U.S.ARMY

TRAFFIC BEHAVIOR NEAR COASTAL STRUCTURES

COASTAL NAVIGATION PORTFOLIO MANAGEMENT

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COASTAL INLETS RESEARCH PROGRAM

FY20 IN PROGRESS REVIEW

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CIRP
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Problem Statement

Existing functional performance metrics for coastal structures allocate appx. $50M annually but weakly describe structure performance. Metric development is required for direct inspection of in-situ vessel traffic that will adequately describe performance.

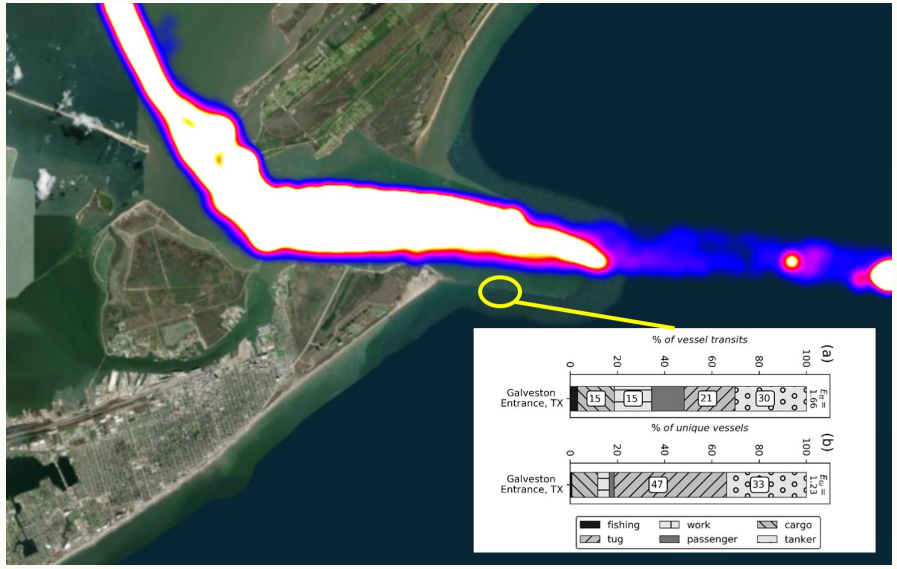
- **This research seeks to identify methods to measure interactions between vessel traffic and infrastructure using archival AIS data to inform and align management of coastal navigation projects with levels of use at *portfolio scale*.**

Present

Level of Functionality	TABLE F-10 Coastal Navigation Structures Functional Condition Rating (FCR) Table
Full -- A	No notable impact, project performing as designed.
Sufficient – B	(1) Infrequent or periodic limitations on navigability, or (2) minor/periodic increases in dredge quantity
Reduced -- C	(1) Less than 10% of the time, design vessels cannot navigate or operate within authorized limits; (2) O&M dredging requirements in the Entrance and Bar Channel have increased less than 10%, as compared to the long-term average annual rate.
Severely Degraded -- D	(1) 10-20% of the time, design vessels cannot navigate or operate within authorized limits; (2) O&M dredging requirements in the Entrance and Bar Channel have increased 10-20%, as compared to the long-term average annual rate.
Completely Degraded -- F	(1)-20-40% of the time, design vessels cannot navigate or operate within authorized limits; (2) O&M dredging requirements in the Entrance and Bar Channel have 20-40%, as compared to the long-term average annual rate.

vs.

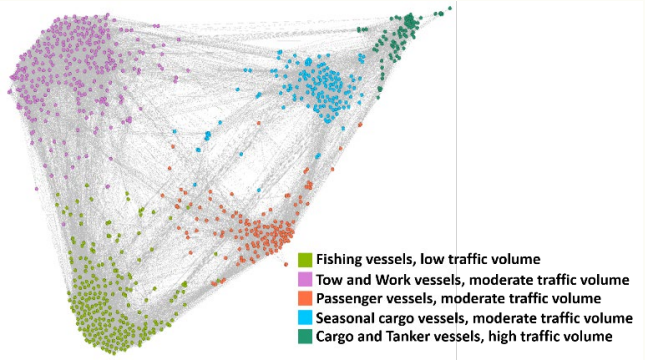
Future



- Strategic R&D advances Machine Learning / Artificial Intelligence capabilities related to connecting, integrating and analyzing data and model output to produce navigation decision support information.
- 2019-N-1332 – Waterway transit times from AIS Data
- 2017-N-52 Further Development of CPT and AIS software products

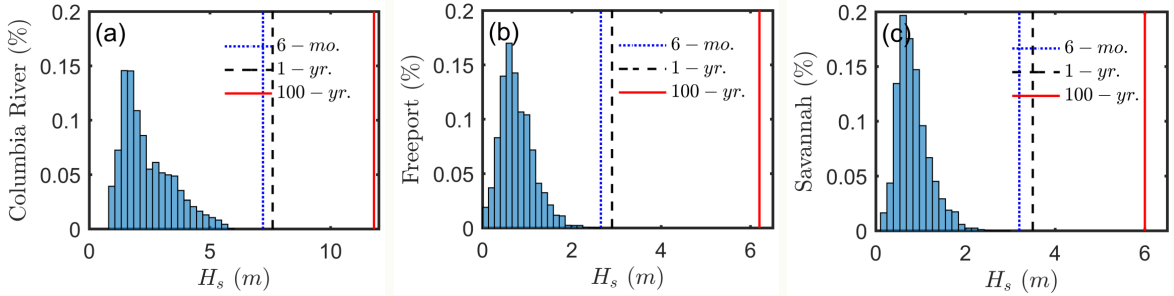
Capability and Strategic Impact Statement

Vessel-based metrics will enable USACE to more effectively allocate coastal infrastructure maintenance funds *based on use* than present metrics allow.

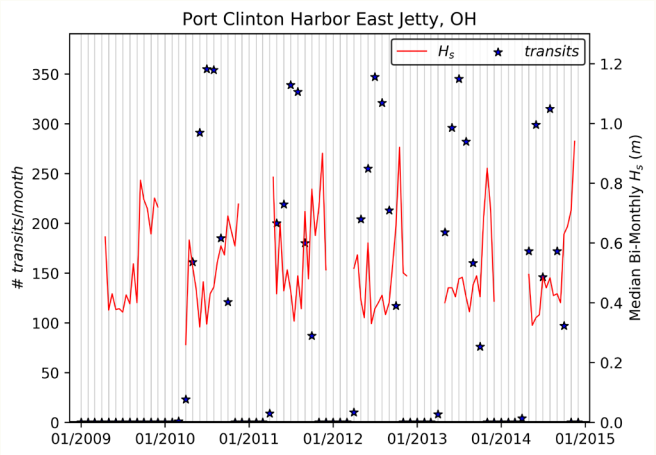


Vessel-based metrics will deliver funds to objectively benefit vessels.

Wave heights during vessel transits, 2012-2014



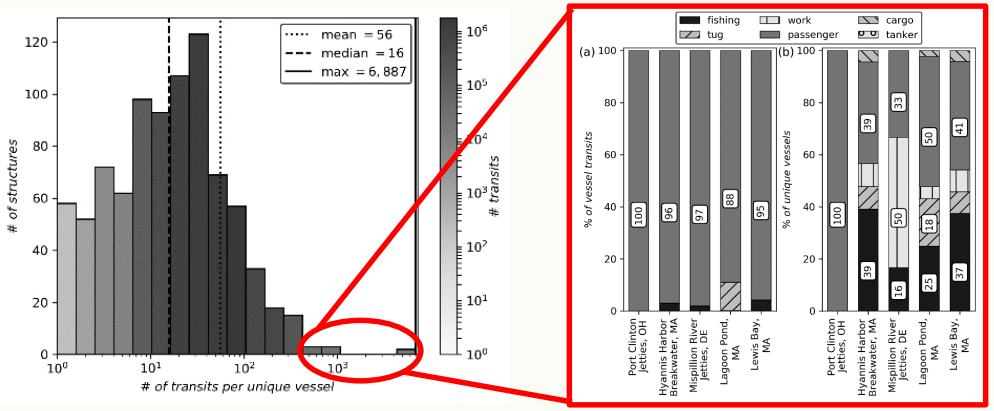
Based on 10k observed historical transits it can be concluded that structure design criteria far exceed vessel operating parameters.



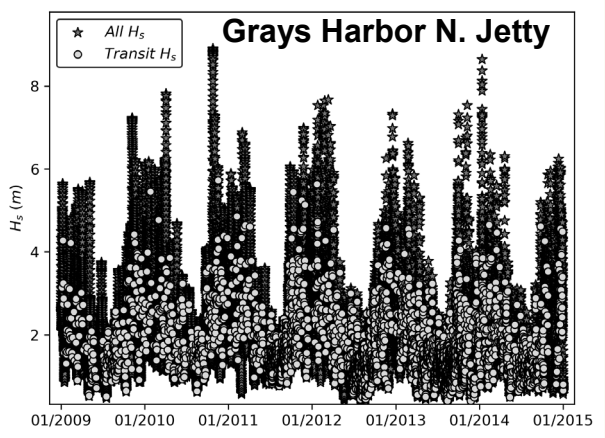
Negative correlation of vessel traffic and wave activity indicate limited potential for wave sheltering.

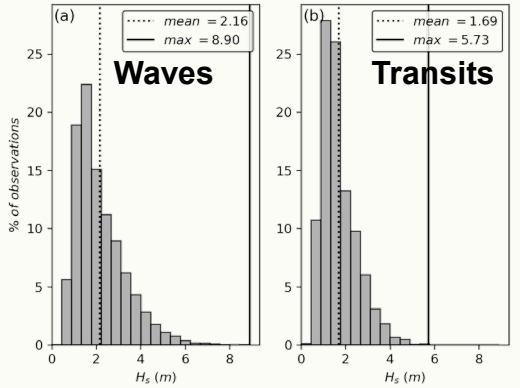
Given over 10M vessel transits, what can be said about traffic near 1k coastal structures?

- **Measurable ∩ Meaningful**
  - **Number and types of vessels**
  - **Number of transits per vessel & type**
  - **Timing of transits, seasonality**
  - **Proximity to structure**
  - ***Use trends***

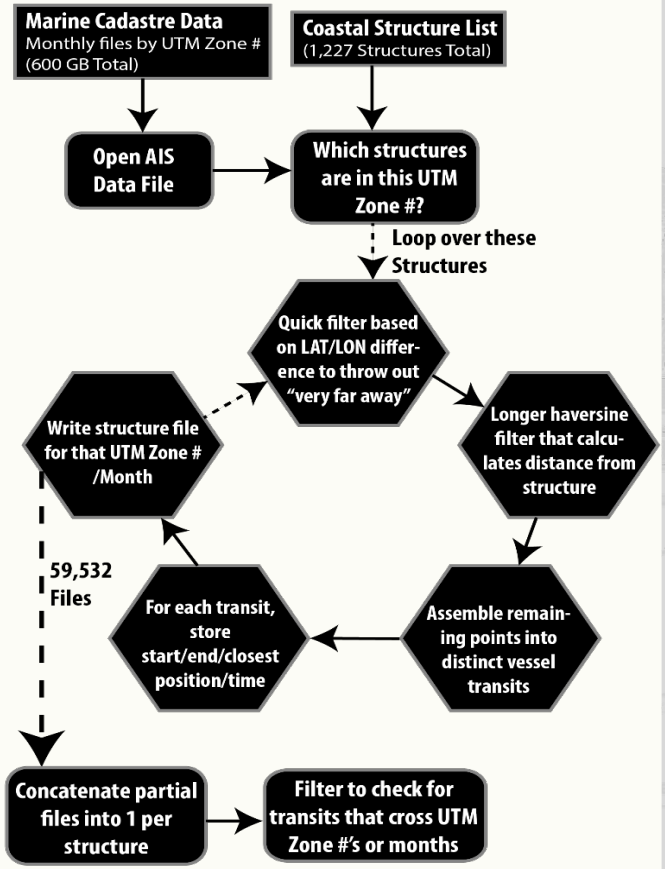


Who uses it and how much?





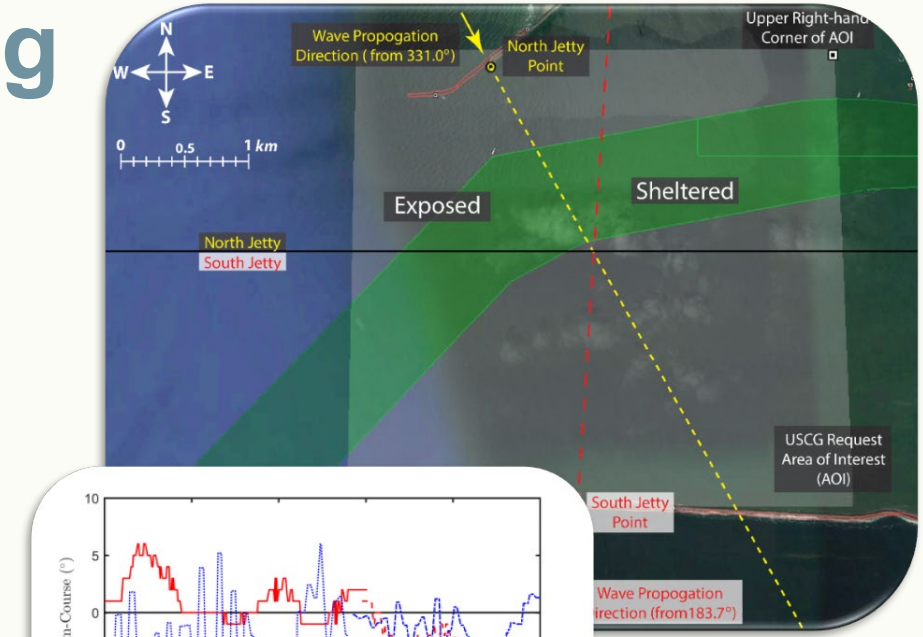
Under what conditions?



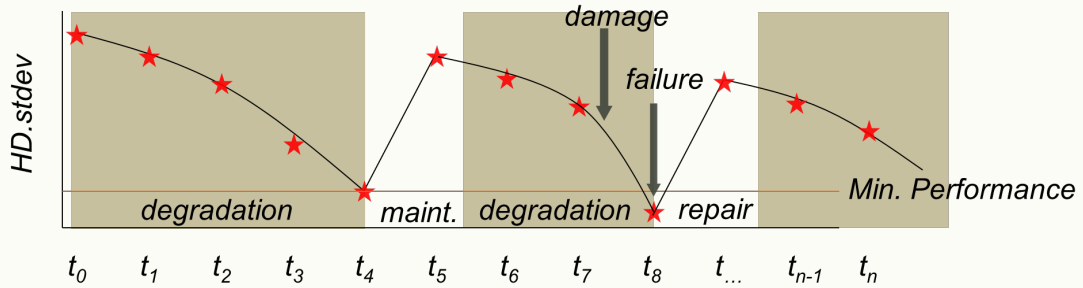
Parallel computational approach.

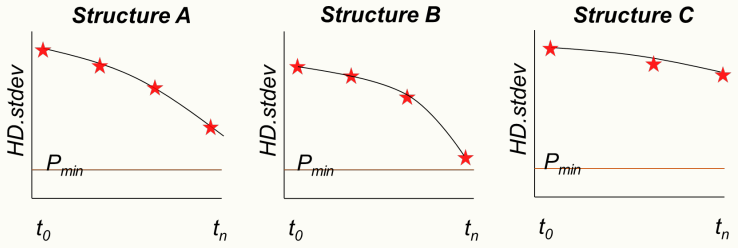
Vessel Transit Modeling

- **Vessel-based Metrics are evolving:**
  - Vessel transit count
  - Number of unique vessels
  - Transits/unique vessel
  - Seasonal time-series decomposition
  - Information Entropy
- **Additional metrics are necessary:**
  - Structure hazard curves
  - Maintenance history
  - Vessel-wave correlation
  - Field input
- **Portfolio scale analysis requires parallel approach**
  - Historical vessel data (~600GB)
  - Structure portfolio (~1,200 structures)



A developed measure of "navigability" can be used to prioritize structure repair, provided it can be observed to change with structure condition.





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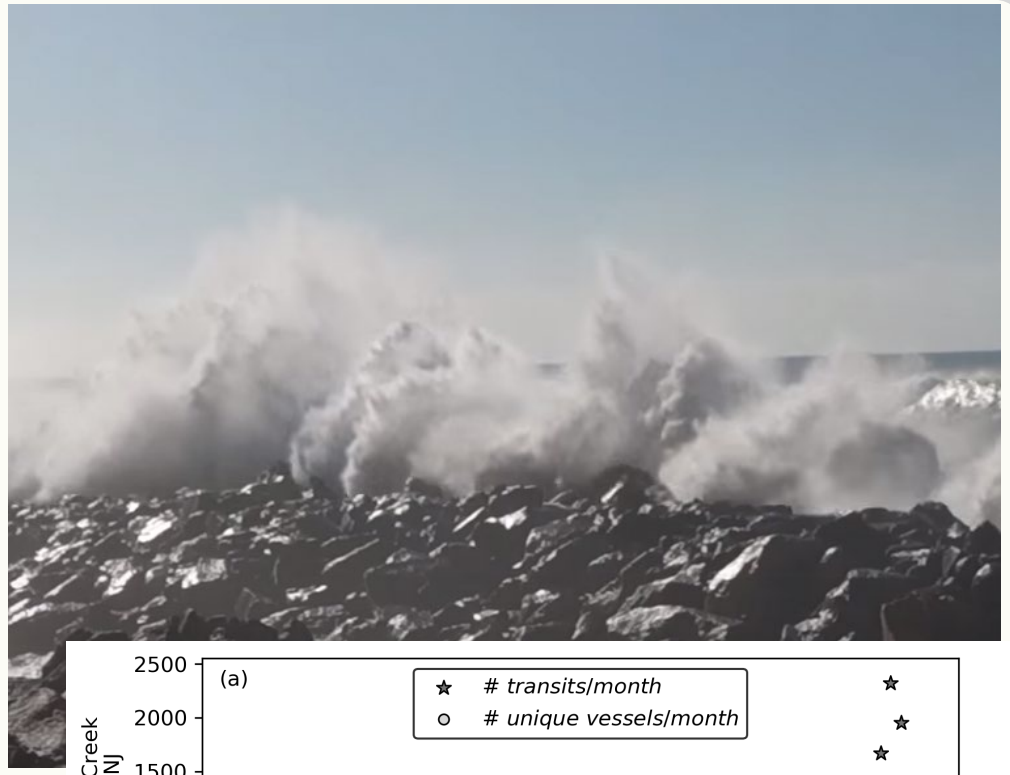
Summary

FY20 Major Advances in Capability

- Expanded HPC AIS archive to 11 years
- Eliminated low-value metrics
- Identified new metric data sources

FY20 Major Products & Collaborations

- 1 Presentation to AAPA
- 1 CWG presentation
- 1 CIRP TD
- JP: Mining Marine Vessel AIS Data to Inform Coastal Structure Management, *ASCE J. of Waterways… (1,500+ downloads)*



Morro Bay Jetty
YouTube
Reno Gregory

FY21 Plans

- Incorporate revised data metrics, including field metric input.
- Evaluate natural experiment to determine feasibility of "navigability" metric further development