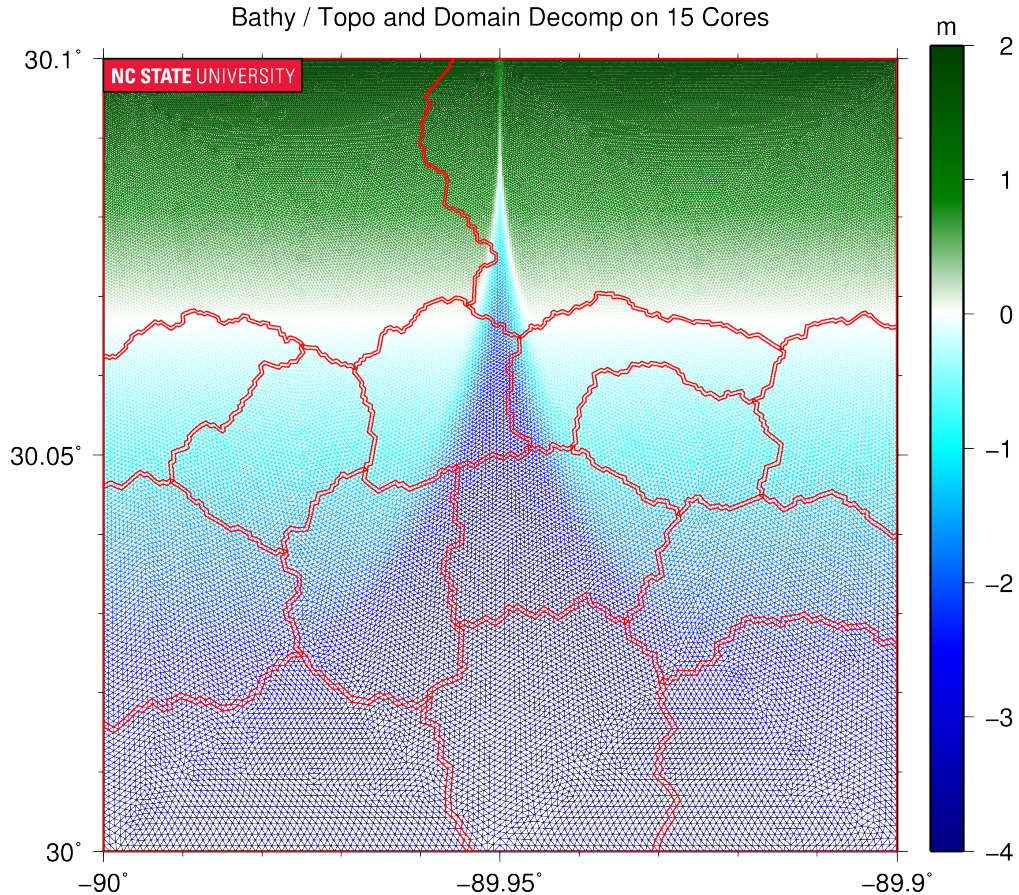

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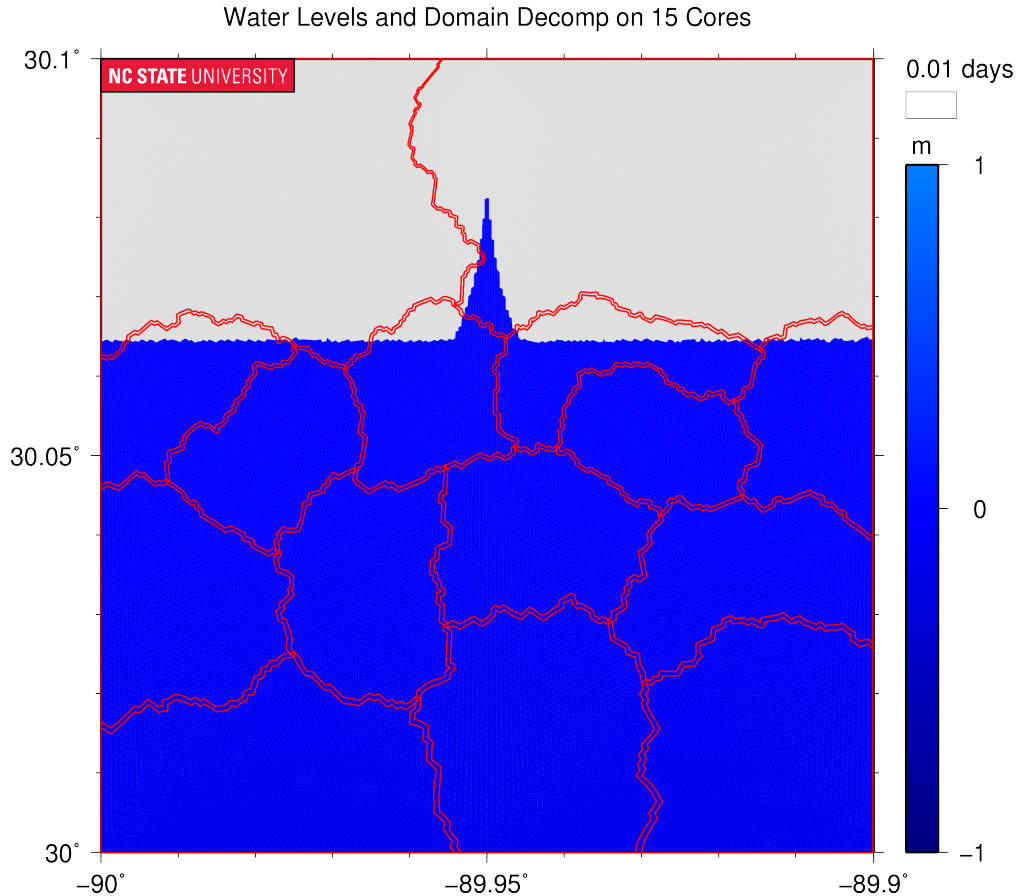
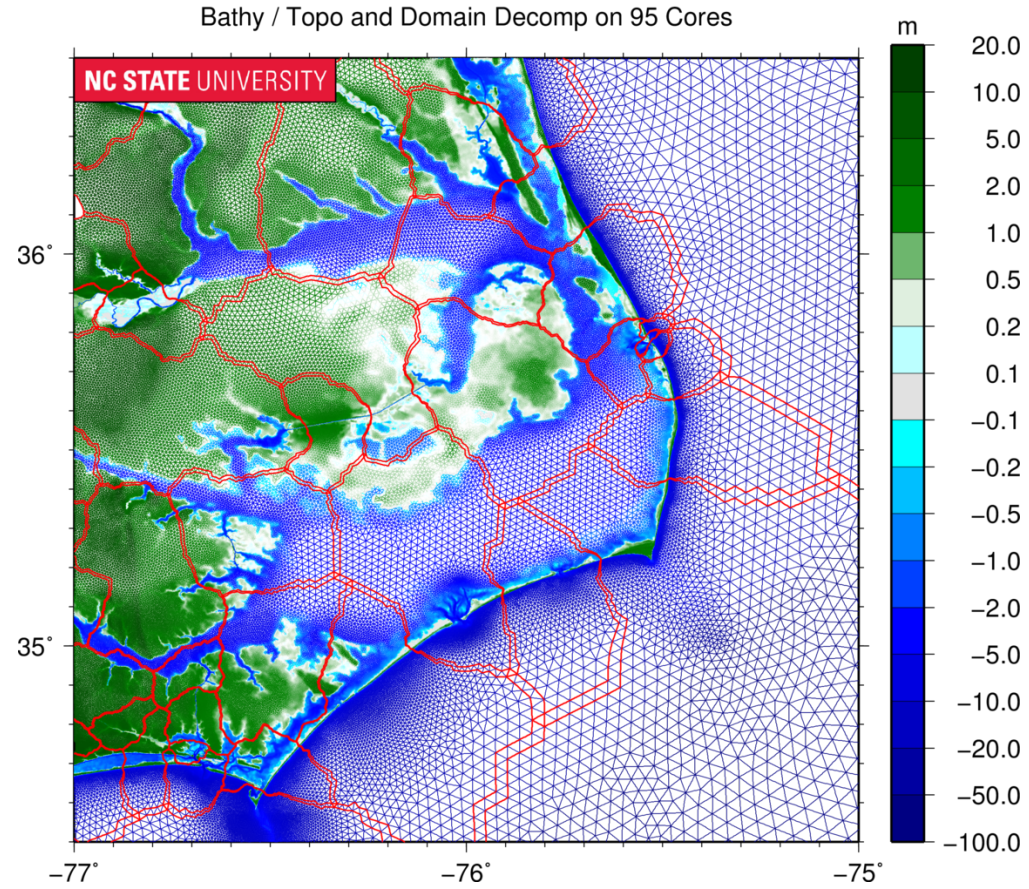
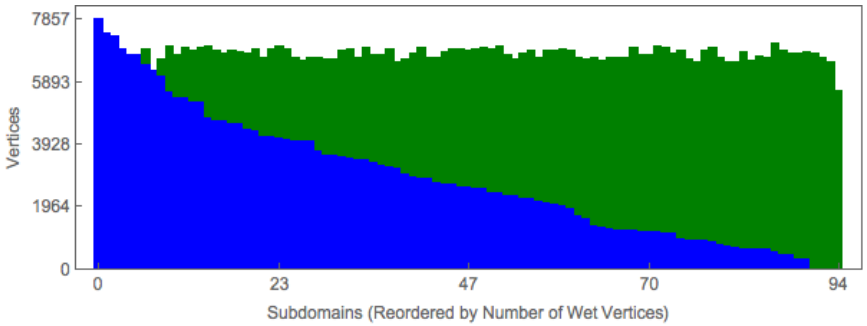


Test	Code Version	Cores	CPU-hr	% Change
Wet/Dry	ADCIRC v52.22	15	4.46	
	+ load balancing		2.88	**− 35.3**

3. Dynamic Load Balancing

Example in North Carolina during Irene





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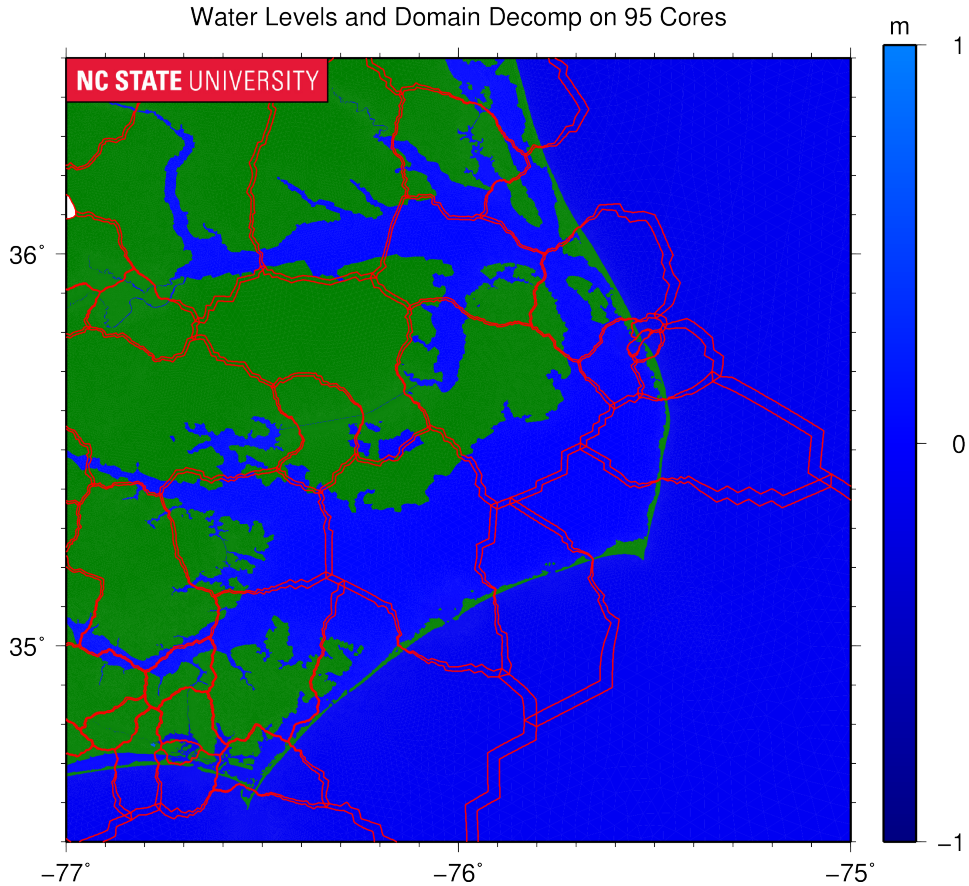

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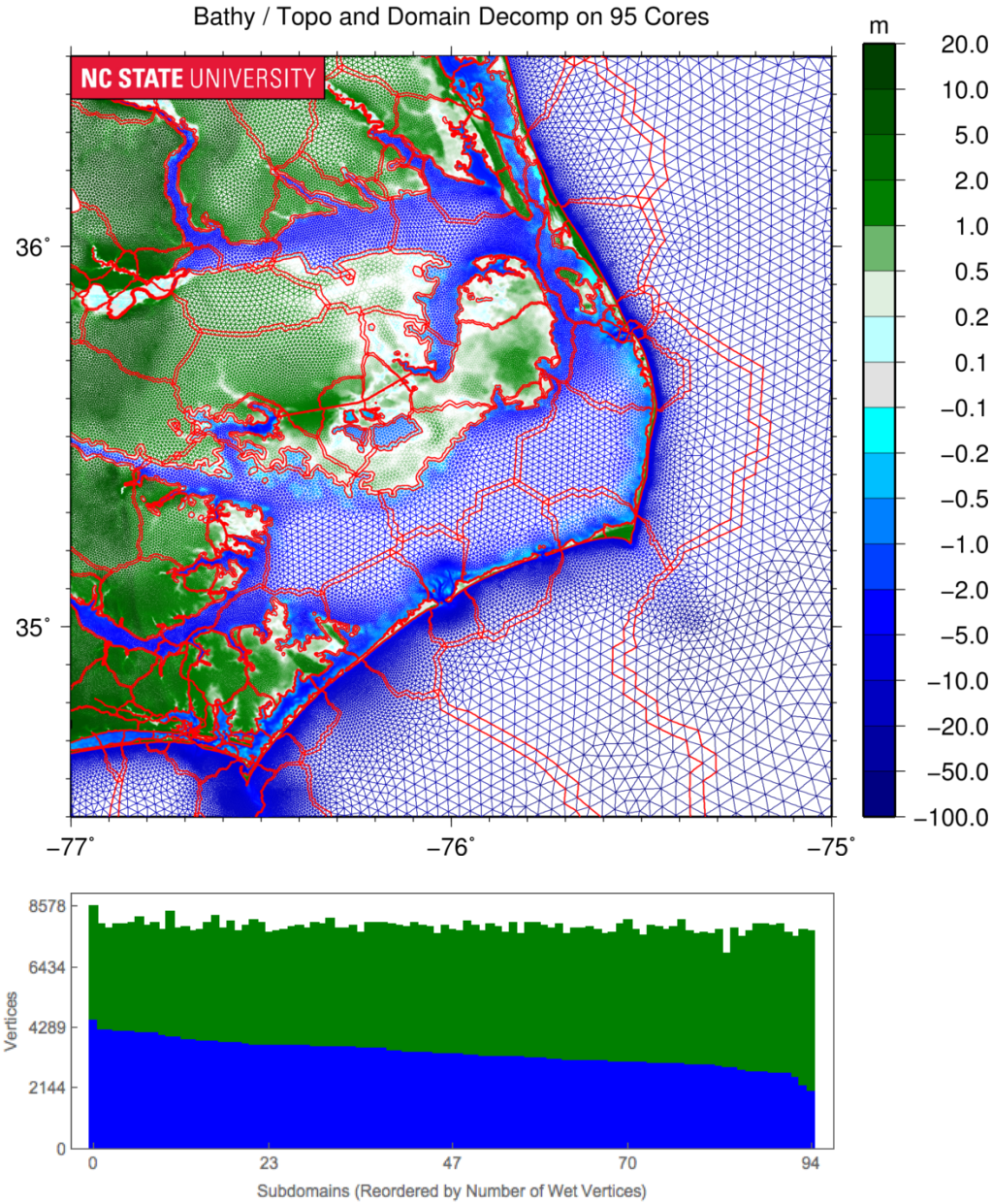

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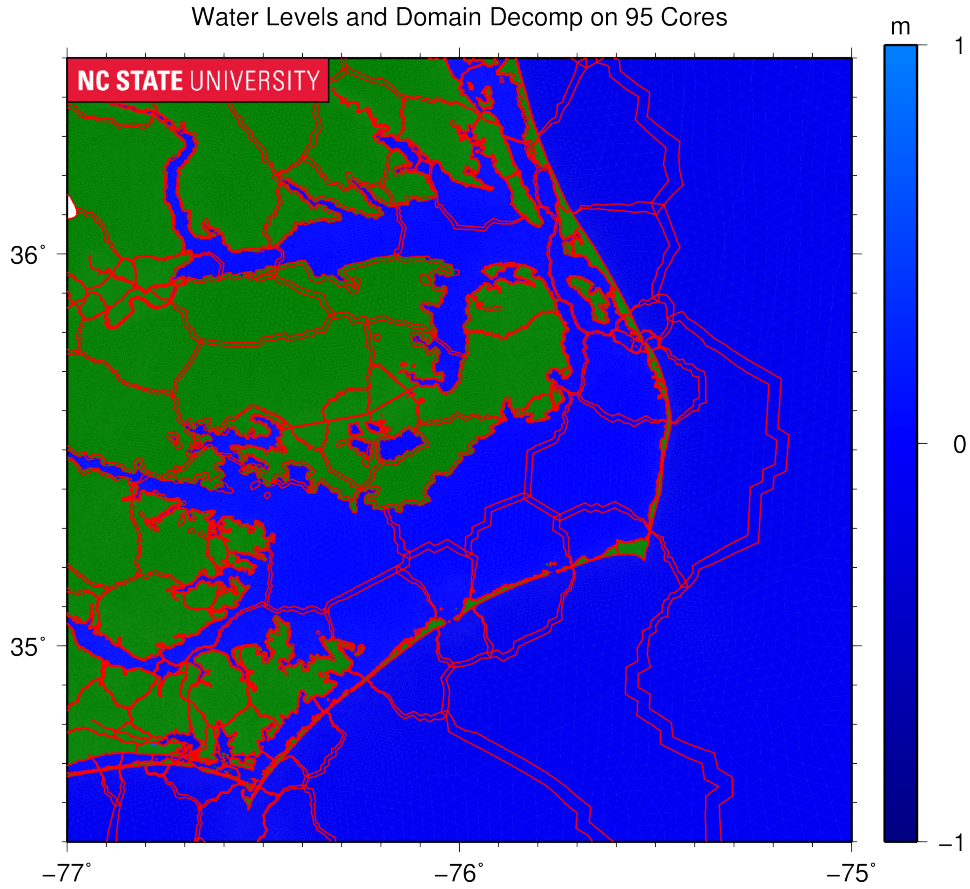


Test	Code Version	Cores	CPU-hr	% Change
Tides	ADCIRC v52.22	95	259.2	
	+ load balancing		210.7	**− 18.7**
Irene	ADCIRC v52.22	95	334.3	
	+ load balancing		263.3	**− 21.2**

3. Dynamic Load Balancing

Integrating with Zoltan

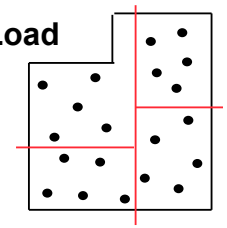
Slide 3

Sandia National Laboratories

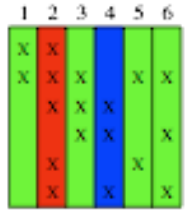
The Zoltan Toolkit

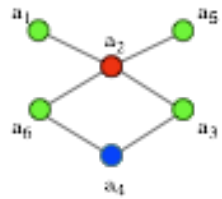
- **Library of data management services for unstructured, dynamic and/or adaptive computations.**

Dynamic Load Balancing

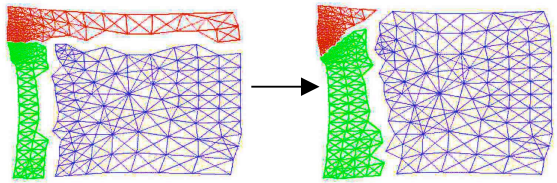


Graph Coloring

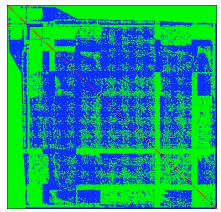




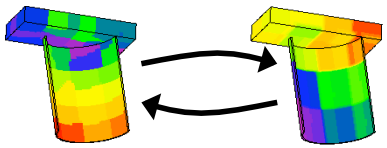
Data Migration



Matrix Ordering



Unstructured Communication



Distributed Data Directories

A	B	C	D	E	F	G	H	I
0	1	0	2	1	0	1	2	1

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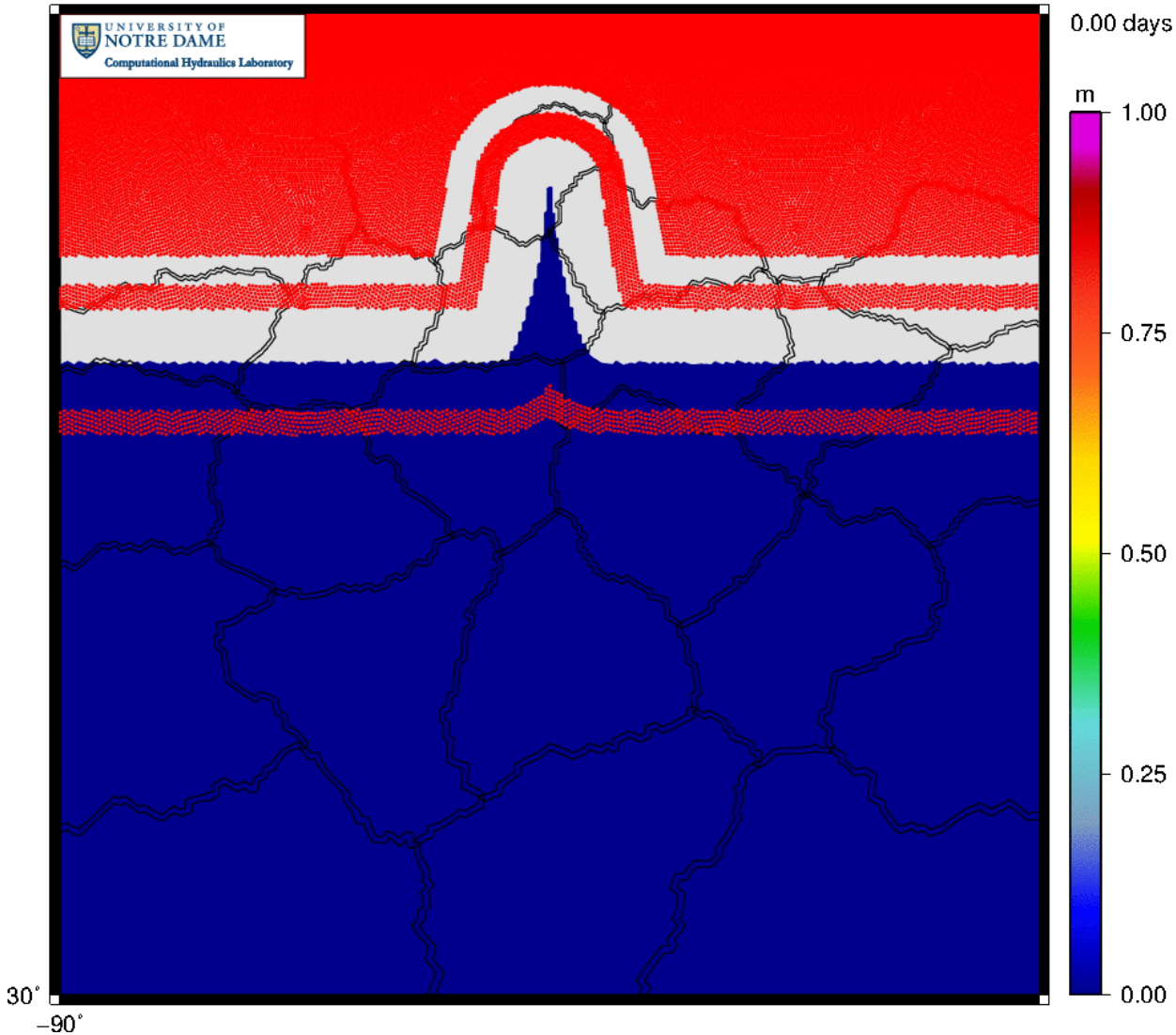
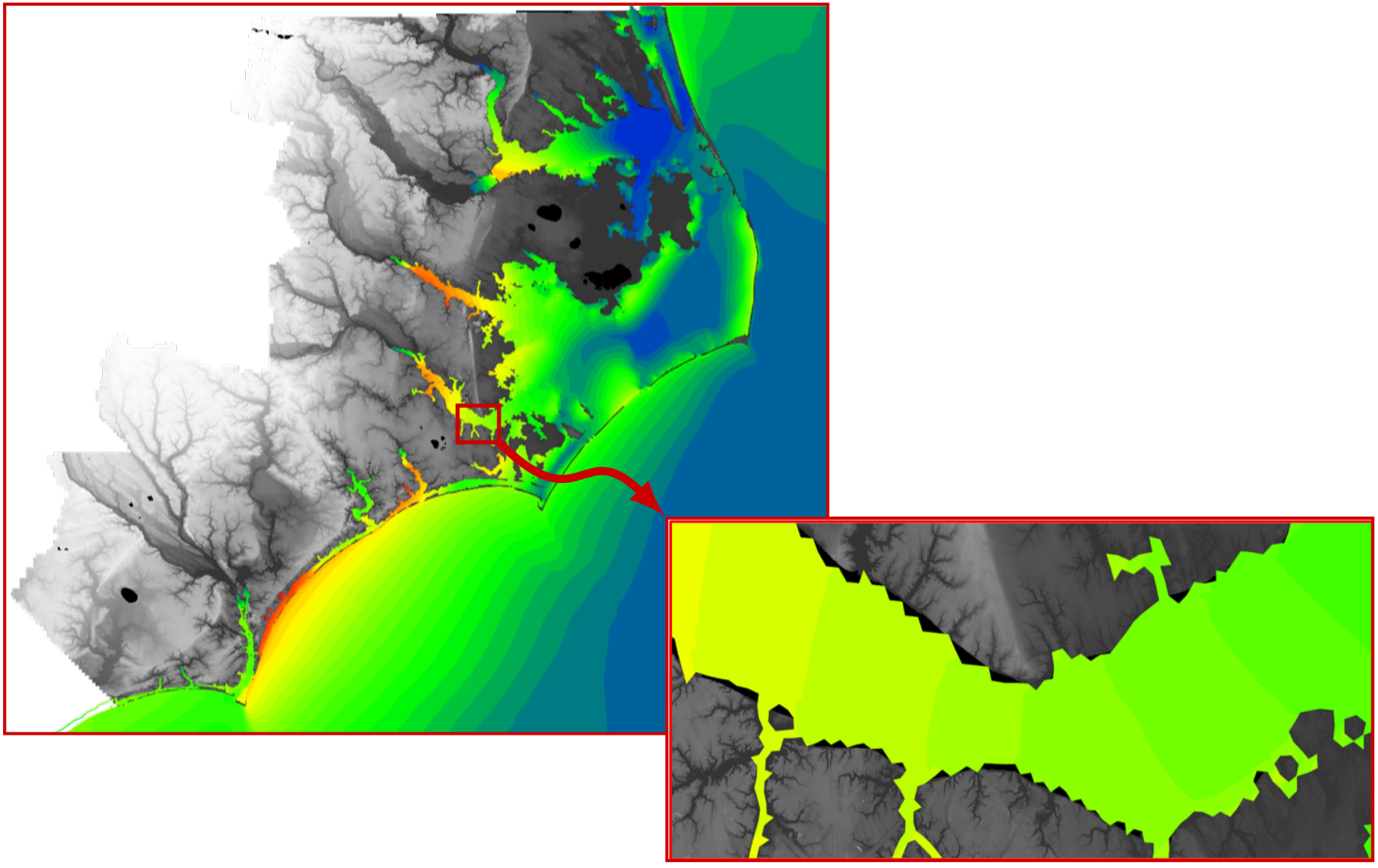
Integrating with Zoltan



K Roberts, JC Dietrich, JJ Westerink, *et al.* (2018), in preparation.

4. GIS Techniques

Downscaling of Flood Forecasts from Matthew



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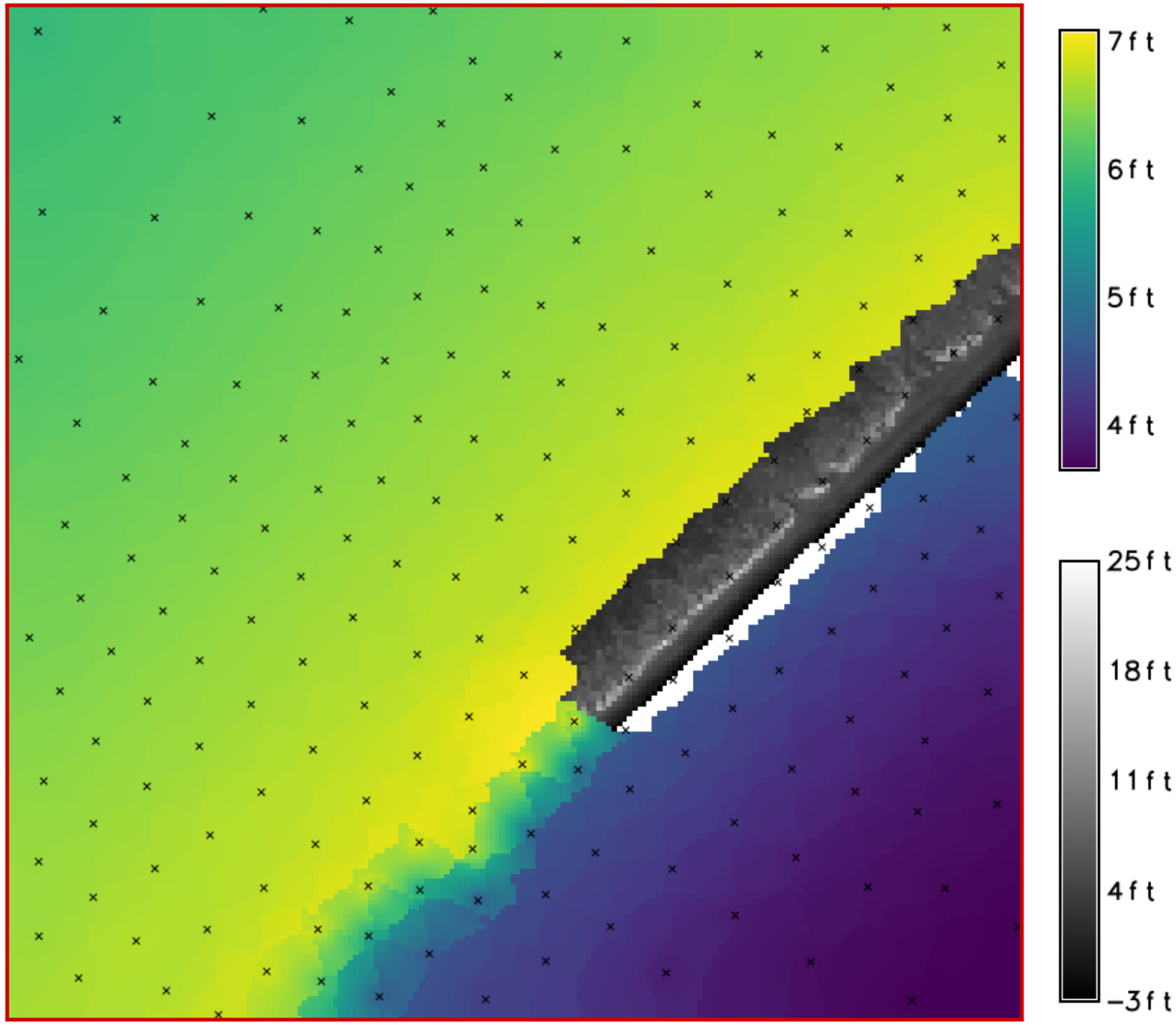

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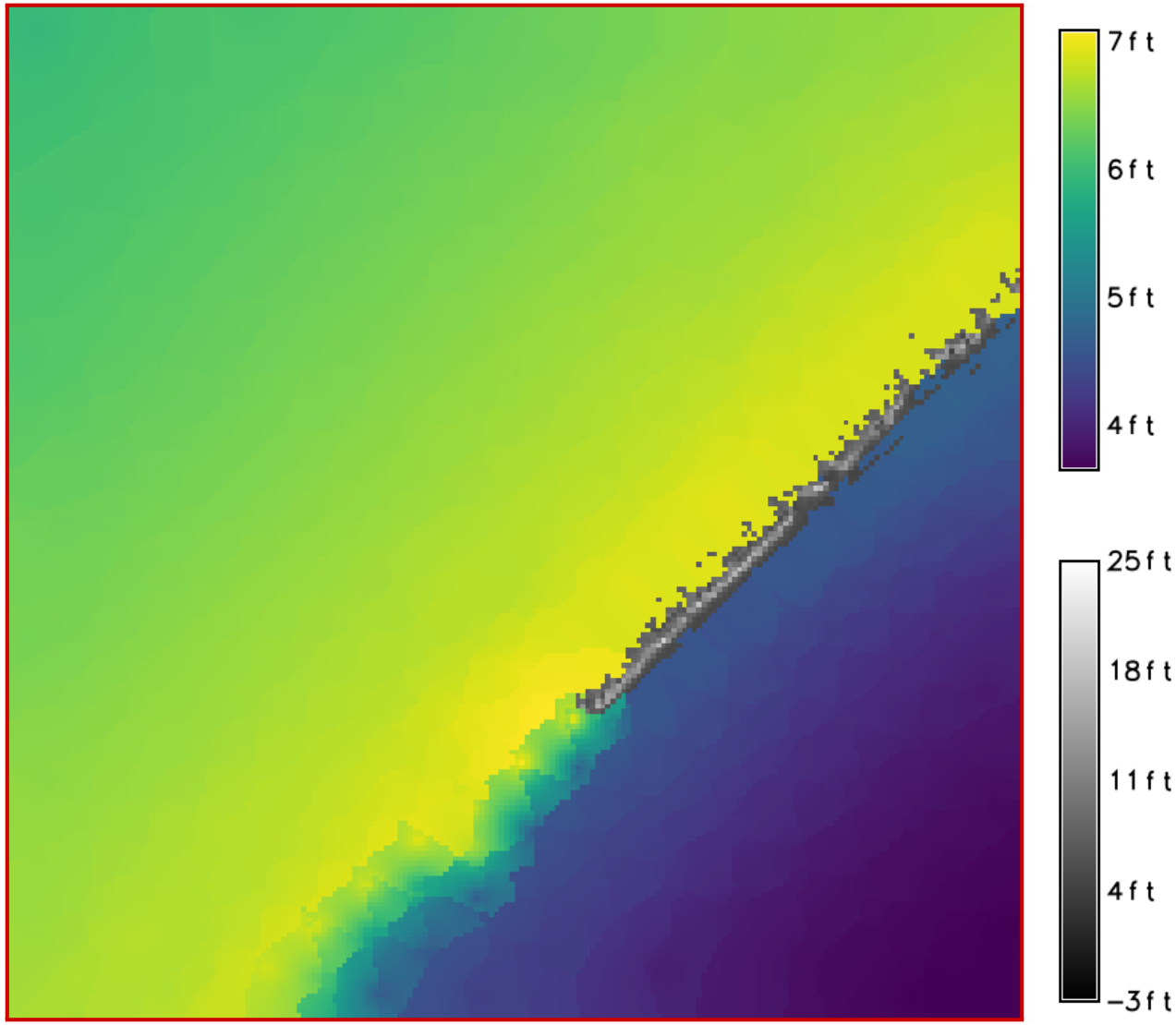

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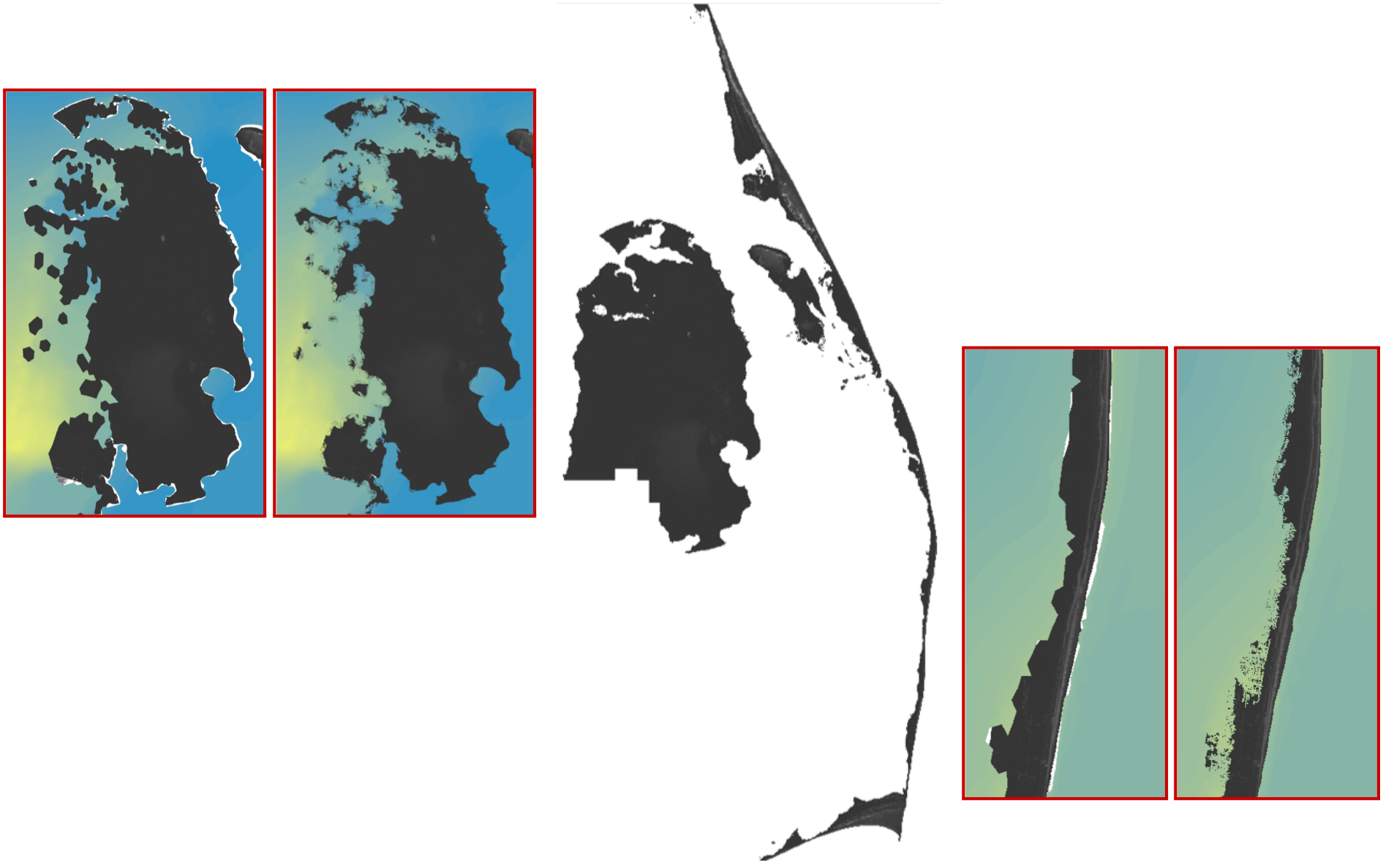

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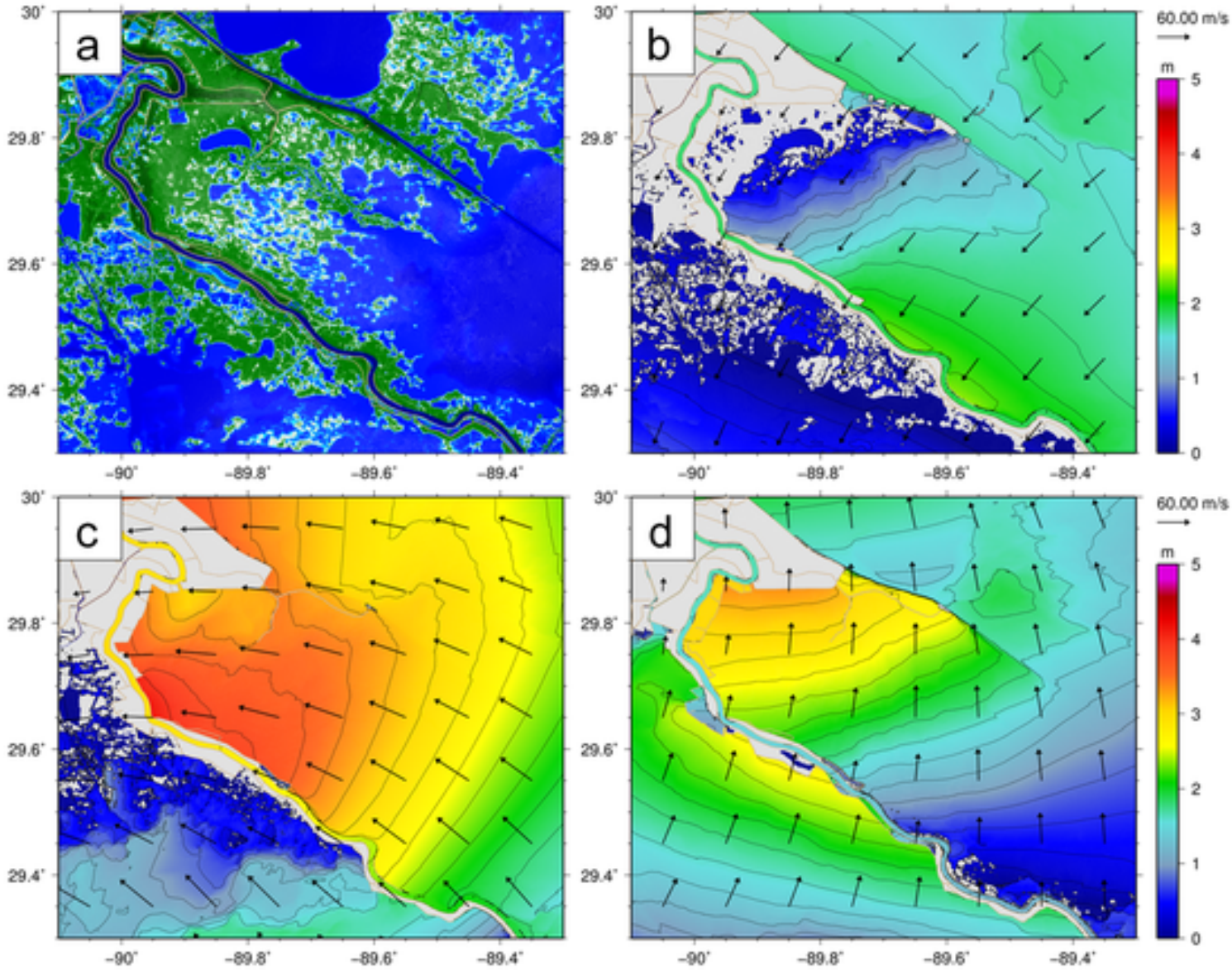

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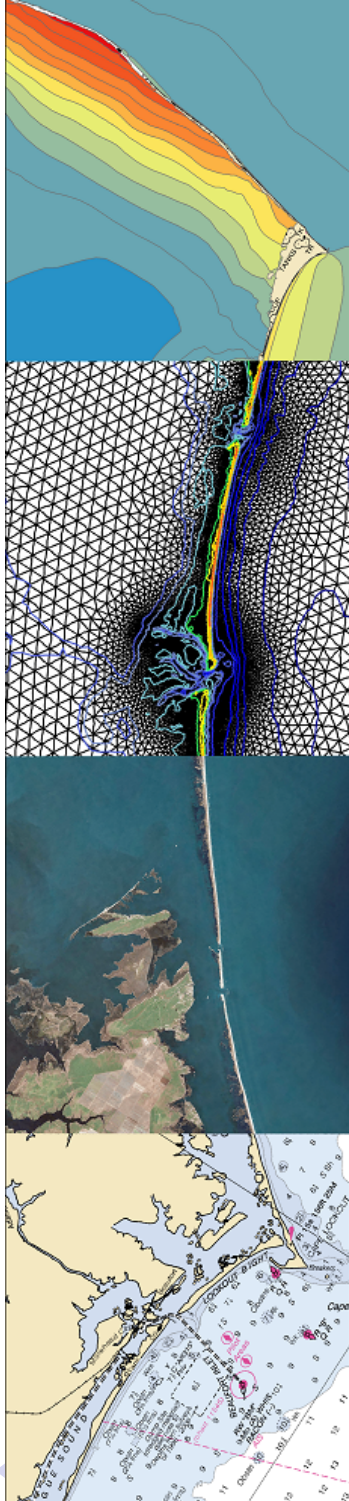

Summary and Discussion

How Can We Speed Up Our Coastal Flooding Models?

Can we be smarter in our use of HPC resources?

- Dynamic load balancing for wet/dry problems
- Initial speed-up of 20%, but should get even better
- May require a significant code re-write

Can we gain efficiency by coarsening our mesh?

- Sub-mesh-scale parameterizations?
- GIS techniques with simplified physics?