Understanding Marine Transportation System Resilience – An Overview of Activities from the 2017 Hurricane Season

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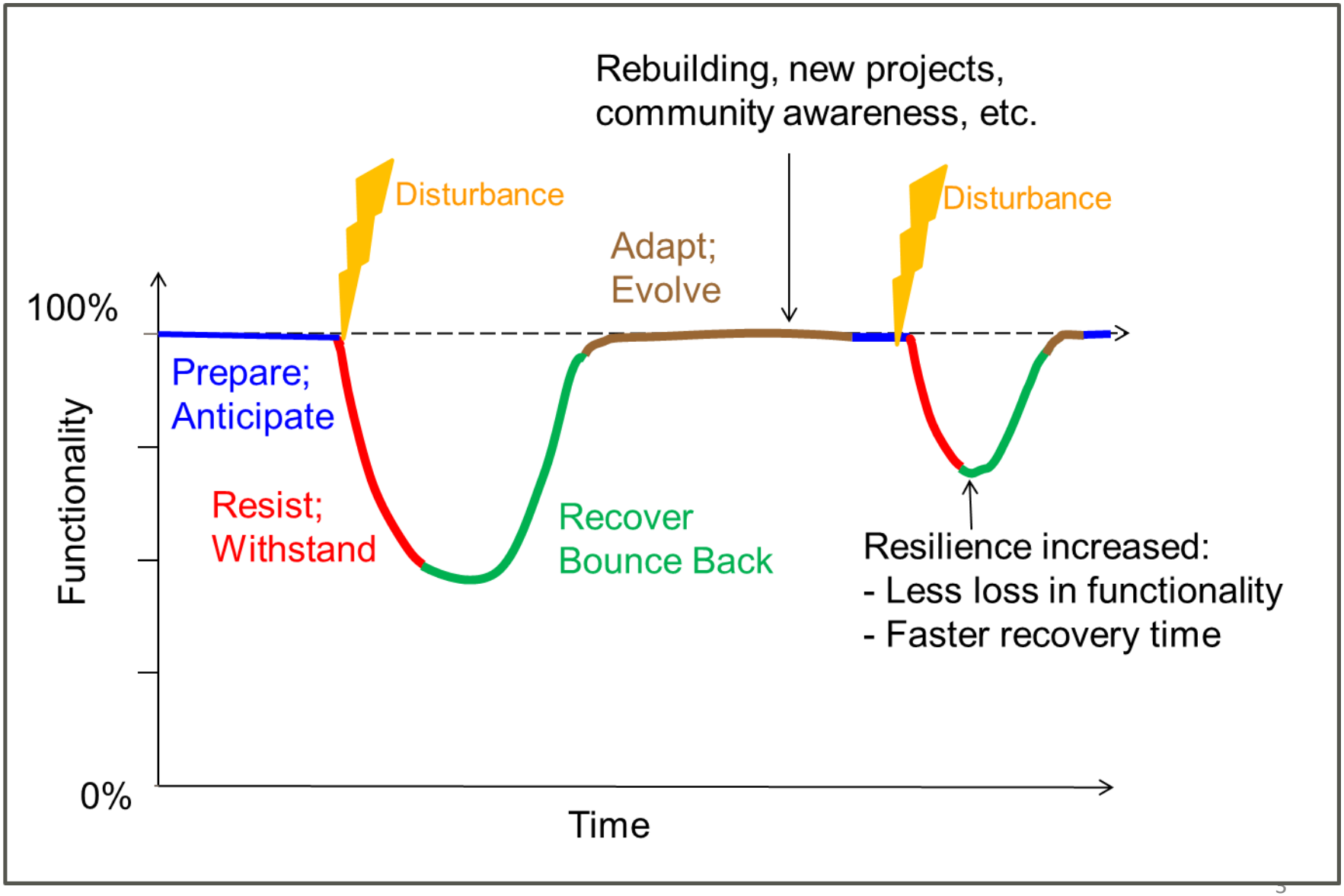
Presentation Overview

- Report - The 2017 Hurricane Season: Recommendations for a Resilient Path Forward for the Marine Transportation System
- 2017 Hurricane Season Data Gathering
- Port Resilience Assessment and Decision Guide

Resilience Over Time



Cycle of Resilience

Through data and experts elicitation, we can gather information on *how* the MTS was able to Resist and Recover to inform future Adaptation and Preparation

- Key actions or decisions
- Datasets to aid critical actions and decisions
- Interdependencies with non-feds
- Best practices
- Opportunities to increase resilience

U.S. Committee on the Marine Transportation System Resilience Integrated Action Team (R-IAT)

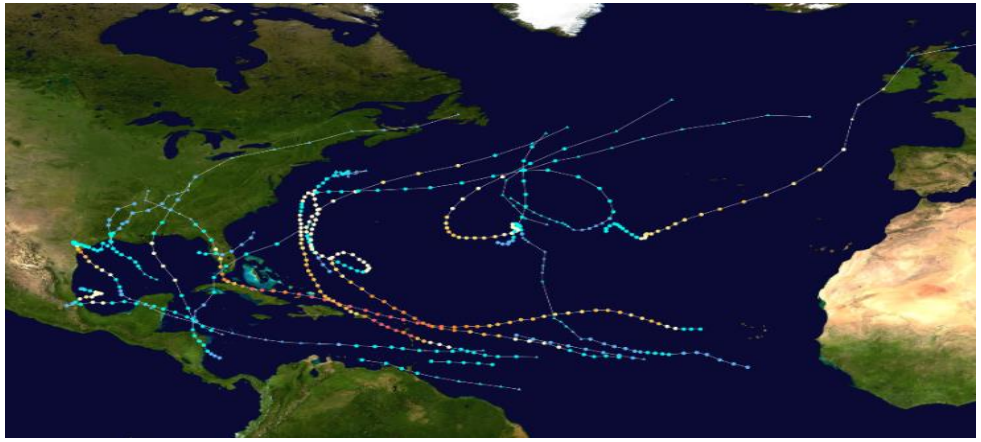
Katherine Chambers (ERDC-CHL) presents hurricane analysis results to the U.S. Committee on the Marine Transportation System Coordinating Board

- R-IAT requested by the Coordinating Board to ID lessons learned from 2017 hurricane season
- 12 member agencies
- 1 workshop with 35 workshop attendees
- Team co-lead by USACE-ERDC and NOAA

2017 Hurricane Season

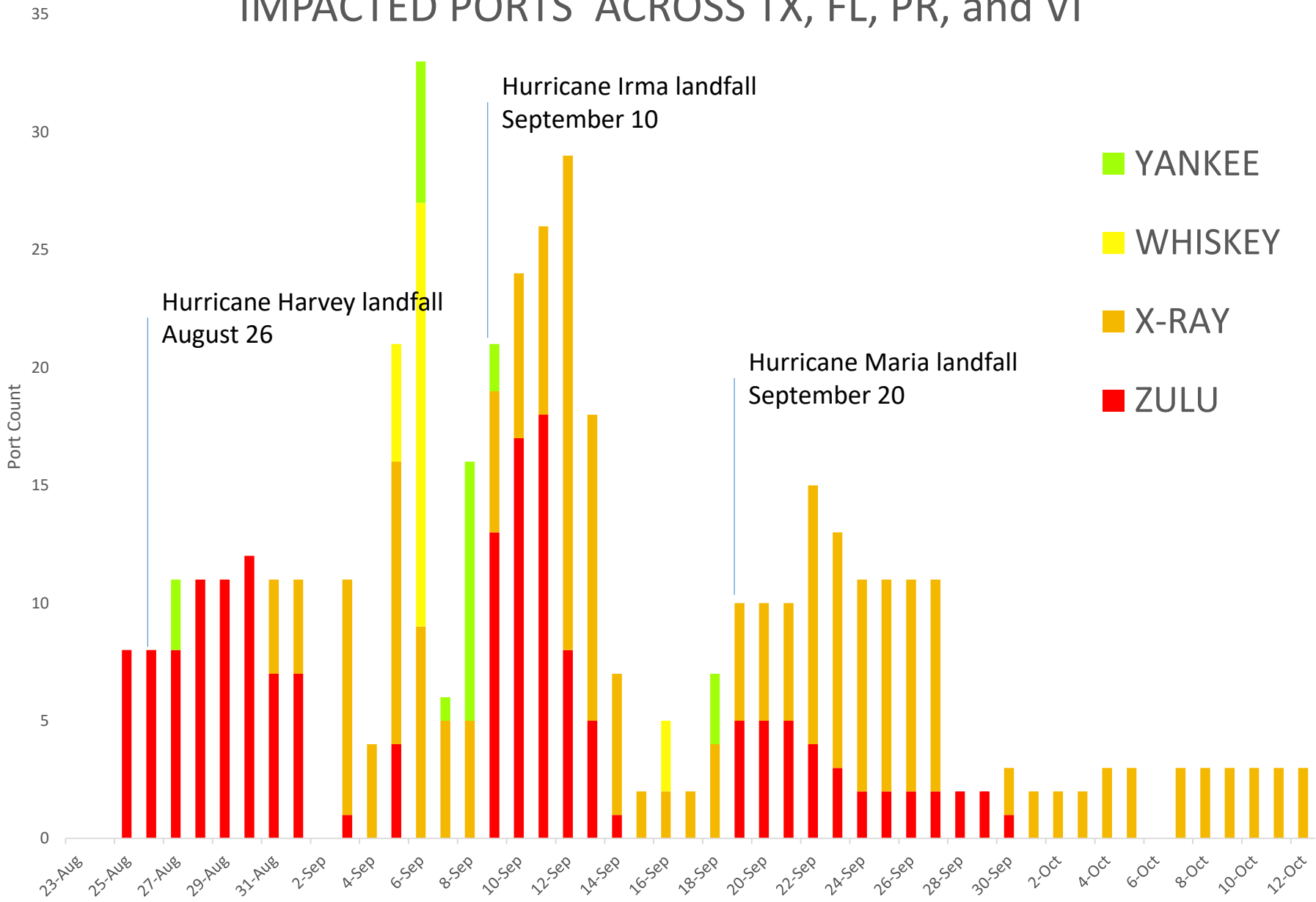
- 17 named storms
- 7 U.S. landfalling storms
  - 3 major hurricanes: Harvey, Irma, Maria
- 25.8 million people affected
- 4.6 million registered for federal assistance with FEMA
- Weather events in 2017 amounted to $306.2 billion in cumulative costs which included hurricanes Harvey ($125B), Irma ($50B), and Maria ($90B)*

Satellite image of three hurricanes in the Atlantic at once on Sept. 8: Katia, Irma and Jose. (NOAA/NASA)



* NOAA Office for Coastal Management, Fast Facts: Hurricane Costs.

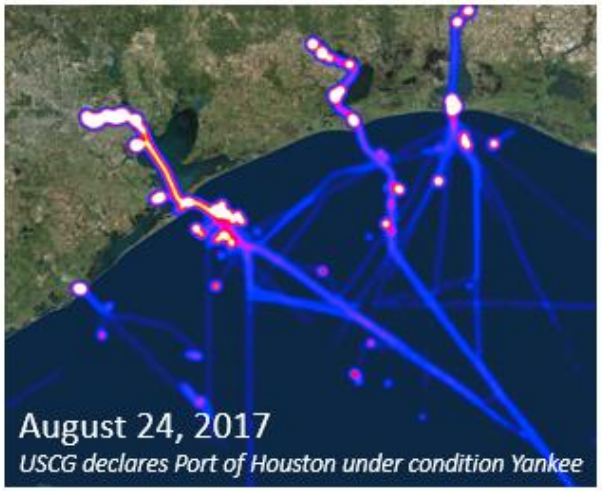
IMPACTED PORTS ACROSS TX, FL, PR, and VI

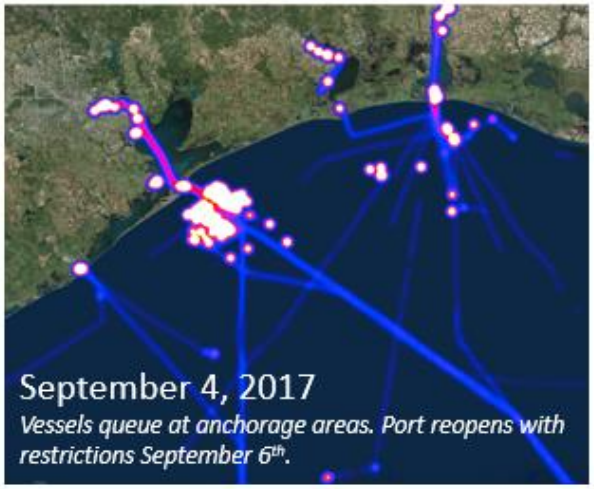


Gulf Region

Hurricane Harvey Cargo and Tanker Vessel Signal Density Plots

Created with ERDC Automatic Identification System Analysis Package (AISAP)

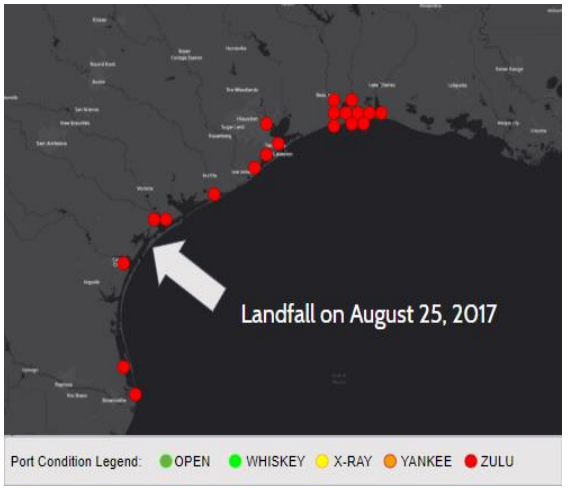




ERDC Navigation Data Performance Team: Katherine Touzinsky, Kenneth N. Mitchell, Patricia Dijoseph, Marin Kress

Hurricane **Harvey**

- Challenges
  - Flooding caused indirect impacts to supporting infrastructure
  - Lack of knowledge management and collaborative tools regarding port condition or status
  - Redundant information requests



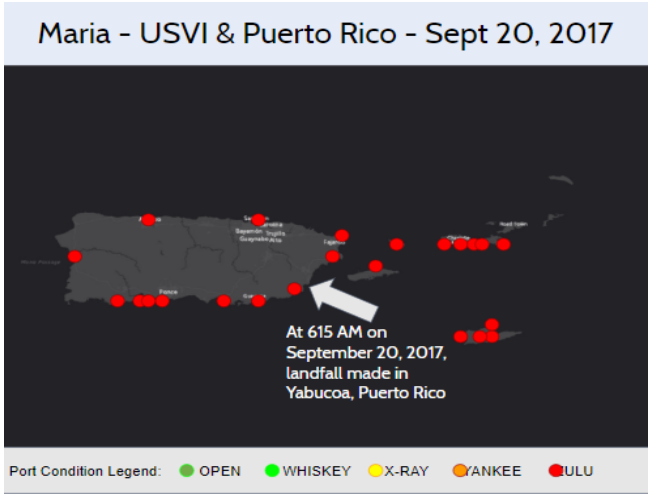
- Successes
  - Early communication
  - Centralized information distribution
  - Pre-prioritized resource placement
  - Execution of drills and training
  - Early closure of energy facilities
  - Efficient restoration of ATONS following storm
  - Cross agency communication
  - Engagement with public sector for resource needs
  - Delegation of FEMA mission assignments

Hurricane **Irma**

- Challenges
  - Power outages
  - Debris removal between storms
  - Resource allocation between commerce, tourism, & EM
  - Equipment pre-positioning in FL
  - Availability of resources and funds
- Successes
  - Early communication on critical ports and supporting infrastructure
  - Critical Aids to Navigation identified in advance
  - Updated coastal imagery for fast surveys
  - Transportation and accommodation arrangements
  - Mobile integrated Survey Team kits when operating vessels of opportunity
  - Repurposing vessels directed to Texas
  - Coordination with local business advisory councils and initiatives

Hurricane **Maria**

- Challenges
  - Lack of space for shipping & seaport operations
  - Lack of supporting infrastructure (road, electric, water)
  - First responder challenges
  - Negative press
  - Balancing emergency supply with commercial supply



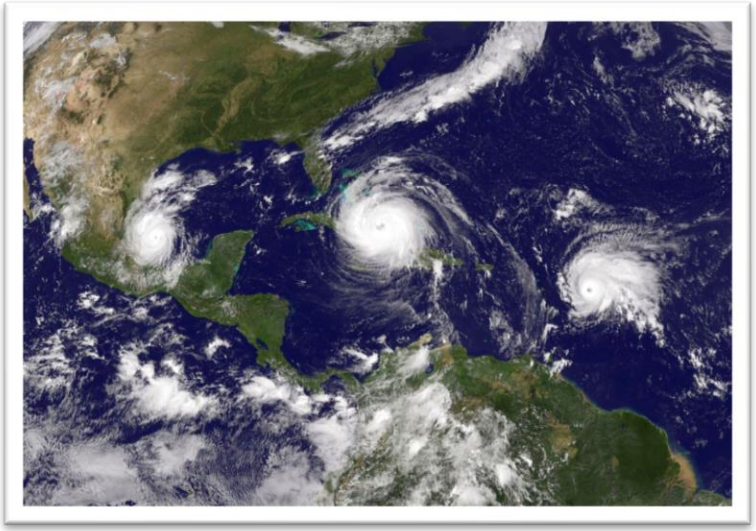
- Successes
  - First responders with Spanish language skills
  - Interagency collaboration and sharing of information
  - AIS-ATON utilized to help facilitate re-opening of San Juan by rapidly triaging ATONS in the field

Summary: Best Practices for MTS Response and Recovery

- Hurricane Season Kickoff Meeting
- Full Scale Hurricane Exercise
- Clear lines of communication
- Interagency efforts for navigation channel reopening
- Pre and post-storm port assessments
- ATON verification and resiliency

Summary: Opportunities to Enhance Response and Recovery

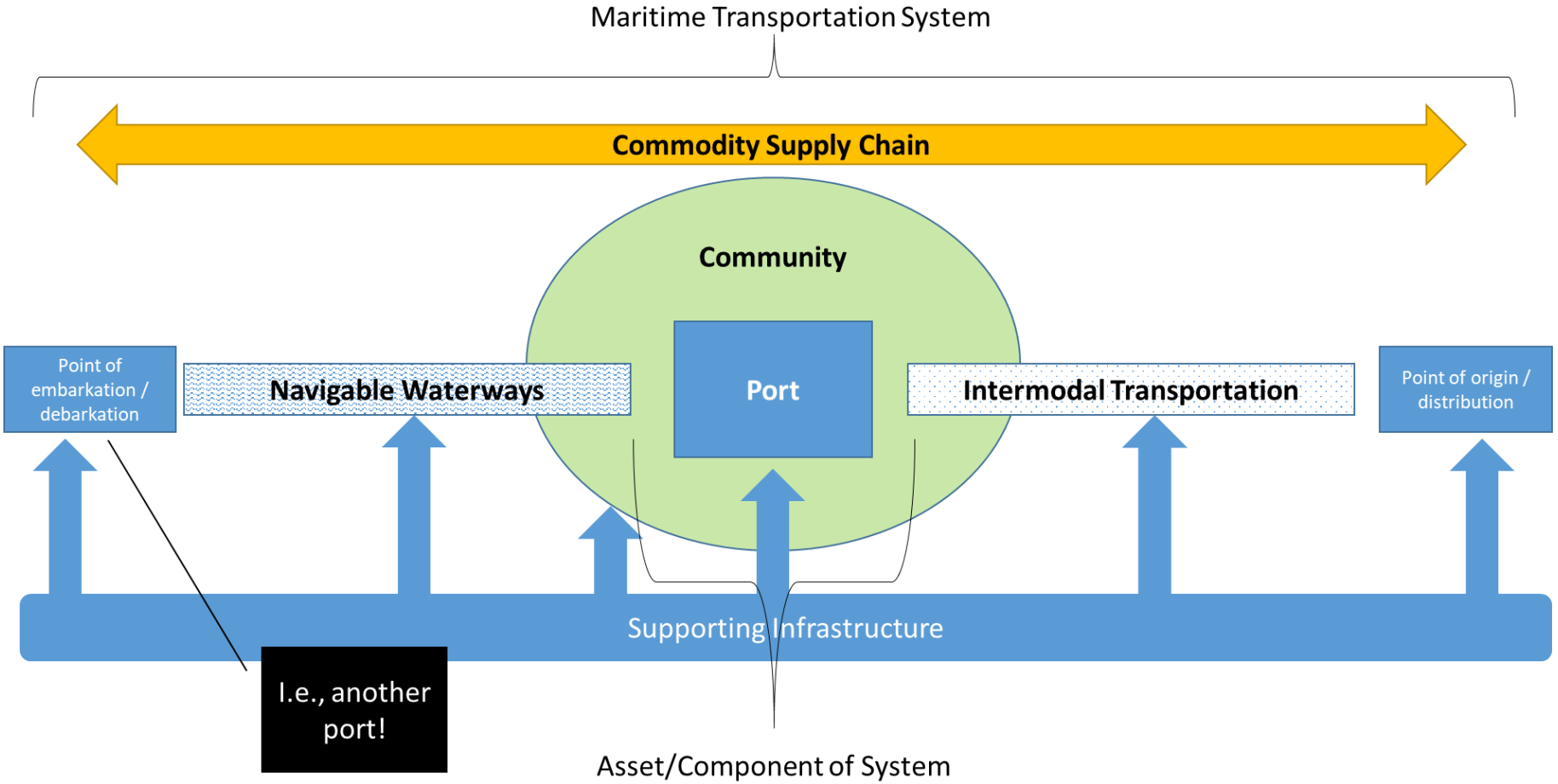
- Need for tools & protocols for prioritization at the regional or national level
- Pre-staging of survey teams & equipment
- Evaluating Port Status vs. Channel Status
- How to aid port employees returning to work

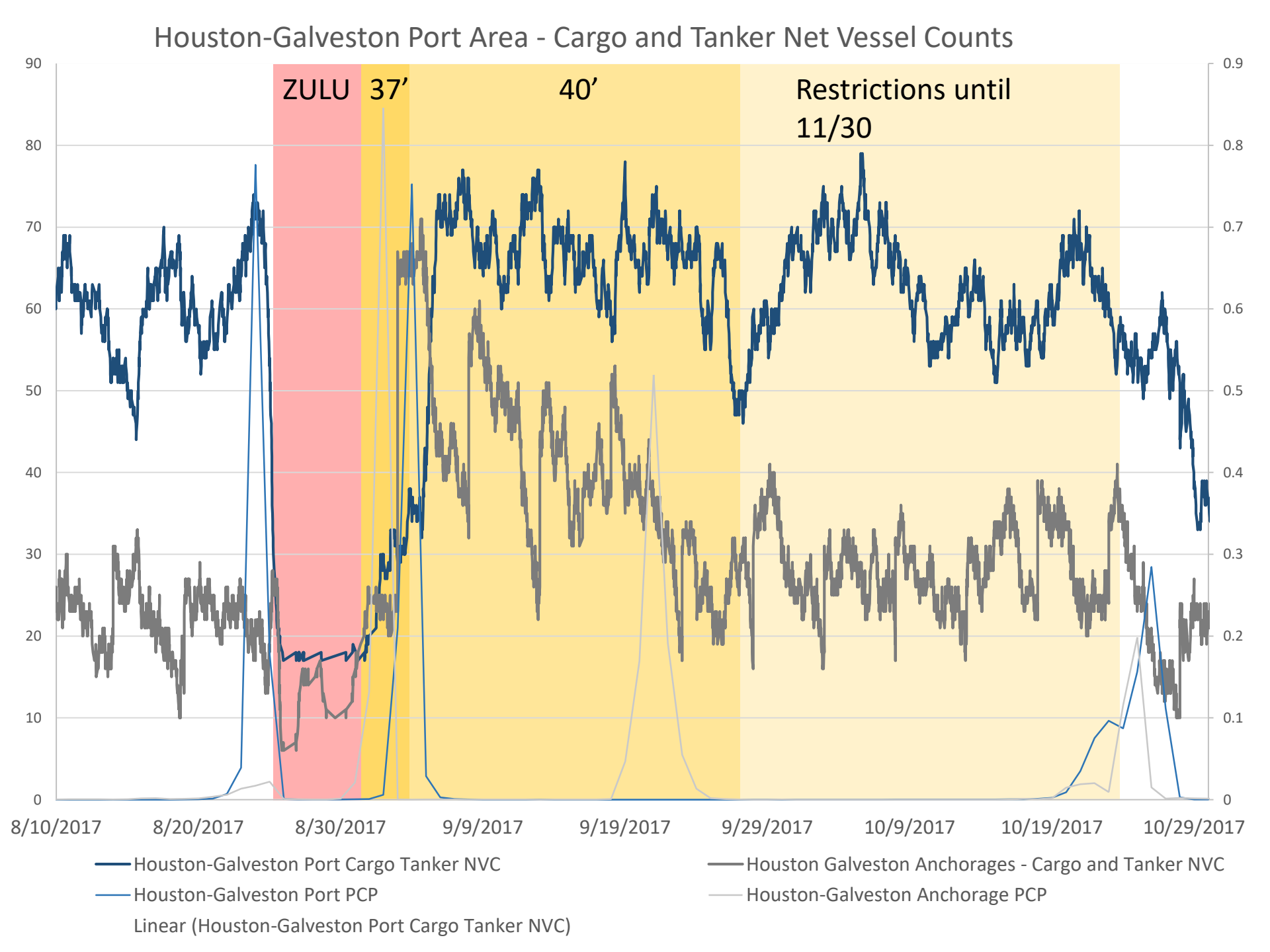


Data Analysis of Hurricane Impacts

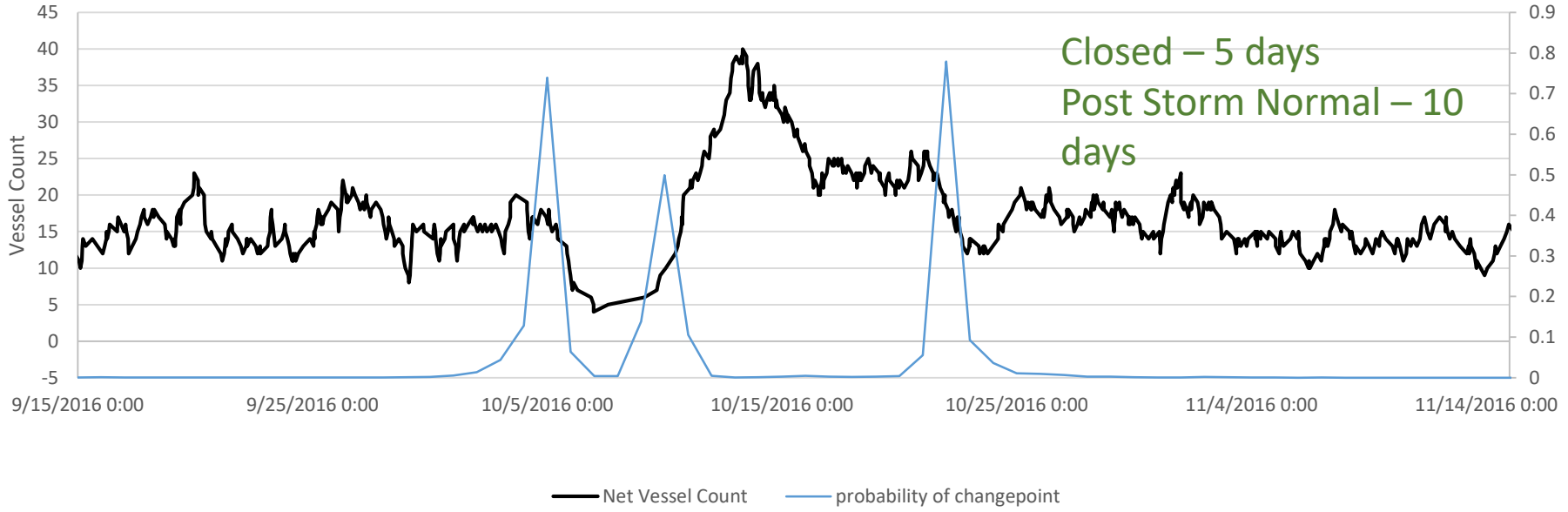
- Automatic Identification System (AIS) Data can be used to understand more than just heatmaps!
- Captures recovery via observational data
- Can provide insights into MTS performance via the function of commodity movement on waterways

Single Port System

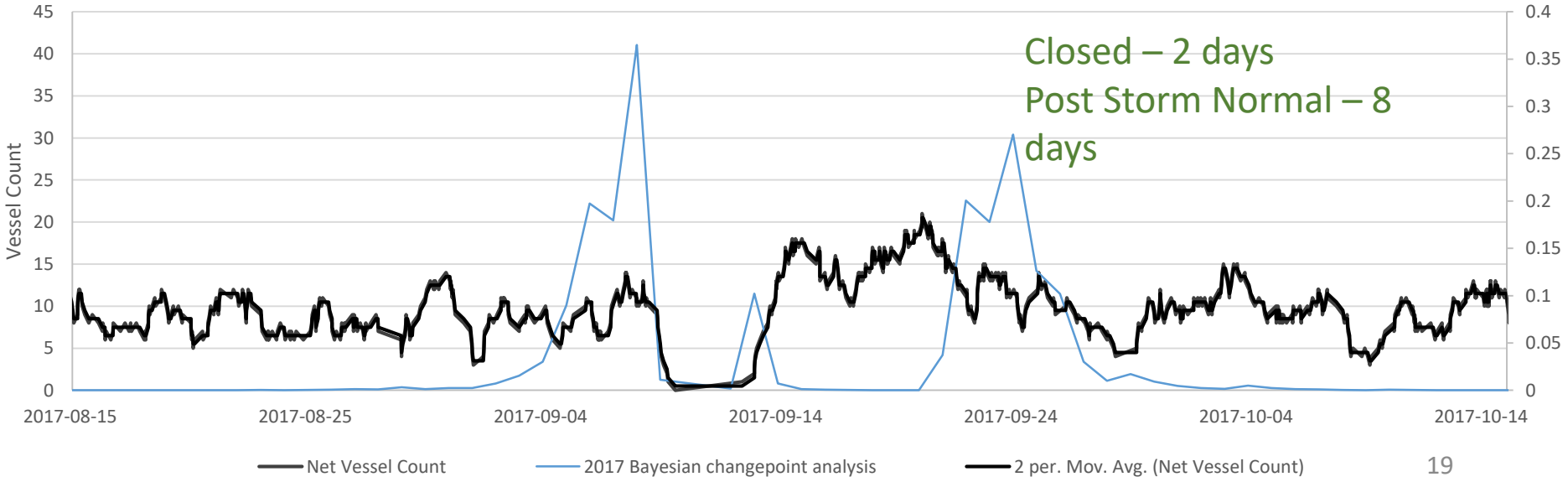



Houston-Galveston Port Area - Cargo and Tanker Net Vessel Counts
ZULU
37’
40’
Restrictions until 11/30
90
80
70
60
50
40
30
20
10
0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
8/10/2017
8/20/2017
8/30/2017
9/9/2017
9/19/2017
9/29/2017
10/9/2017
10/19/2017
10/29/2017
Houston-Galveston Port Cargo Tanker NVC
Houston Galveston Anchorages - Cargo and Tanker NVC
Houston-Galveston Port PCP
Houston-Galveston Anchorage PCP
Linear (Houston-Galveston Port Cargo Tanker NVC)

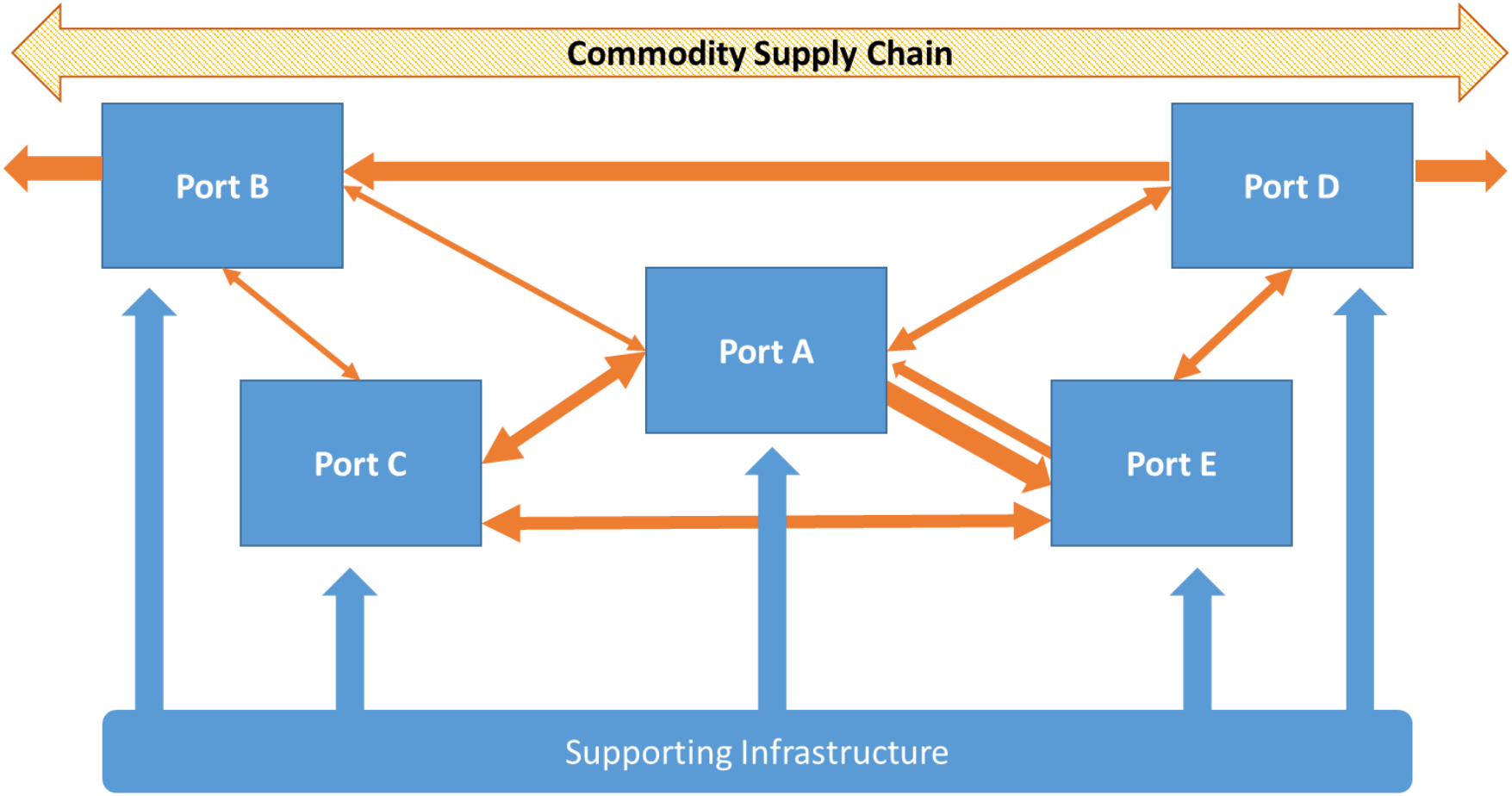
Port of Savannah – Net Vessel Count for 2016 Hurricane Matthew

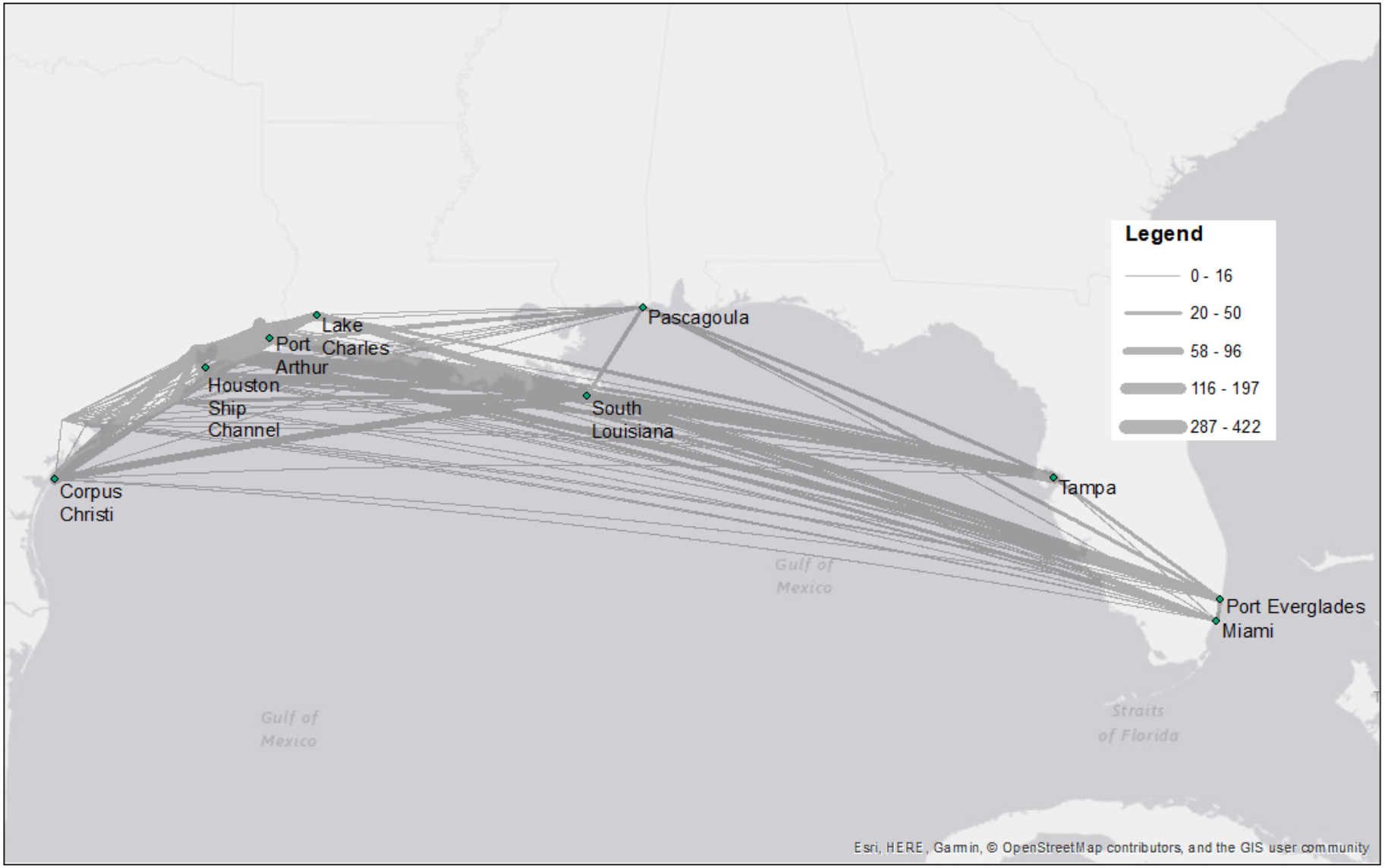


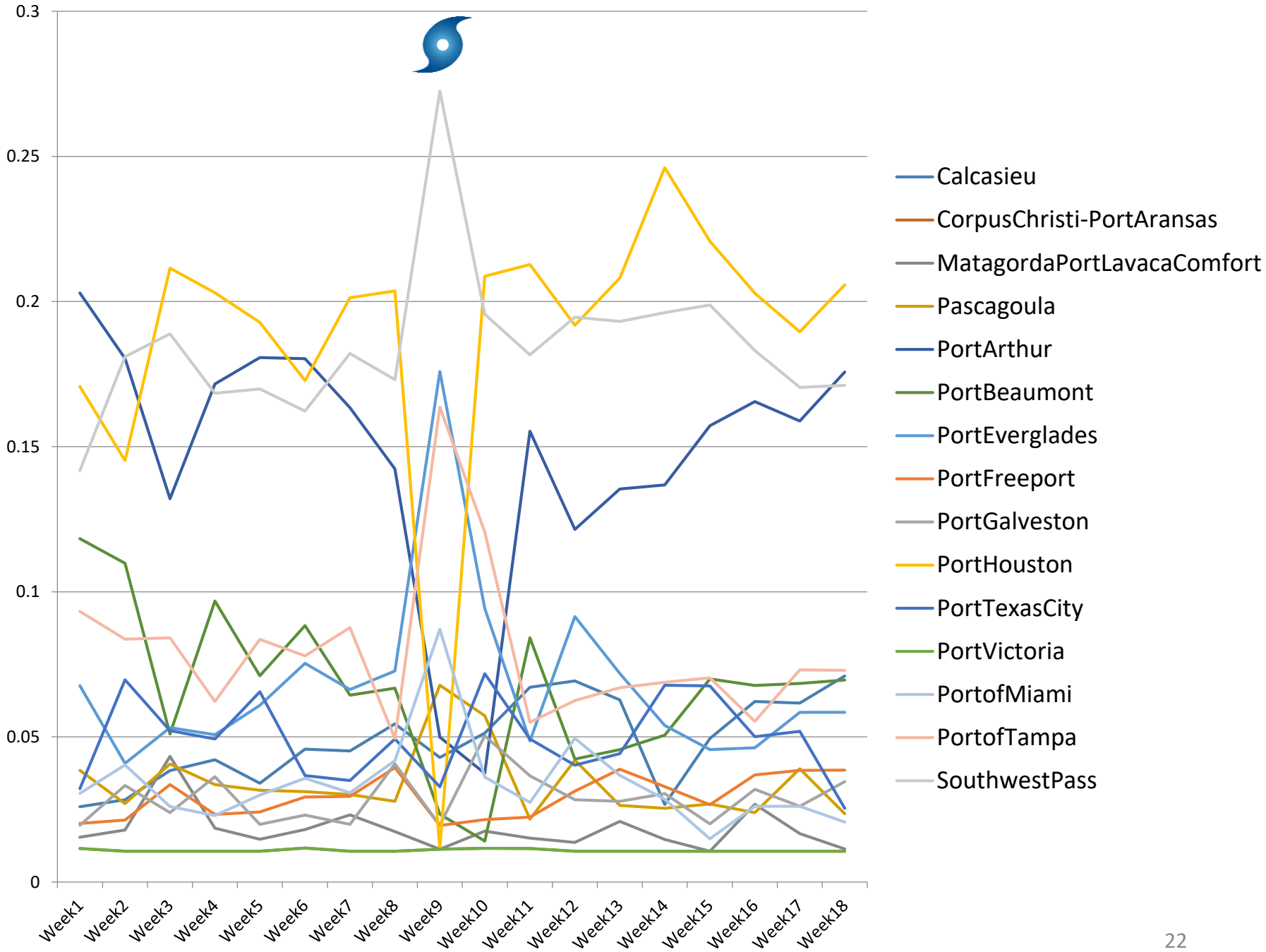
Port of Savannah - Net Vessel Count for 2017 Hurricane Irma

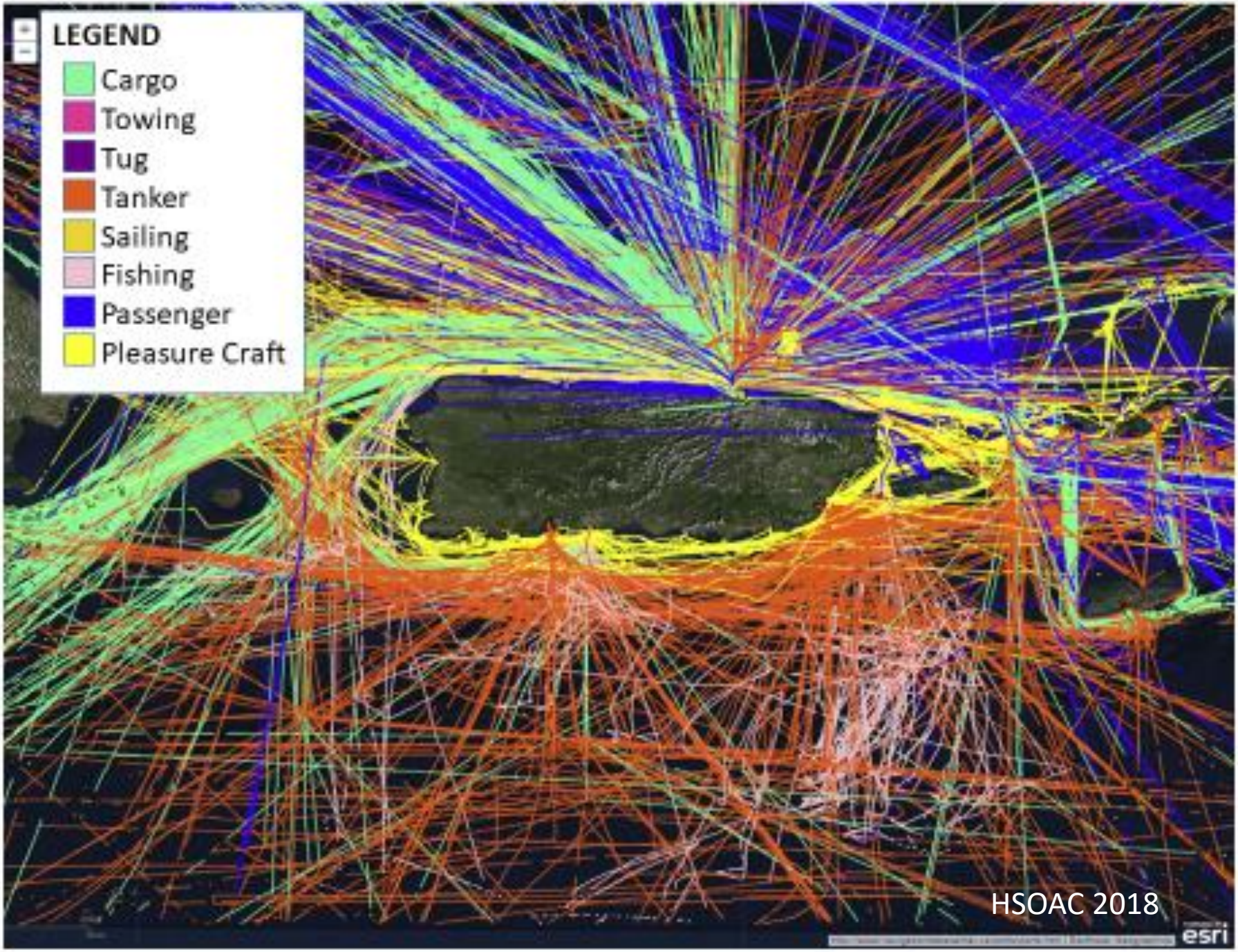


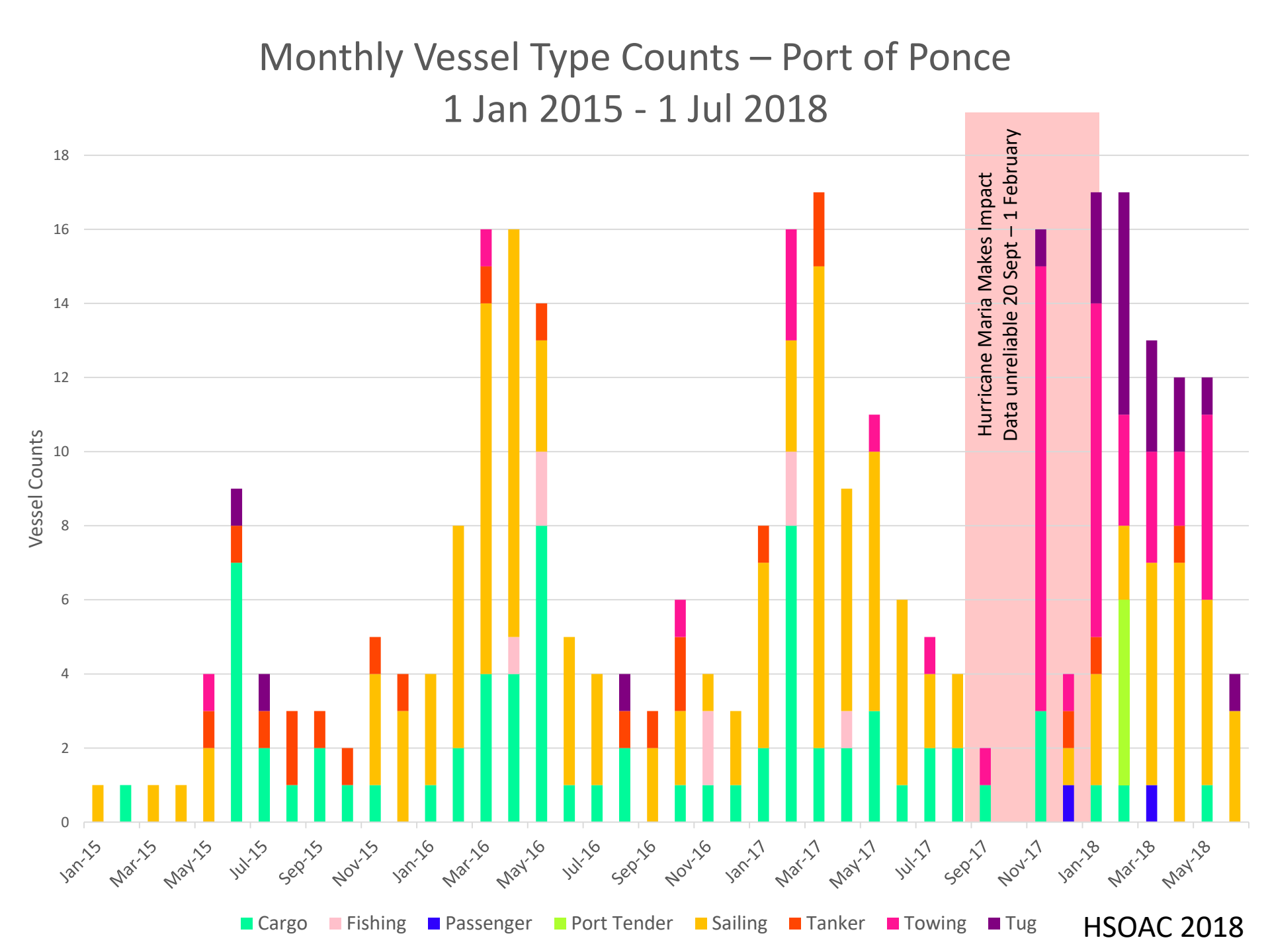
Multiple Port System




Legend
0 - 16
20 - 50
58 - 96
116 - 197
287 - 422
Lake Charles
Port Arthur
Houston Ship Channel
Pascagoula
South Louisiana
Corpus Christi
Tampa
Port Everglades
Miami
Gulf of Mexico
Gulf of Mexico
Straits of Florida
Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community


0.3
0.25
0.2
0.15
0.1
0.05
0
Week1
Week2
Week3
Week4
Week5
Week6
Week7
Week8
Week9
Week10
Week11
Week12
Week13
Week14
Week15
Week16
Week17
Week18
Calcasieu
CorpusChristi-PortAransas
MatagordaPortLavacaComfort
Pascagoula
PortArthur
PortBeaumont
PortEverglades
PortFreeport
PortGalveston
PortHouston
PortTexasCity
PortVictoria
PortofMiami
PortofTampa
SouthwestPass


LEGEND
Cargo
Towing
Tug
Tanker
Sailing
Fishing
Passenger
Pleasure Craft
HSOAC 2018
esri


Monthly Vessel Type Counts – Port of Ponce
1 Jan 2015 - 1 Jul 2018
Vessel Counts
0
2
4
6
8
10
12
14
16
18
Hurricane Maria Makes Impact
Data unreliable 20 Sept – 1 February
Jan-15
Mar-15
May-15
Jul-15
Sep-15
Nov-15
Jan-16
Mar-16
May-16
Jul-16
Sep-16
Nov-16
Jan-17
Mar-17
May-17
Jul-17
Sep-17
Nov-17
Jan-18
Mar-18
May-18
Cargo
Fishing
Passenger
Port Tender
Sailing
Tanker
Towing
Tug
HSOAC 2018

Resilience for Port Stakeholders

Where do we start with understanding MTS resilience?

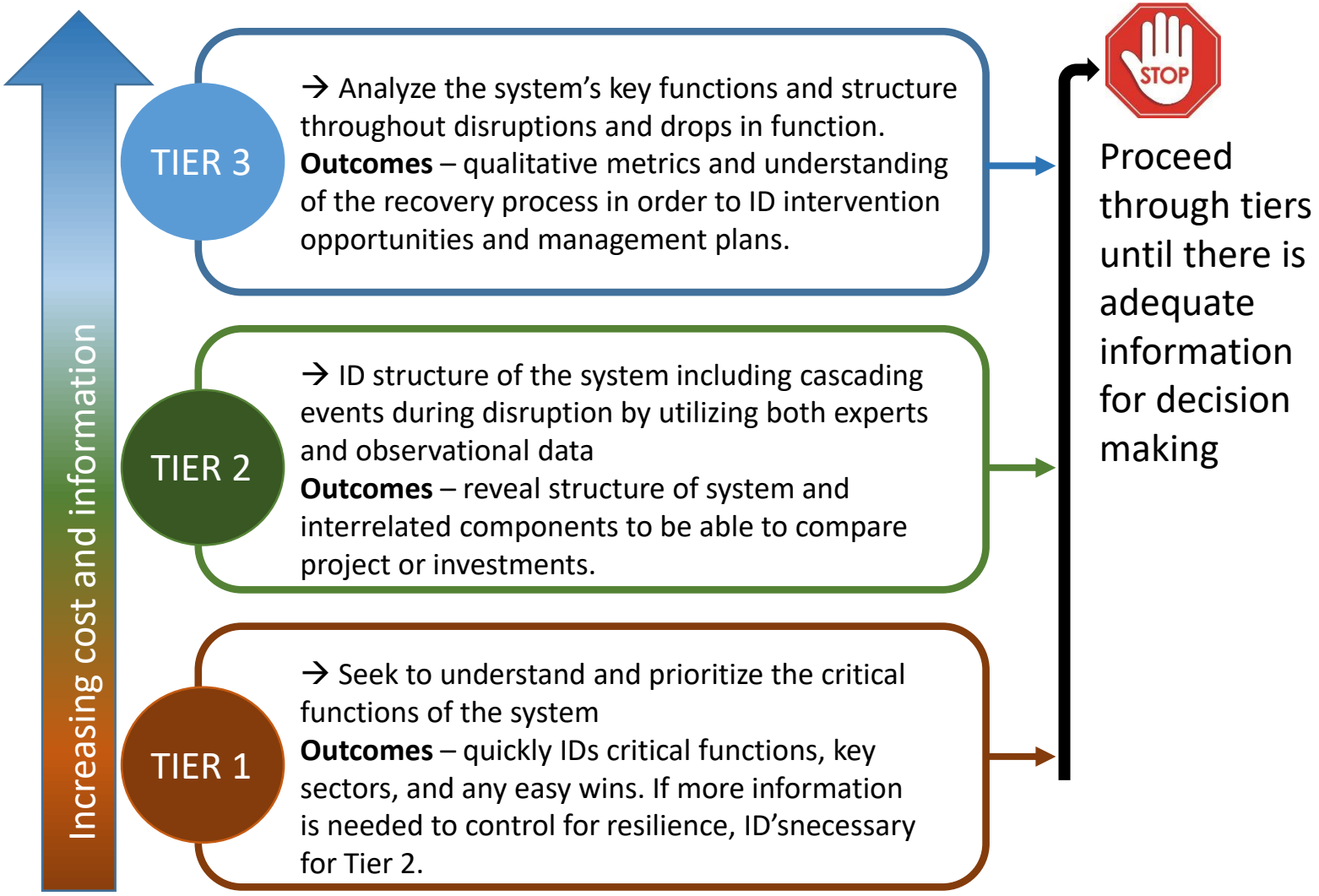
What information best facilitates decisions about resilience improvements?

How do we analyze critical infrastructure dependencies and cascading failures?

How do we benchmark progress?

How can this information best be disseminated to stakeholders?

Port Resilience Assessment and Decision Guide



Tool Example	Single Port	MTS Supply Chain	Inland Waterway
Tier 3	- Bayesian Network Analysis (Schultz et al 2016) - Assessment and Measurement of Port Disruption (Weaver 2019)	Outstanding Need for methodologies!	- Bayesian Kernel Critical Infrastructure Analysis of L&D (Baroud 2014)
Tier 2	- Scenario-based exercise with expert elicitation (many examples)	- PORT MAPPER (Trepte and Kai 2014) - Multiple Port Vulnerability Indicators Methodology (Becker 2018)	- Collaborative Modeling to Support Adaptive and Resilient Water Resource Governance in the Inland Northwest (King and Thorton 2016)
Tier 1	- Port Resilience Index (NOAA 2016) - MTS Recovery Plan Guidelines (USCG 2018)	- Supply chain resilience planning - Dredge Optimization Scheduler (USACE 2018)	- Improving Freight Transportation Resilience in Response to Supply Chain Disruptions (NCRFP 2019)

Questions?

U.S. Committee on the Marine Transportation System, The 2017 Hurricane Season: Recommendations for a Resilient Path Forward for the Marine Transportation System, U.S. Department of Transportation, Washington, D.C.

Full report available for download at:
https://www.cmts.gov/downloads/CMTS_RIAT_2017Hurricanes.pdf

Or contact -

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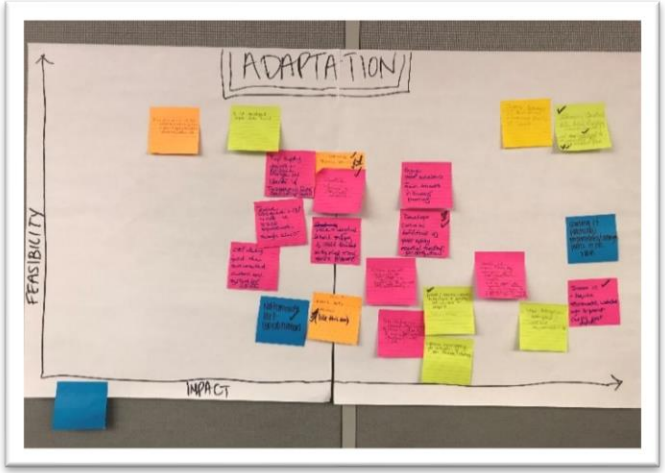
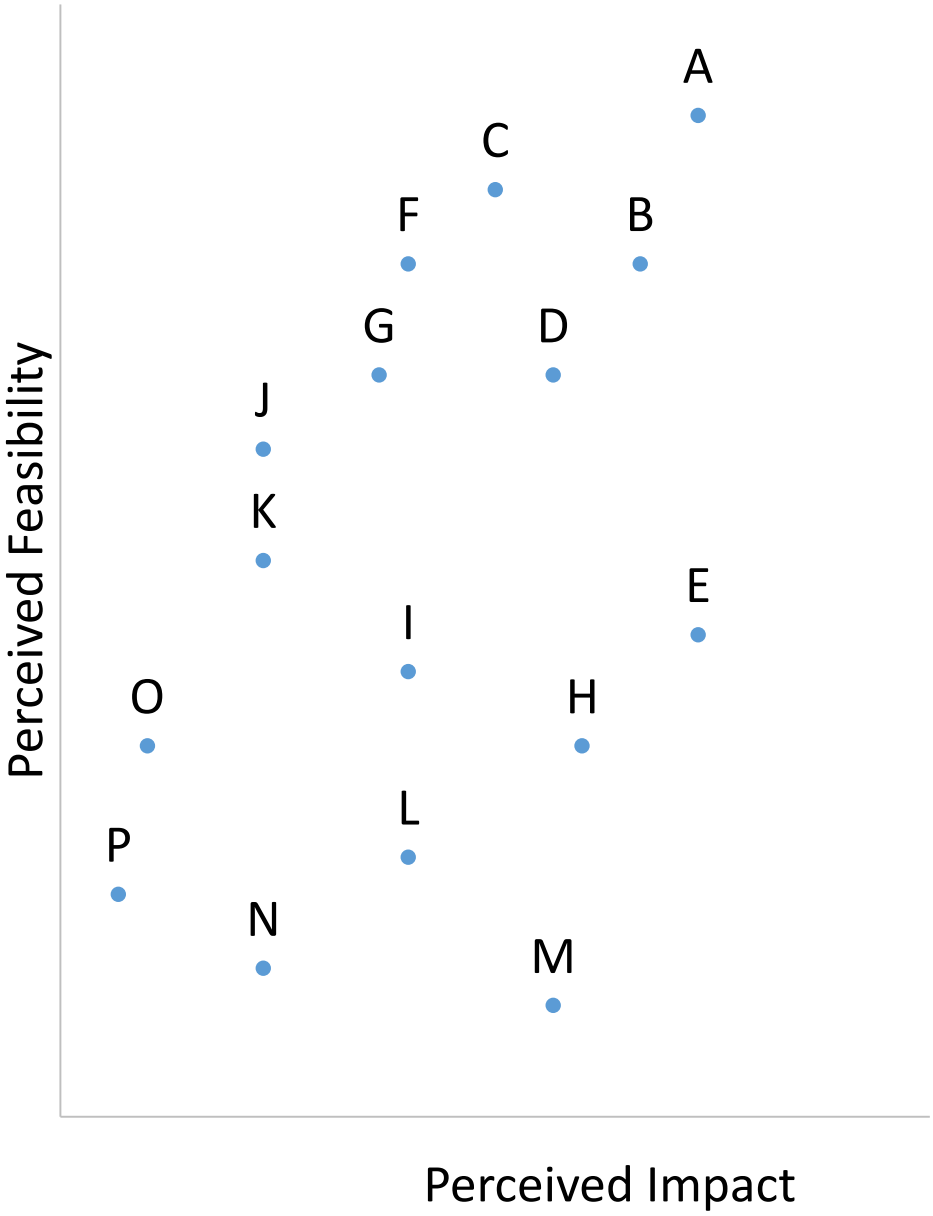
Federal Actions to Minimize Disruption and Enhance Resilience

Findings were identified by applying the Resilience Framework and separated into categories:

- Preparation actions
- Response and recovery actions
- Adaptation actions



PREPARATION ACTIONS



A	Annual Exercises, Training, Drills
B	Pre-stage recovery assets
C	Proactive Port Assessments
D	Pre-establish a contracting mechanism for response
E	Promote proactive maintenance
F	Consider long term plan for recovery
G	Engage with FEMA in advance
H	Promote mutual aid agreements
I	Promote continuity of management
J	Prioritize critical infrastructure
K	Establish Port Advisory Teams
L	Establish Surge Force w/ private industry
M	Maintain facilities that supply redundancy
N	Multi-agency GIS-based data viewer
O	Establish Regional Port Advisory Teams
P	Predetermine response and recovery priorities

Recommendations:

PREPARE

- **Prioritize key infrastructure systems**
- Identify **critical infrastructure interdependencies**

ABSORB/RESIST

- **Share data** across Federal agencies for recovery projects through interagency teams and data-sharing platforms

ADAPT

- Develop a **common operating picture** of the port system interdependencies and authorities and prioritizations of essential land and maritime functions
- Hold proactive **planning scenario exercises** and interagency training sessions where recommendations from the past season are communicated and incorporated
- Promote or consider new cutting-edge technologies to understand infrastructure redundancies and reduce vulnerabilities to multiple hazards and to improve port services or support in times of operational failure