Future Issues of Risk within the Marine Transportation System

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US Army Corps of Engineers

ERDC

USACE: Cross-Mission Value to the Nation

- Commercial waterways convey 98% of U.S. Imports & exports
- 10,000+ acres wetlands restored/ year
- #1 Provider of outdoor recreation, contributing $16B to local economies
- 25% of U.S. hydropower capacity, 3% of total electricity

USACE: Water Resource Challenges

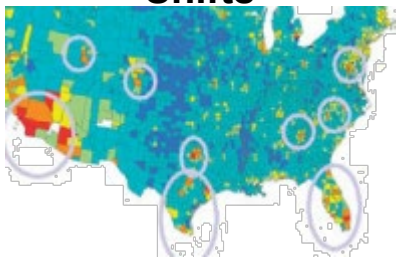
Climate Change

Environment

Governance Federal Budget

Declining Biodiversity

Demographic Shifts



R&D is Key to Addressing Challenges

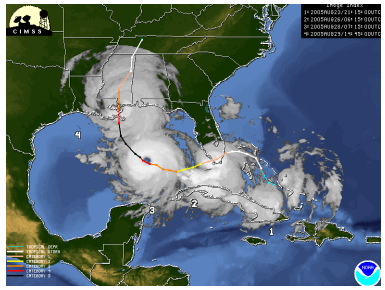
Aging Infrastructure

Globalization

Energy

Increasing demand for water

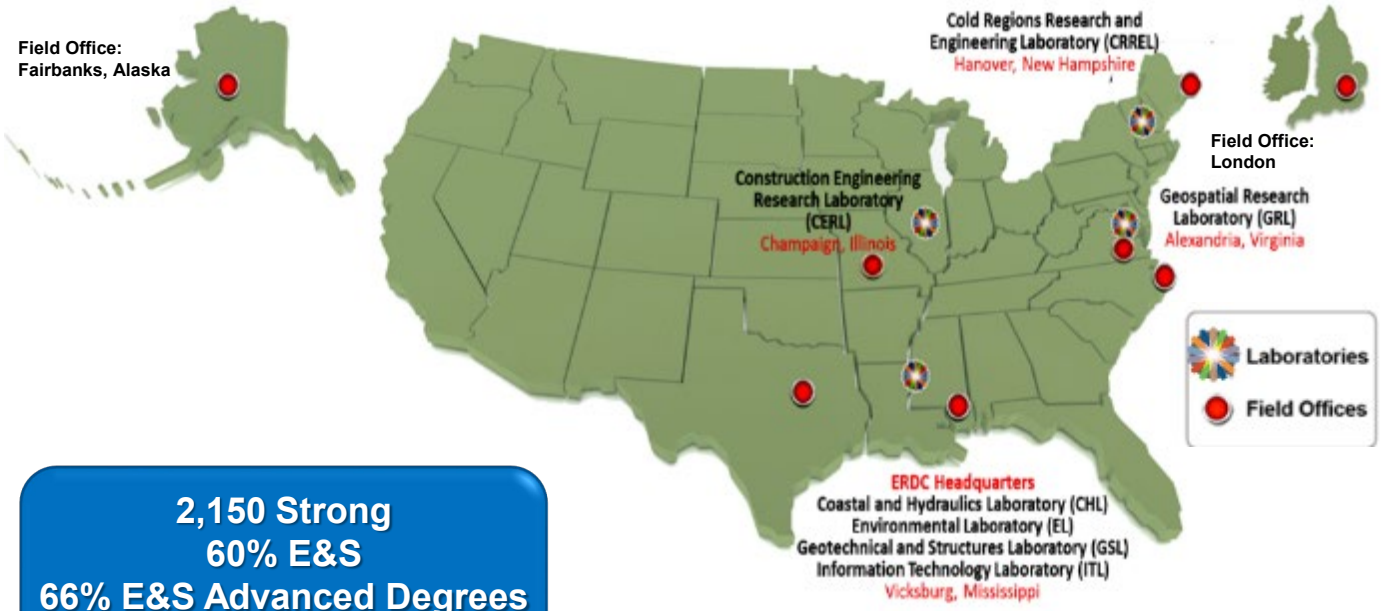
Disaster Preparedness and Response



Need integrated, cross-mission solutions that *quantify present & future impacts, benefits*

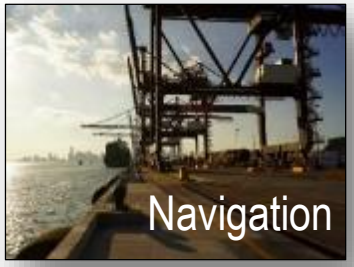
Engineer Research & Development Center

ERDC Vision: To be a World Class Research & Development Organization that **Discovers, Develops & Delivers** New Ways to Make the World Safer and Better Every Day



2,150 Strong
60% E&S
66% E&S Advanced Degrees
31% PhD

Civil Works R&D



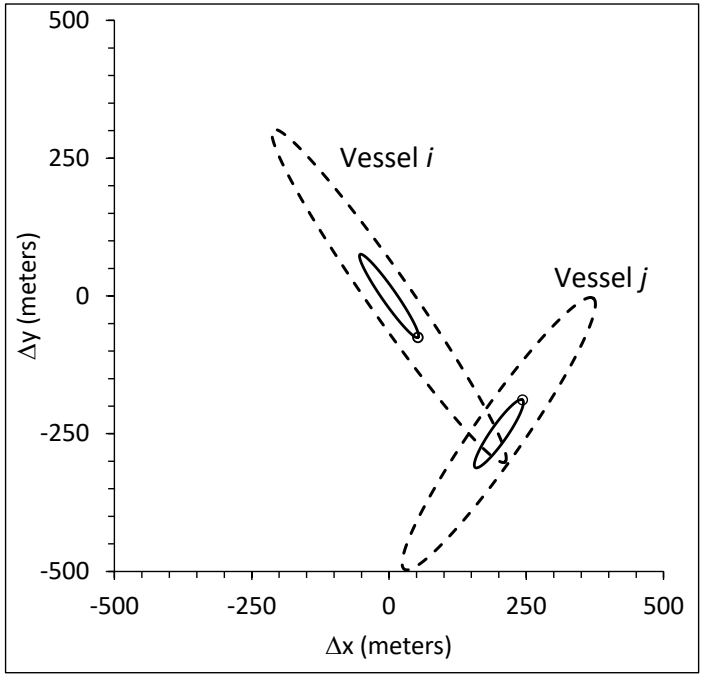
Navigation Risk - Continuum

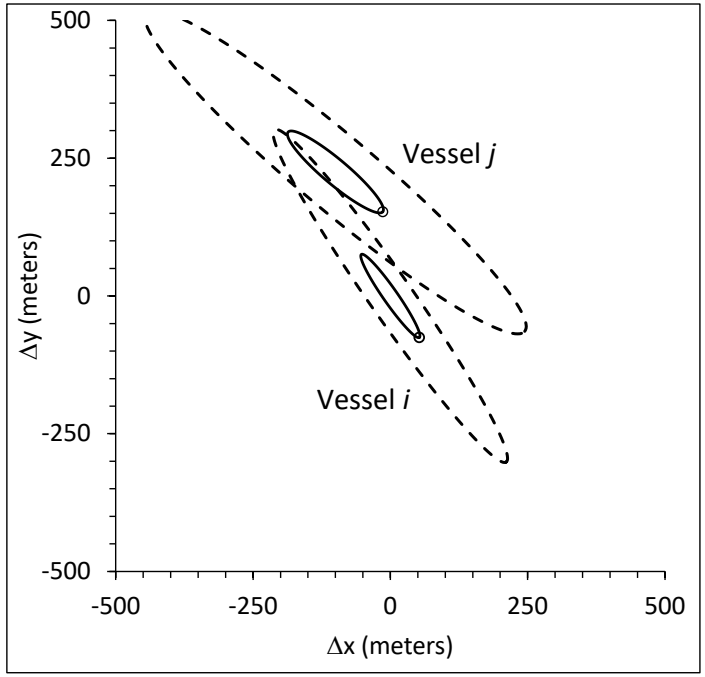
- **Measuring**
  - **Identifying types of risk, locations, behaviors, and areas for further study. Quantitative methods exist for certain types of navigational risk.**
- **Monitoring**
  - **Establishing systems to reliably monitor and provide situation reports at the necessary time scale.**
- **Managing**
  - **Intelligently combining monitoring data with historically-informed situational understanding to minimize risk when possible.**
- **Anticipating**
  - **Forward-looking and worst-case scenario exploration to inform planning, practice, and investment.**

Measuring Maritime Risk: Historical

- Traditional approaches to maritime risk assessment are subjective and qualitative.
- Quantitative assessments of risk are needed to identify priorities and justify investment.
- Ship domain violations (SDV) can be quantified using Automatic Identification System (AIS) data from the USCG Nationwide AIS archive.
- Ship's domain is a pre-defined perimeter area around the actual ship itself, user-defined

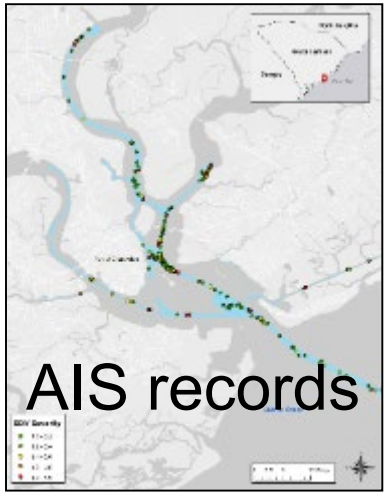
Ship domain violations occur when two domains overlap – no fault is implied.



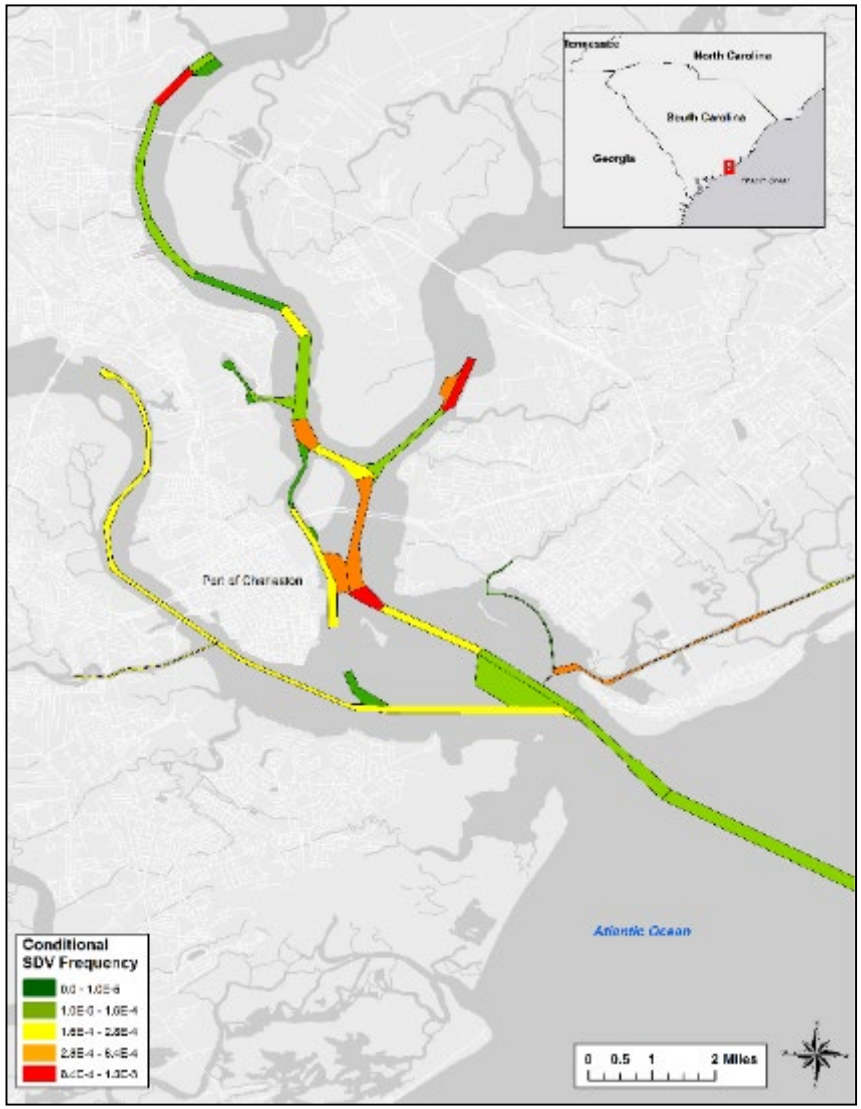


Risk Assessment: Historical → Future

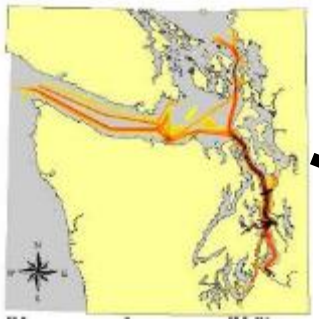
- A year of AIS data was used to locate SDVs and calculate a risk metric: ***Probability that a vessel operating in a reach will be involved in an SDV.***
- Compare and rank channel reaches based on the probability of an SDV.
- In Charleston Harbor, a vessel transiting in a **RED reach is about 10 times more likely to be involved in an SDV** than a vessel transiting in a GREEN reach.



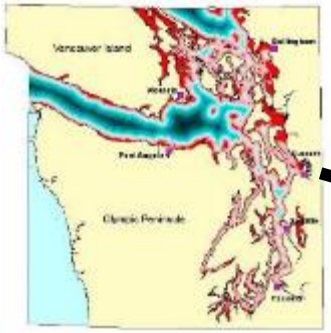
Identify risk 'hot spots'



Monitoring Risk in Real-Time: multiple factors

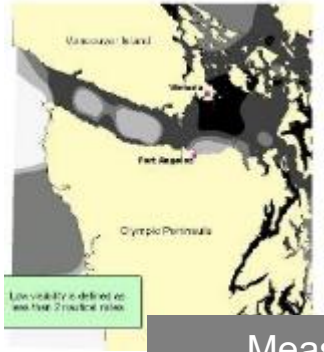


Vessel density

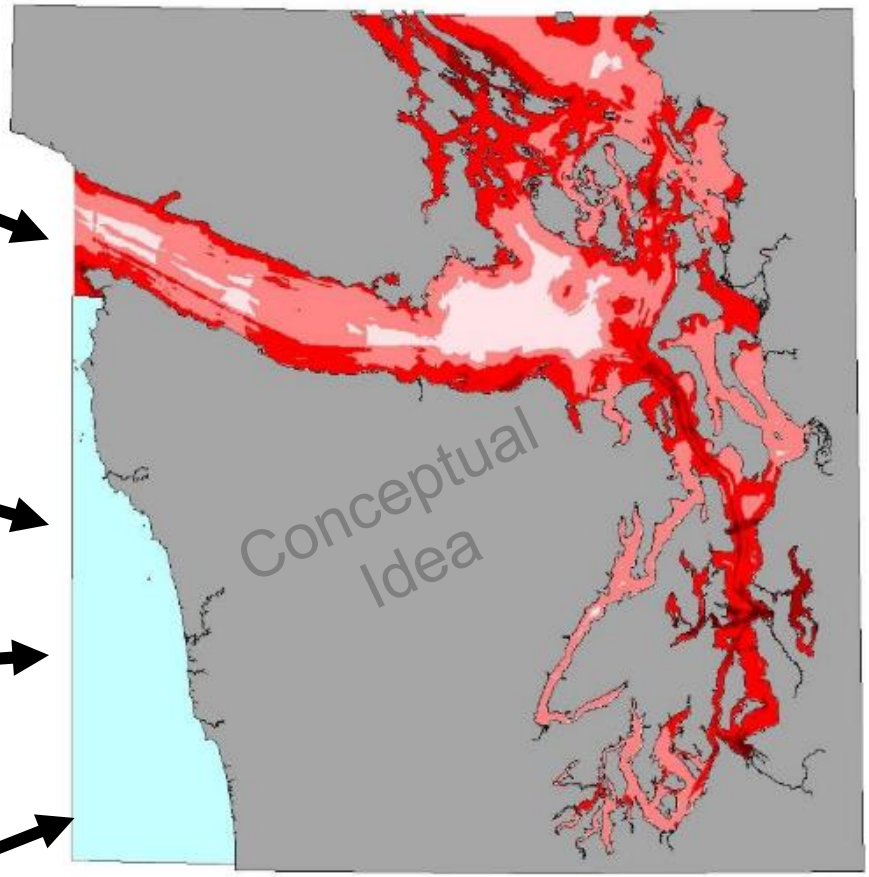


Shoal water

High currents



Low visibility



Overall risk “heat map”

Challenges:

- Data Availability and suitability for analytics
- Processing capability
- How to communicate risk

Monitor+Manage: Communicating and Anticipating Risk in Real-Time

AIS GEOGRAPHIC NOTICE **ADVISEMENT**

Restriction: Entry prohibited

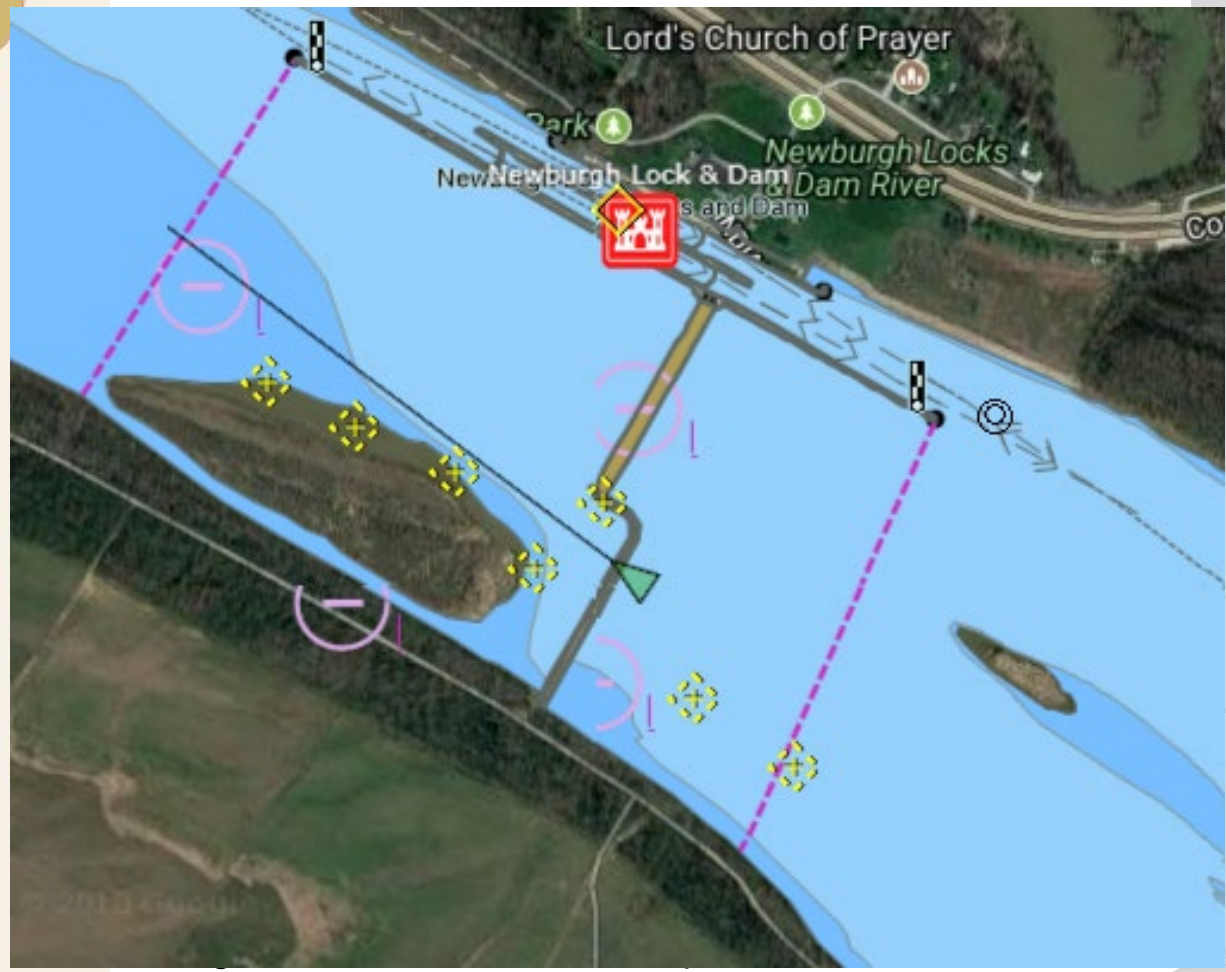
BNM 0273-19

START **2019-05-05 17:00:00**

END **2019-05-11 23:59:00**

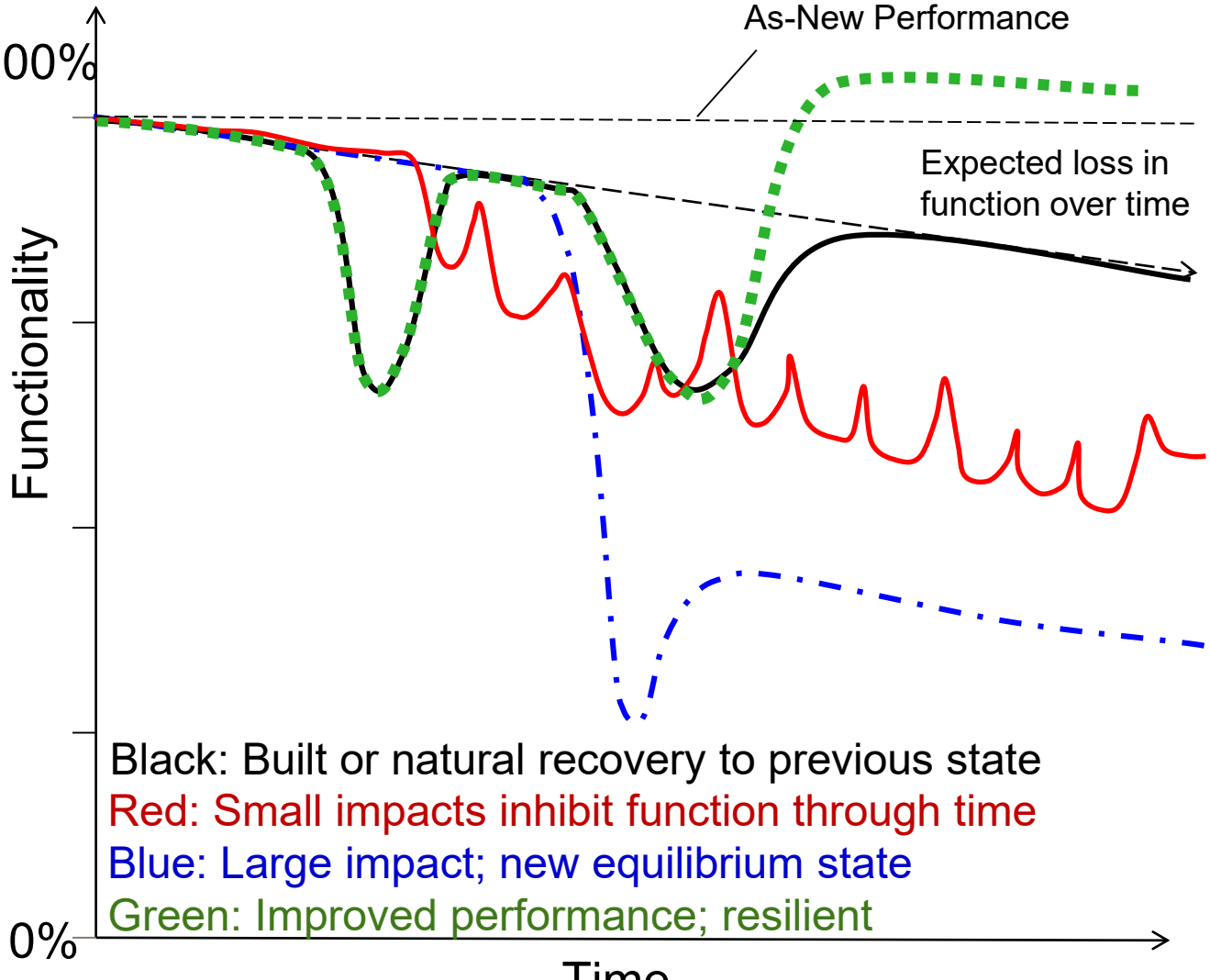
MMSI **003660654** LINKAGE ID 3

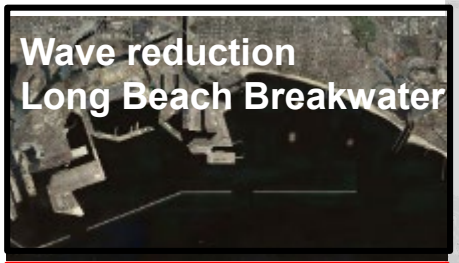
"Virtual" AtoN mark new channel



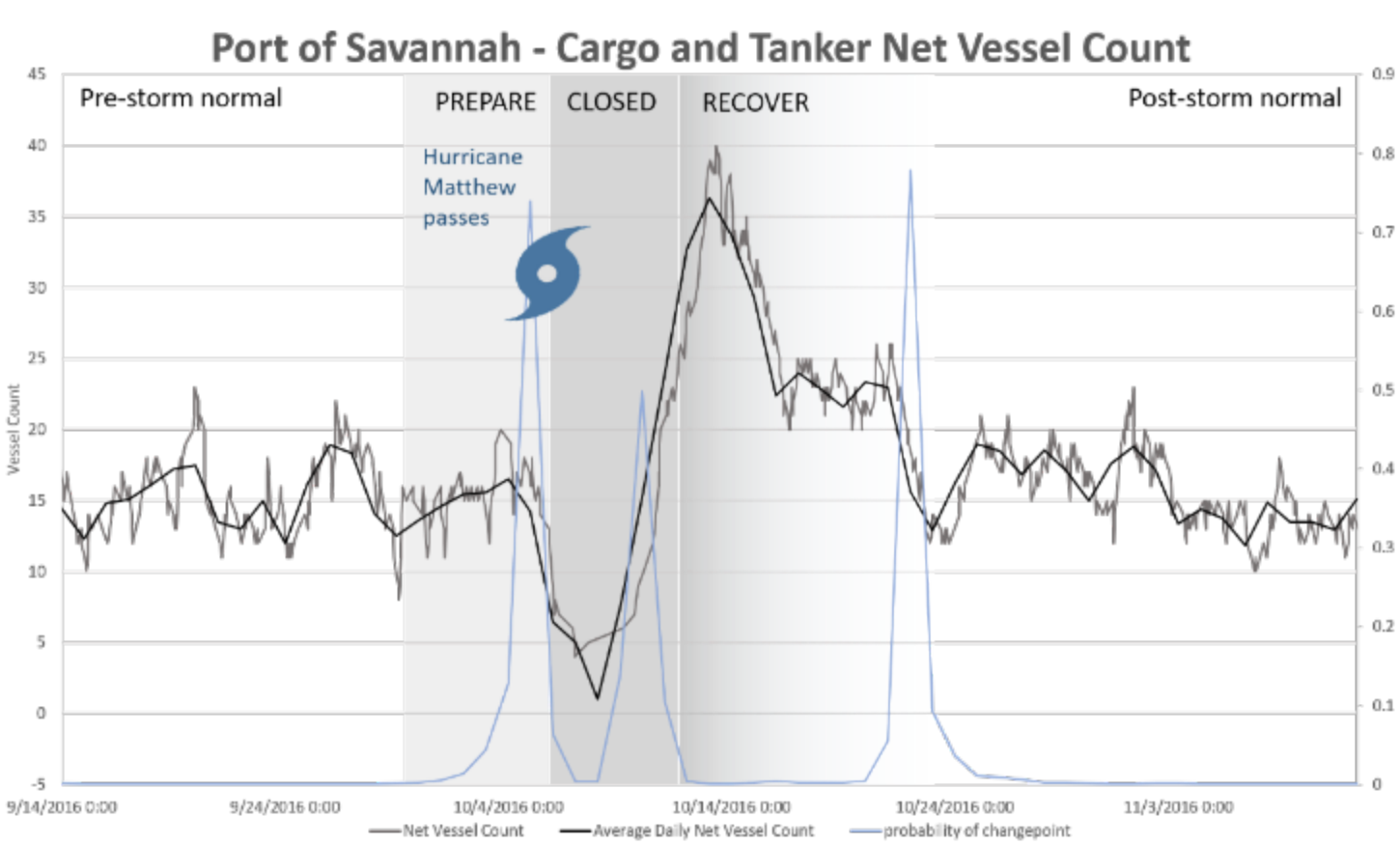
Measuring | Monitoring | Managing | Anticipating

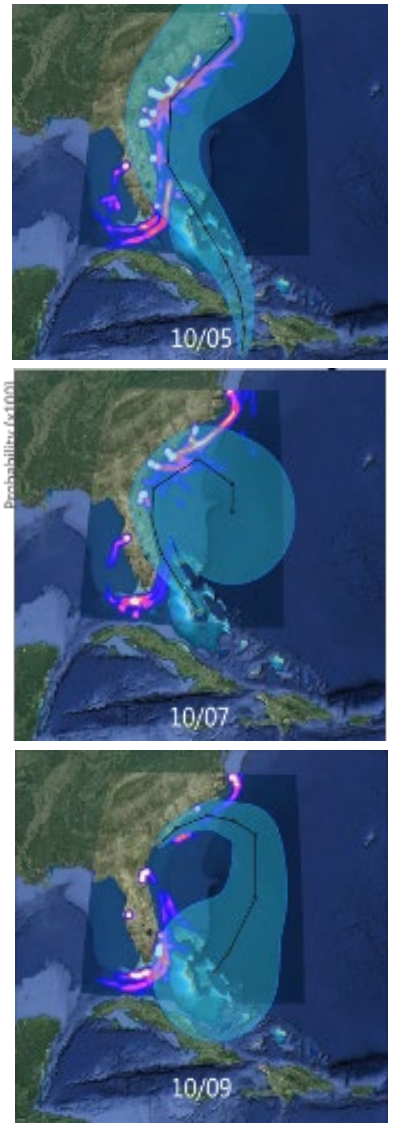
Managing Maritime Risk – Making Improvements Over Time → Resilience





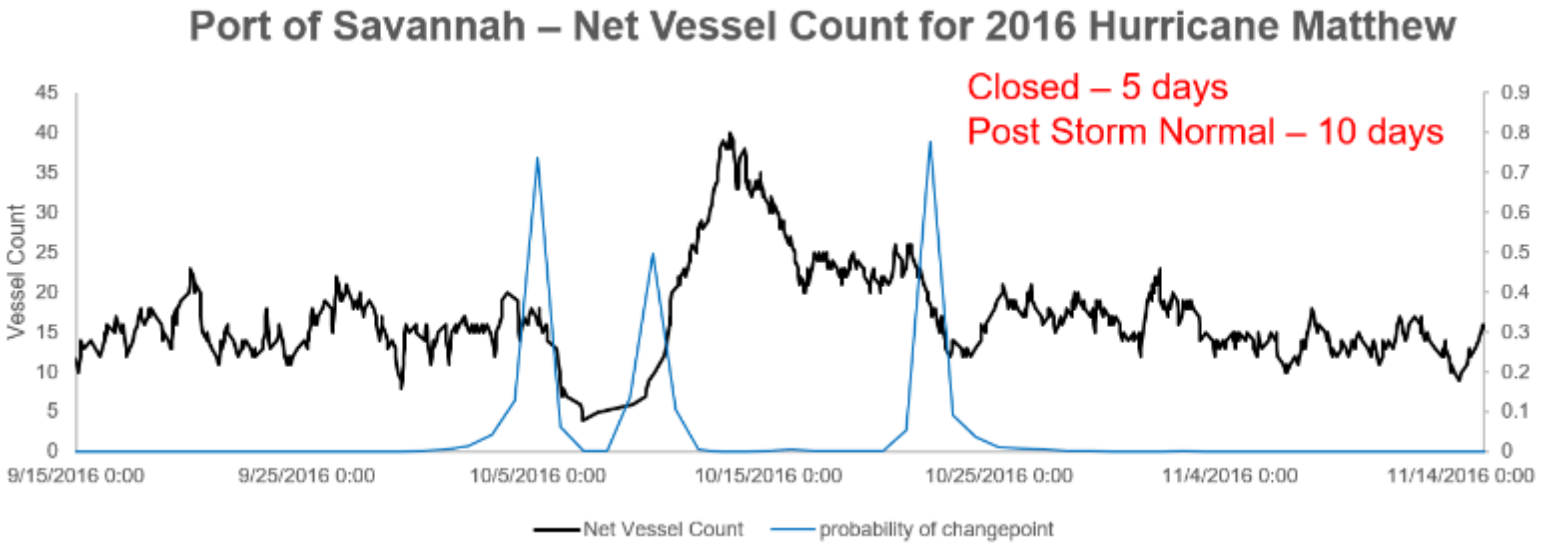
Resilience Metrics and Indices: Matthew (2016)

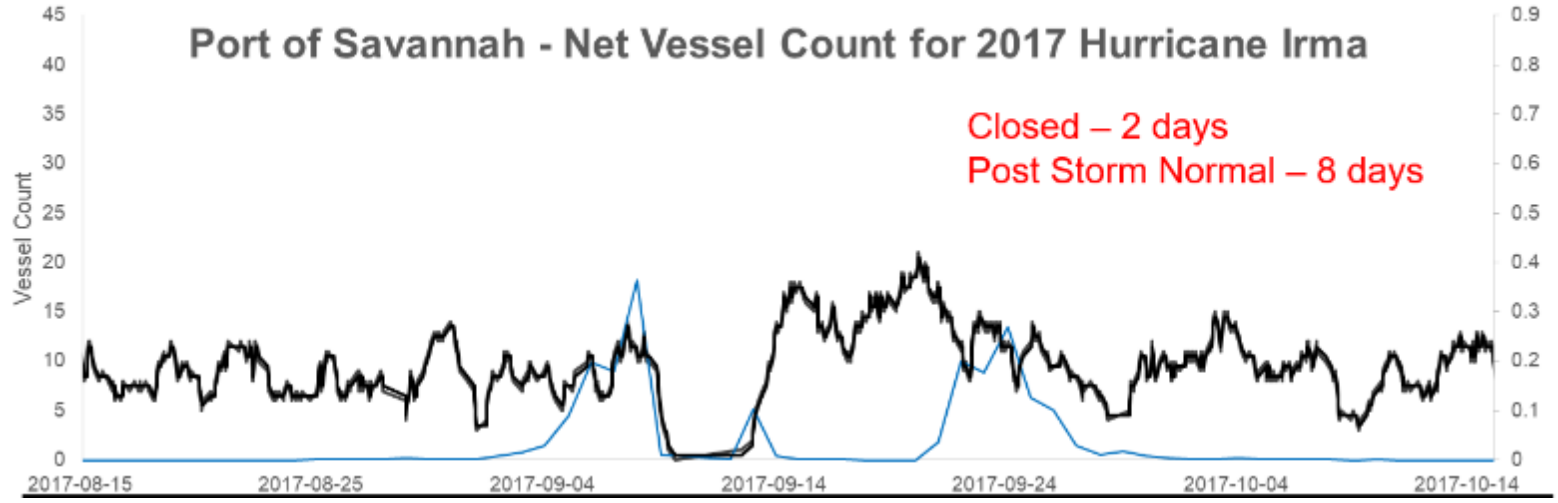




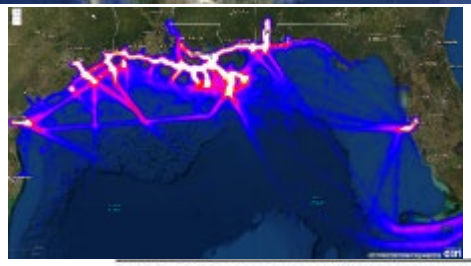
- Understand baseline function of our navigation systems and the impacts of disruptions
- Evaluate and monitor project performance in real-time

Resilience Metrics and Indices: Port of Savannah, *Matthew* (2016) and *Irma* (2017)

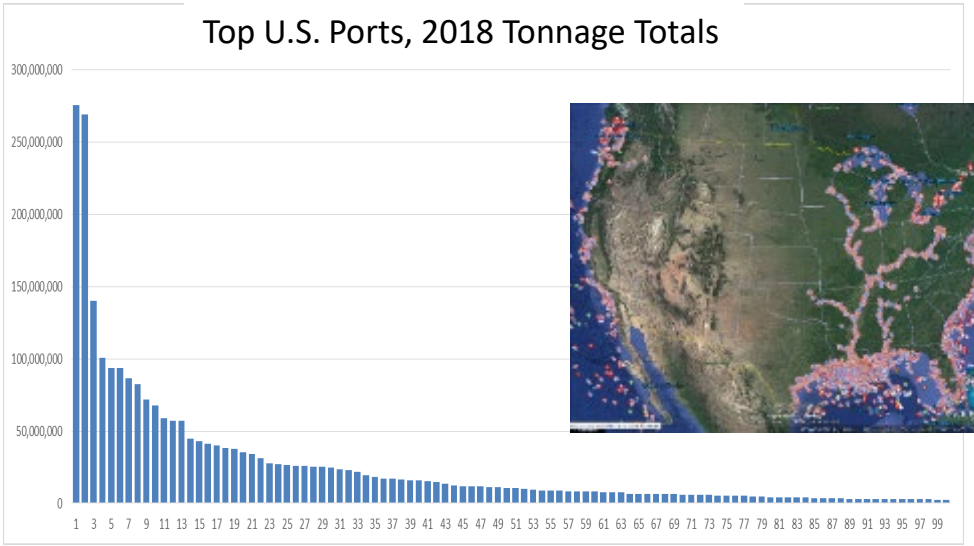




US Marine Transportation System



- MTS and national freight network are both characterized by a relative handful of dominant cargo arteries and traffic chokepoints.
- Prolonged disruptions at these key locations could dramatically impact overall system response.



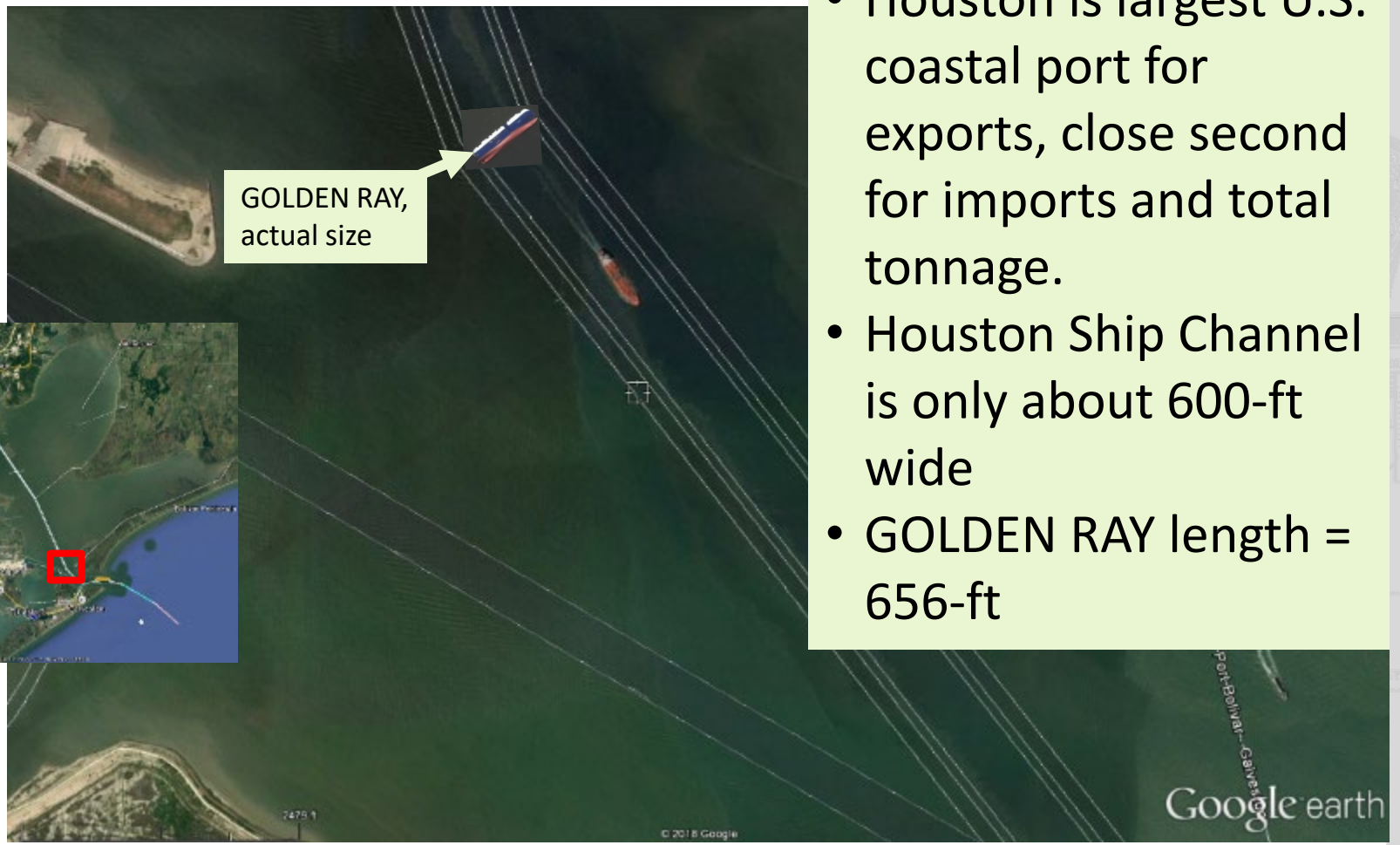
Anticipating Risk: Golden Ray Capsizing

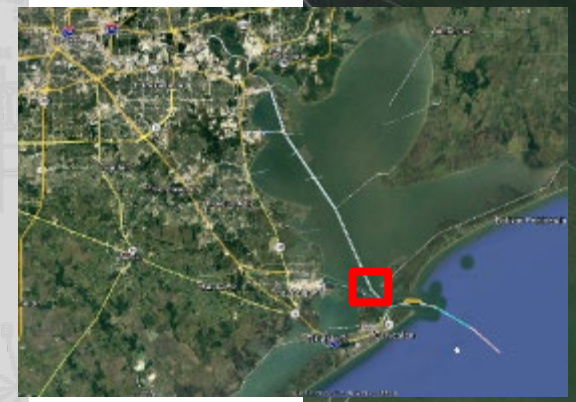
8 Sep 2019

Source: Savannah Morning News

- Pilot's decision to guide vessel out of channel credited with keeping the Port of Brunswick open during months-long salvage operation.
- Among U.S. coastal ports, Brunswick ranks 67th overall for tonnage, but is the 8th largest port for vehicle (roll-on/roll-off) cargo.
- Bad situation, but could have been so much worse…

Anticipating Risk: What if capsizing happened in Houston's Navigation Channel?





- Houston is largest U.S. coastal port for exports, close second for imports and total tonnage.
- Houston Ship Channel is only about 600-ft wide
- GOLDEN RAY length = 656-ft

Future: Improve First-Responder Coordination to High-Impact Maritime Events

- Utilize coupled multiple ship simulators
- Evaluate multi-vessel natural disaster & terrorism threats
  Apply to high-use MTS bottlenecks and choke-points
- Build best practice protocols for multi-agency response