



Future Issues of Risk within the Marine Transportation System

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US Army Corps
of Engineers



USACE: Cross-Mission Value to the Nation



3% of Nation's
Electricity:
\$800 M + in
sales

Stewardship
of
11.7 M Acres
Public Lands

926
Harbors

Environmental
Restoration

12,000 miles of
Commercial
Inland
Waterways

400 miles
of
Shoreline
Protection

~11,750 miles
of Levees

Recreation
Areas
370 M
visitors/yr

Emergency
Responses

68,800
Regulatory
Permit
Actions

- 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



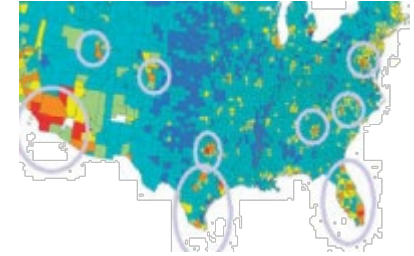
Governance
Federal Budget



Declining
Biodiversity



Demographic
Shifts



R&D is Key to Addressing Challenges

Aging Infrastructure



Globalization



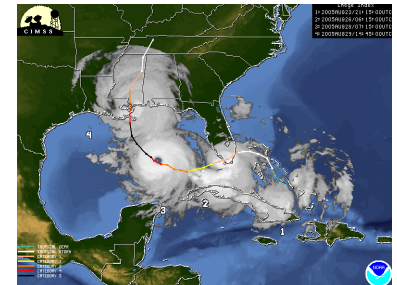
Energy



Increasing demand
for water



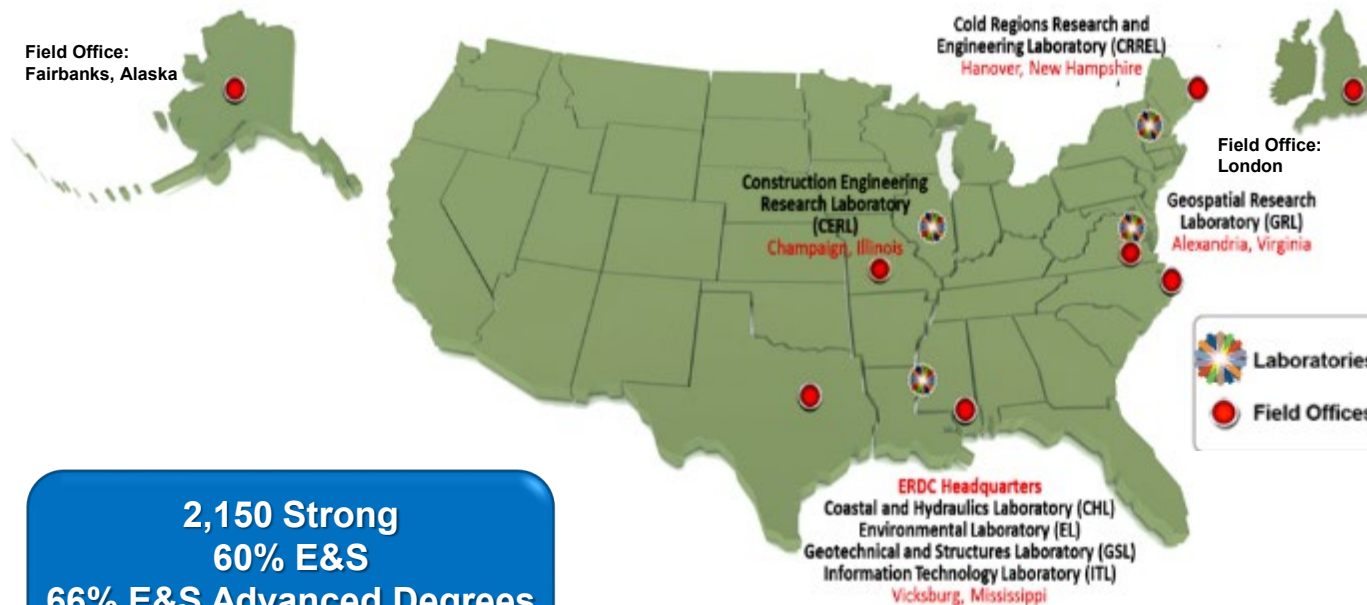
Disaster Preparedness
and Response



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

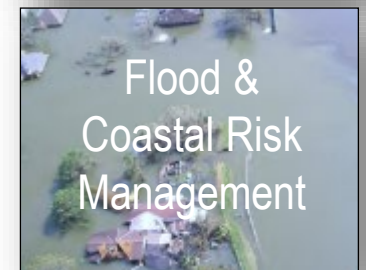
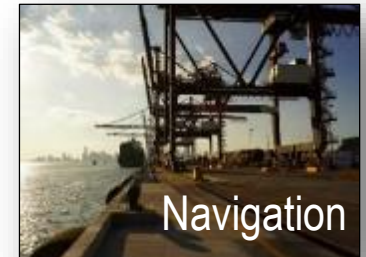
Engineer Research & Development Center

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.

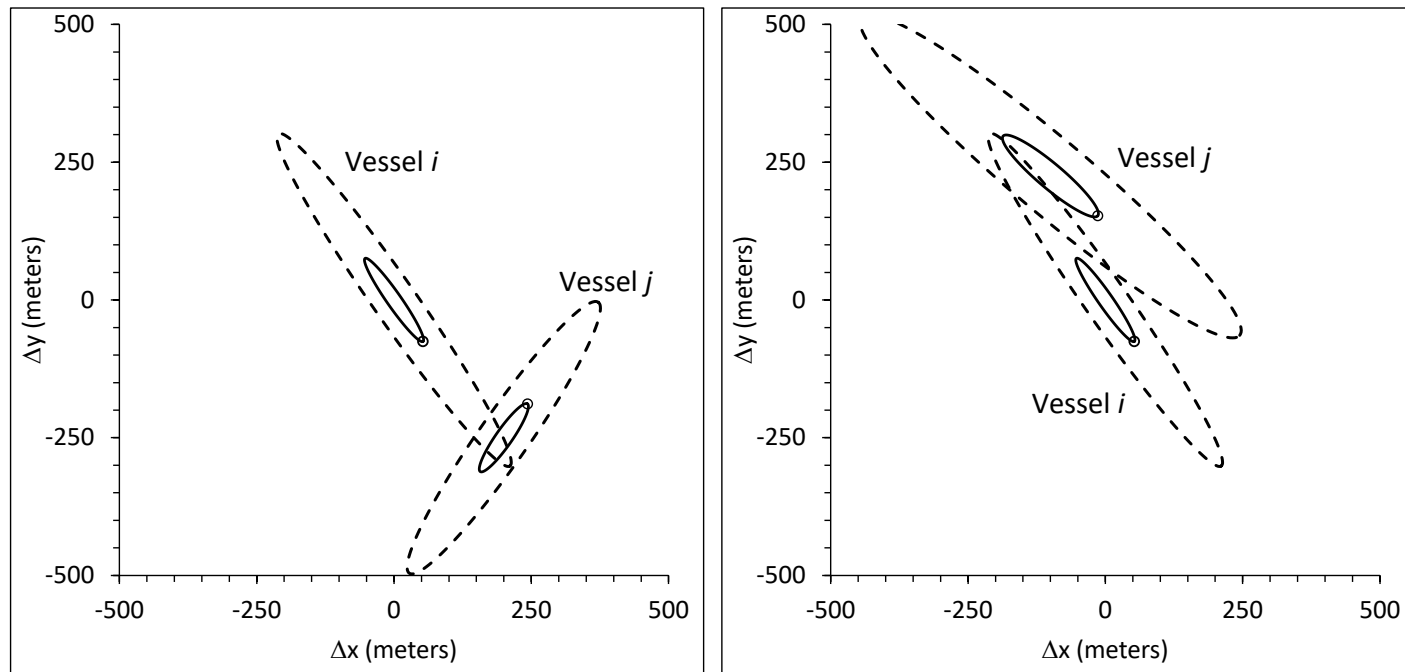
- **Anticipating**

- 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.



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Measuring

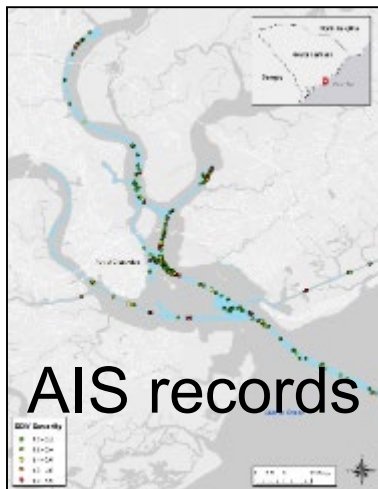
Monitoring

Managing

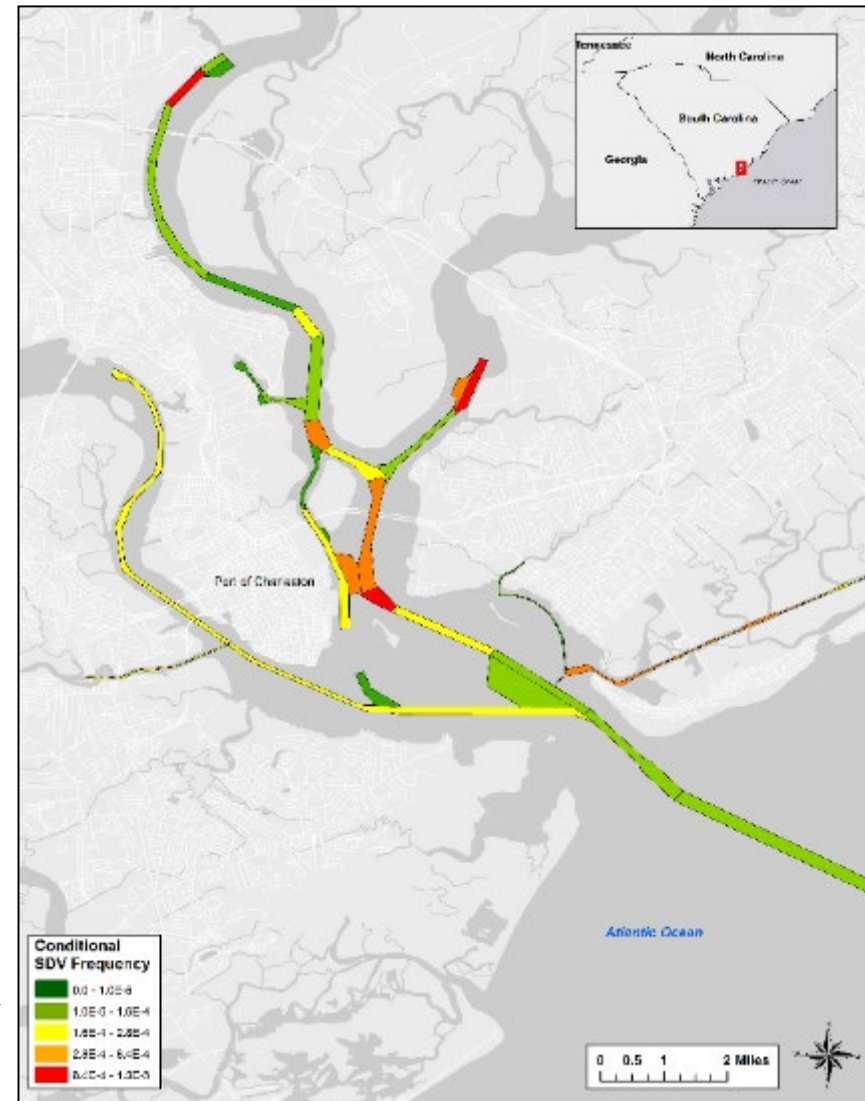
Anticipating

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'



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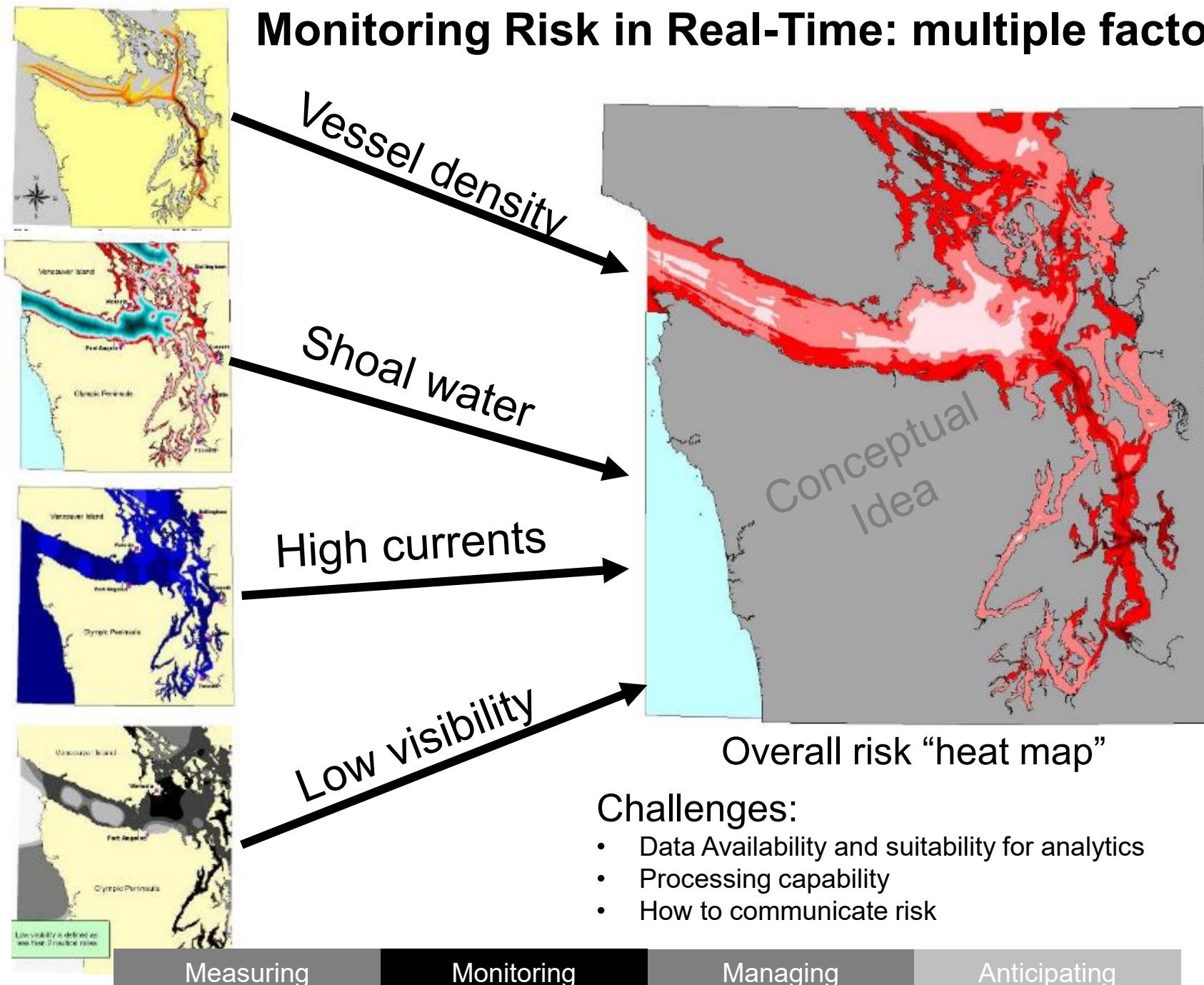
Measuring

Monitoring

Managing

Anticipating

Monitoring Risk in Real-Time: multiple factors



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



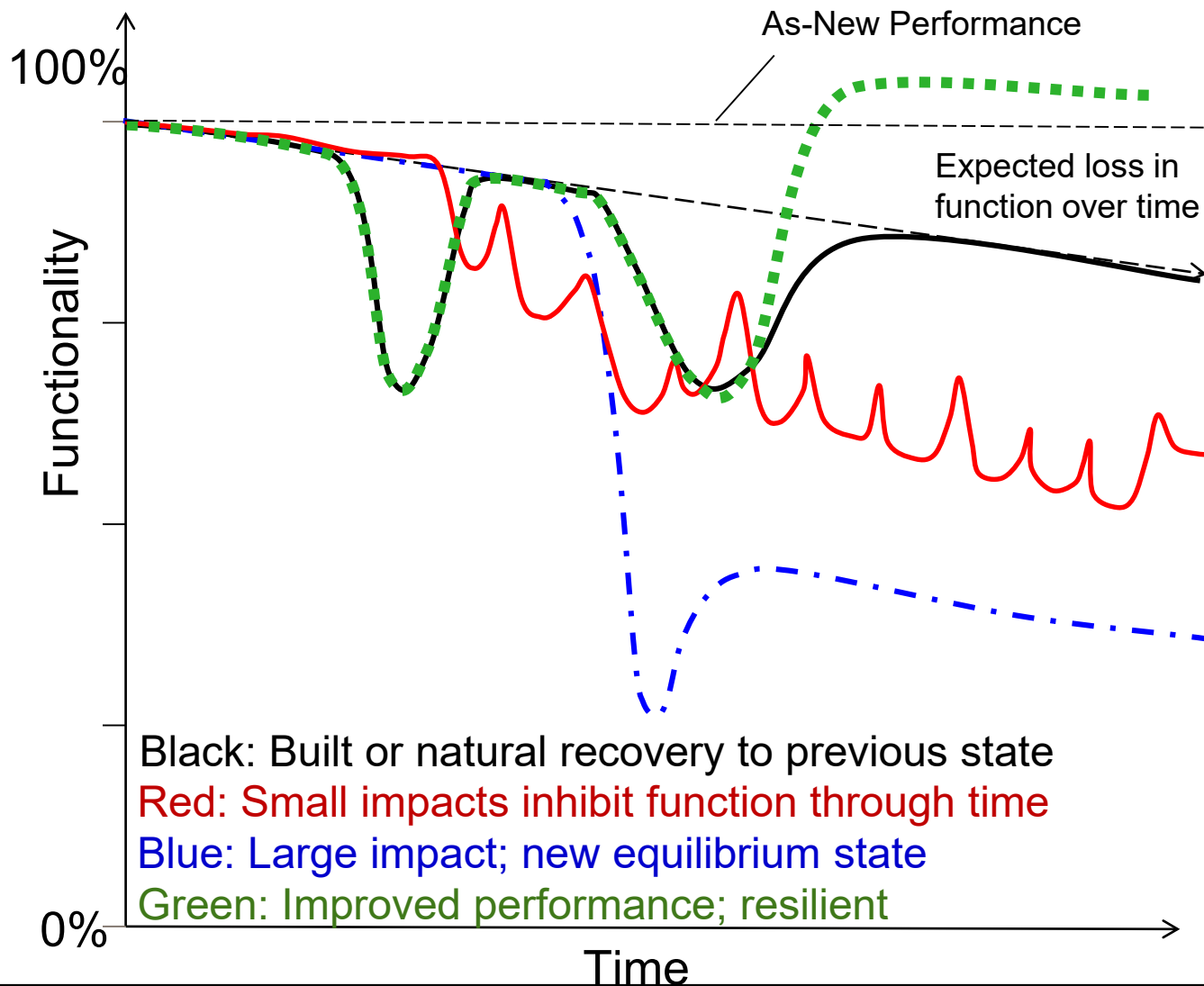
Measuring

Monitoring

Managing

Anticipating

Managing Maritime Risk – Making Improvements Over Time → Resilience



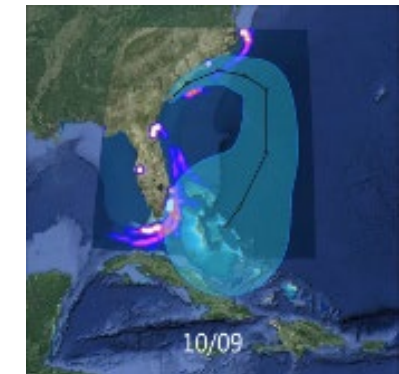
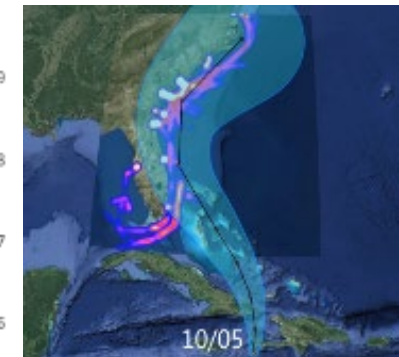
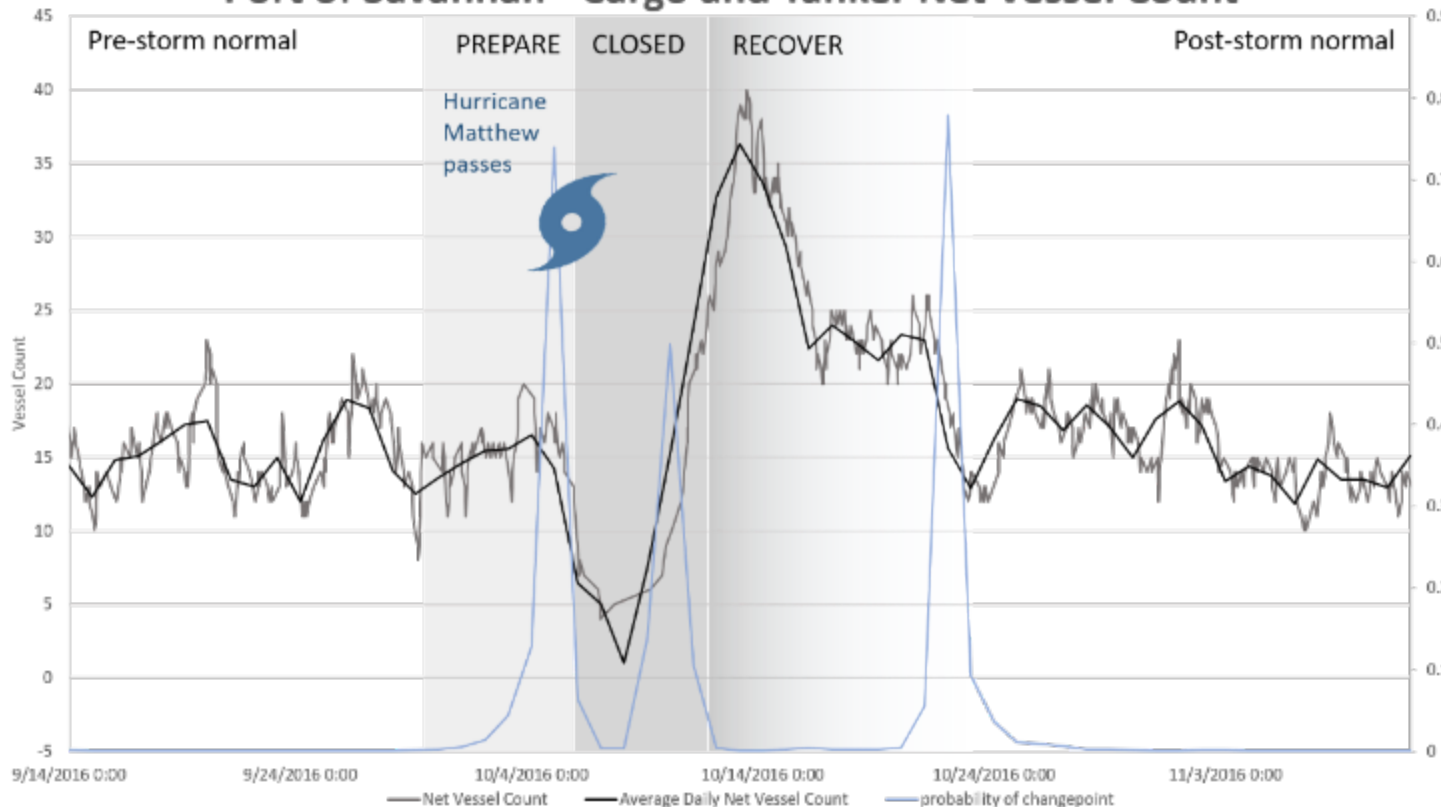
Wave reduction
Long Beach Breakwater

Nuisance flooding
Naval Station Norfolk

Port of Gulfport
Hurricane Katrina

Resilience Metrics and Indices: Matthew (2016)

Port of Savannah - Cargo and Tanker Net Vessel Count



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

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Measuring

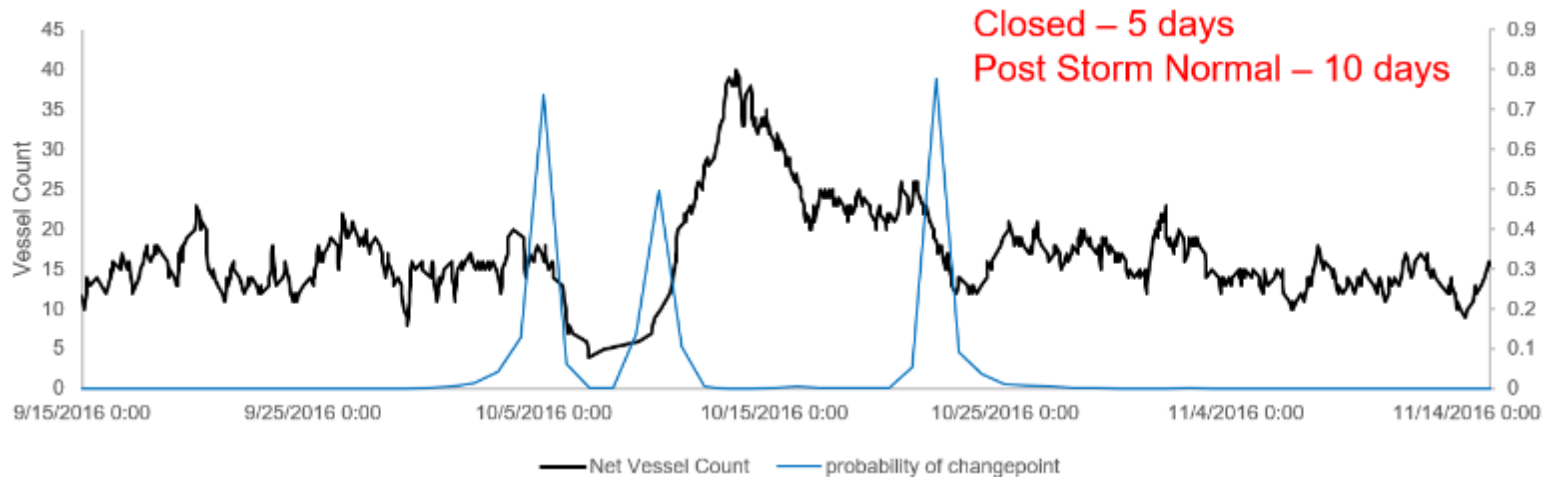
Monitoring

Managing

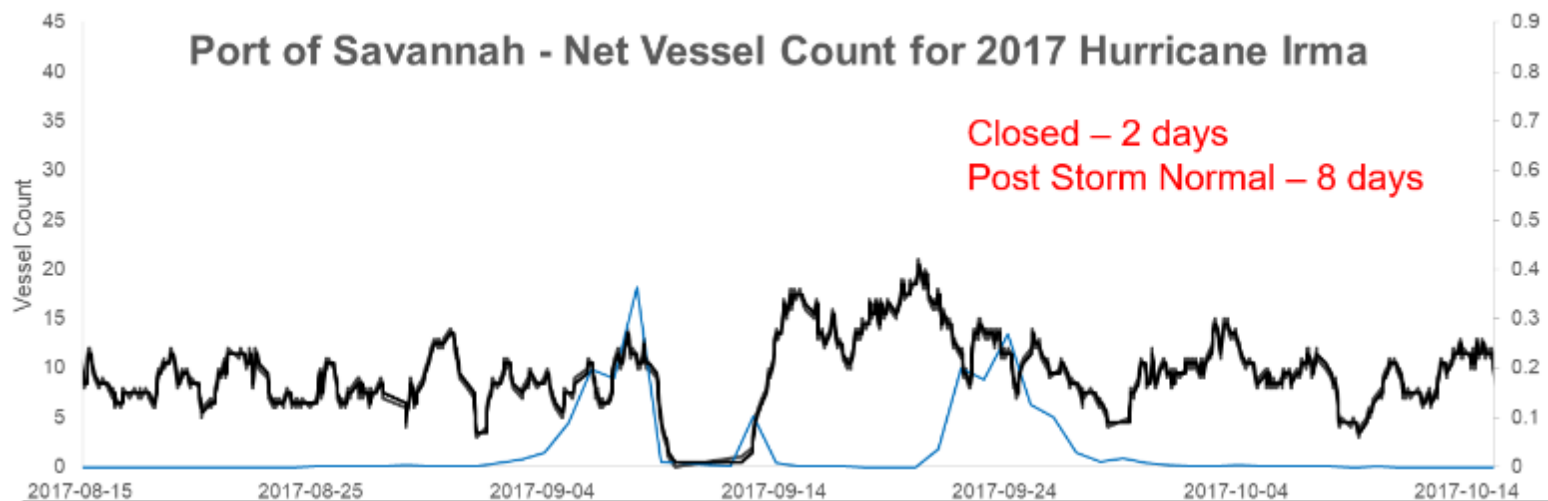
Anticipating

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

Port of Savannah – Net Vessel Count for 2016 Hurricane Matthew



Port of Savannah - Net Vessel Count for 2017 Hurricane Irma



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Measuring

Monitoring

Managing

Anticipating

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.

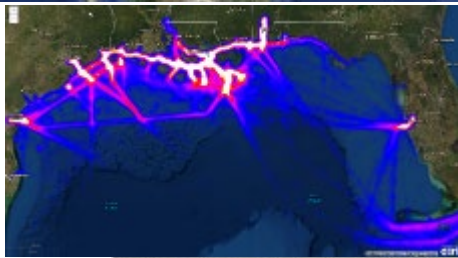
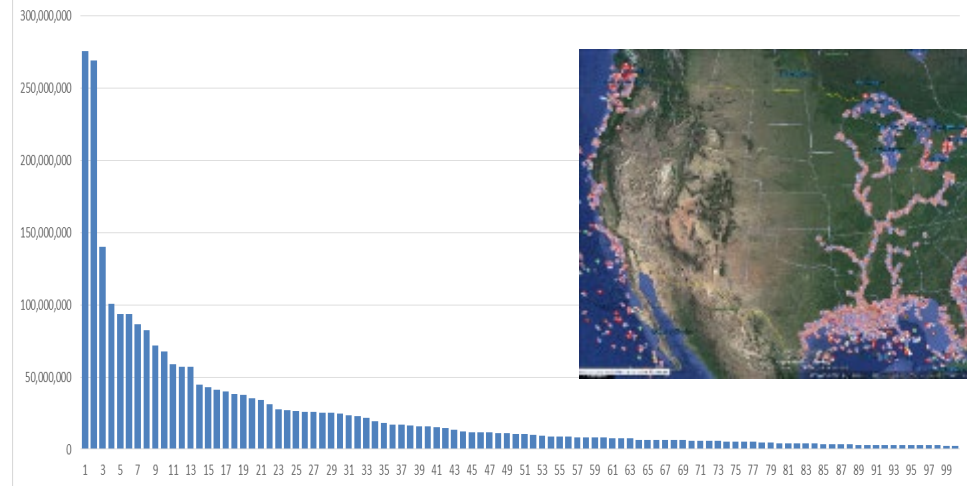


Exhibit 1-22 Tonnage on Highways, Railroads, and Inland Waterways, 2007



Sources: Highways—U.S. Department of Transportation, Federal Highway Administration, Freight Analysis Framework, Version 2.2, 2010. Rail—Based on Surface Transportation Board, Annual Railroad Waybill Sample and rail freight flow assignments done by Oak Ridge National Laboratory. Inland Waterways—U.S. Army Corps of Engineers (USACE), Annual Vessel Operating Activity and Lock Performance Monitoring System data, as processed for USACE by the Tennessee Valley Authority, and USACE, Institute for Water Resources, Waterborne Foreign Trade Data. Water flow assignments done by Oak Ridge National Laboratory.

Top U.S. Ports, 2018 Tonnage Totals



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Measuring

Monitoring

Managing

Anticipating

Anticipating Risk: Golden Ray Capsizing

8 Sep 2019



Port of Brunswick, GA

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...

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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

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Measuring

Monitoring

Managing

Anticipating