PORTFOLIO-SCALE INFRASTRUCTURE ANALYSIS USING AIS DATA

COASTAL NAVIGATION PORTFOLIO MANAGEMENT

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COASTAL INLETS RESEARCH PROGRAM

FY21 IN PROGRESS REVIEW

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US Army Corps of Engineers

CHL COASTAL & HYDRAULICS LABORATORY

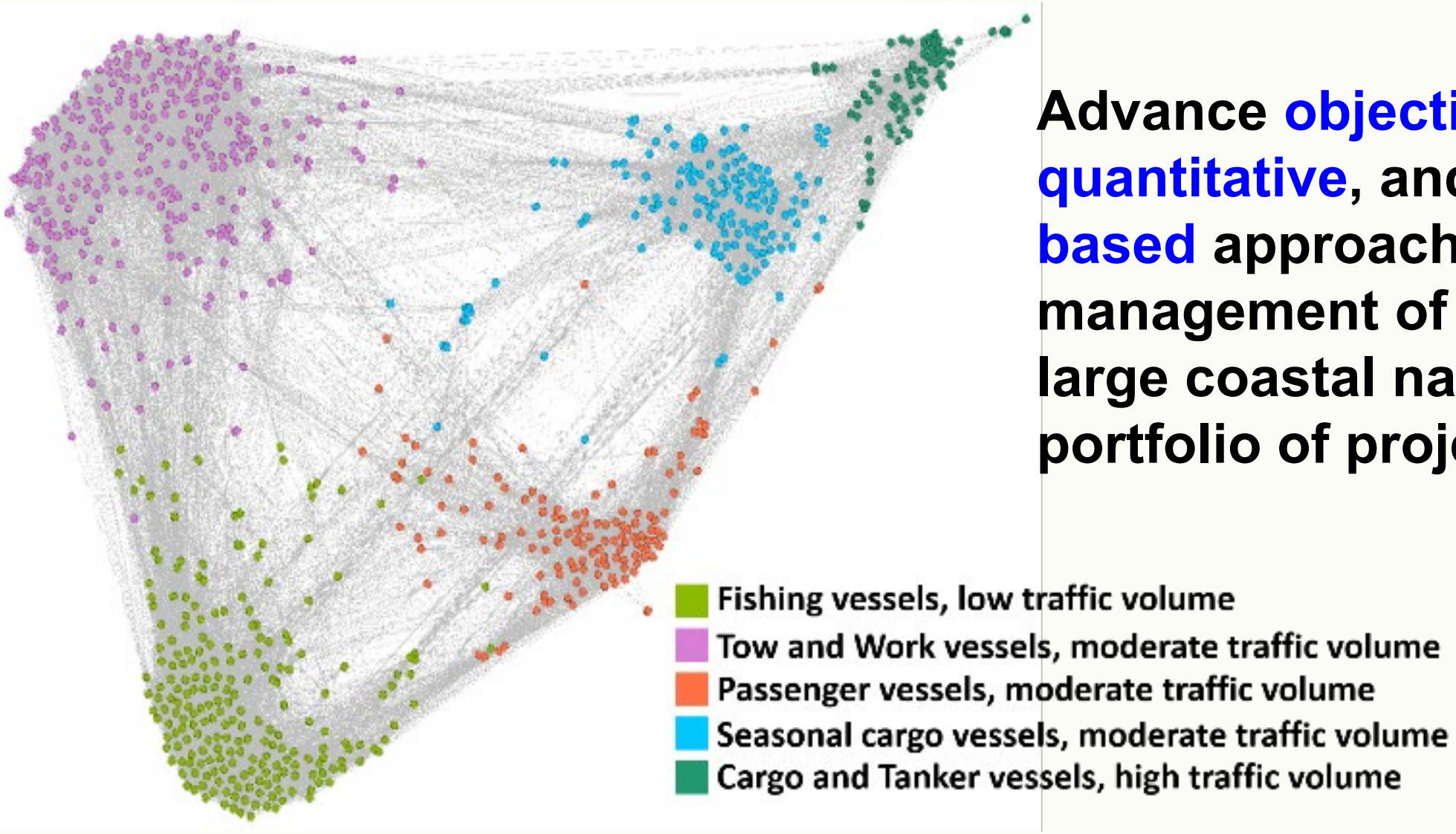
ERDC Engineer Research and Development Center

Problem Statement

- **USACE currently maintains nav. structures using subjective/qualitative performance metrics and prioritizes them with proxy measures of project use (tonnage, cargo value).**
  - **Augment this with quantitative metrics derived from AIS data.**
  - **Cast structure performance in terms of vessel activity for navigation structures.**
  - **Formulate management metrics at "portfolio scale".**

- **SoN's:**
  - **2017-N-52 Further Development of CPT and AIS software products**
  - **2016-N-14 Long-term modeling of coastal structure functionality**
  - **2015-N-15 - Integration of national and local monitoring datasets to support navigation and operations projects**
  - **2015-N-34 - Incorporating methods to evaluate length of navigation channel required for safe and efficient travel of two way traffic in ship simulations**
  - **2015-N-38 - AIS investigation of Dredge Behavior**
  - **2015-N-40 - Reducing the need for dredging**

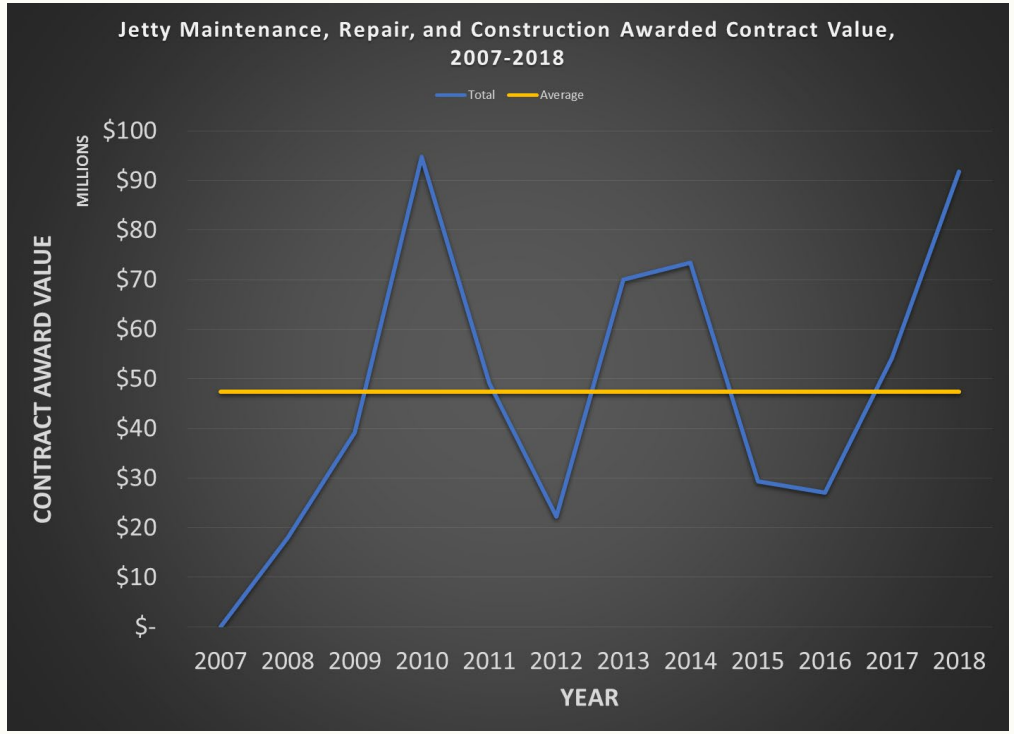
Capability and Strategic Impact Statement



Advance objective, quantitative, and systems-based approaches to management of the Corps' large coastal navigation portfolio of projects.

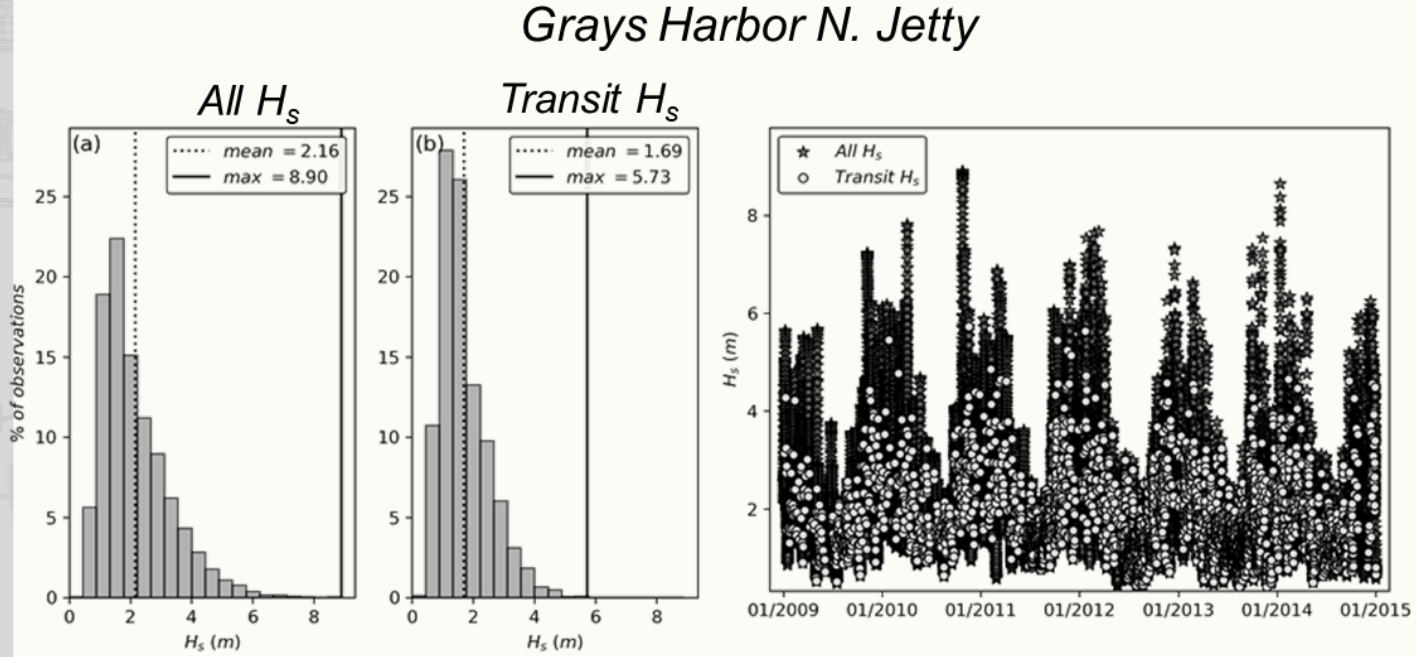
Why this matters.

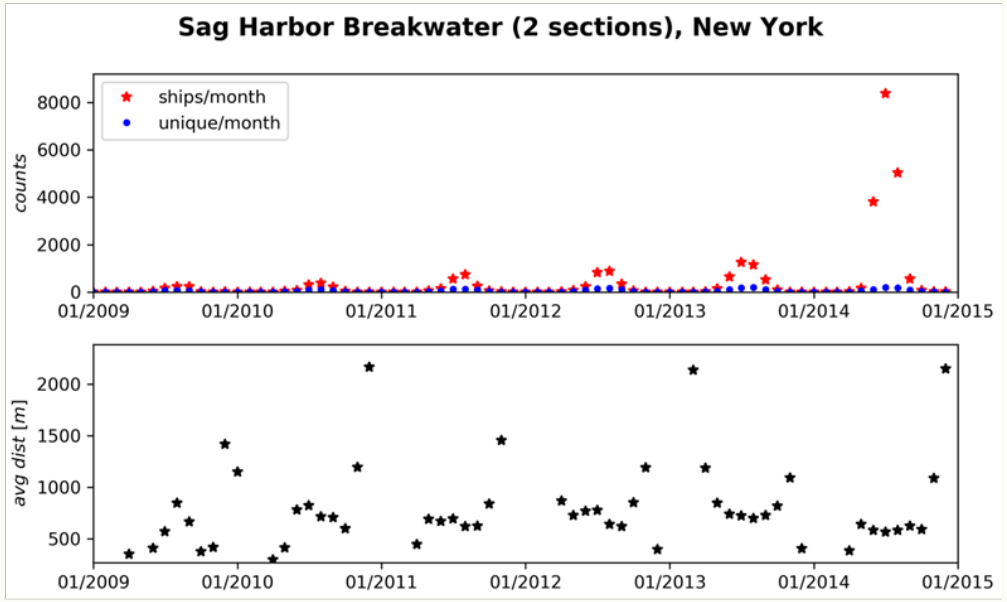
- **Money:**
  - **USACE does not have enough to maintain all structures and dredge all channels.**
- **USACE has spent ~$47M per year on Jetty maintenance/repair/construction:**
  - **The average maintained HMTF project (~521) costs $~1.9M annually.**
  - **~541 HMTF projects are not maintained.**
  - **10-year coastal structure expenditure ≈ 24 HMTF projects.**
- **MCR Repair costs ($257M):**
  - **Project BCR: 1.1**
  - **MCR Repair Costs ≈ 25% annual USACE dredging budget.**



Improved Metrics

- **Adding metrics related to environmental variables:**
  - **Vessel activity near structures correlated with wave height (WIS).**
  - **Activity near structures correlated with water level (NOAA gage data).**
- **Adding structure condition metrics:**
  - **Not objective but describes structure condition and consequence of failure.**
  - **CNS OCA Level 1 Screening Tool.**





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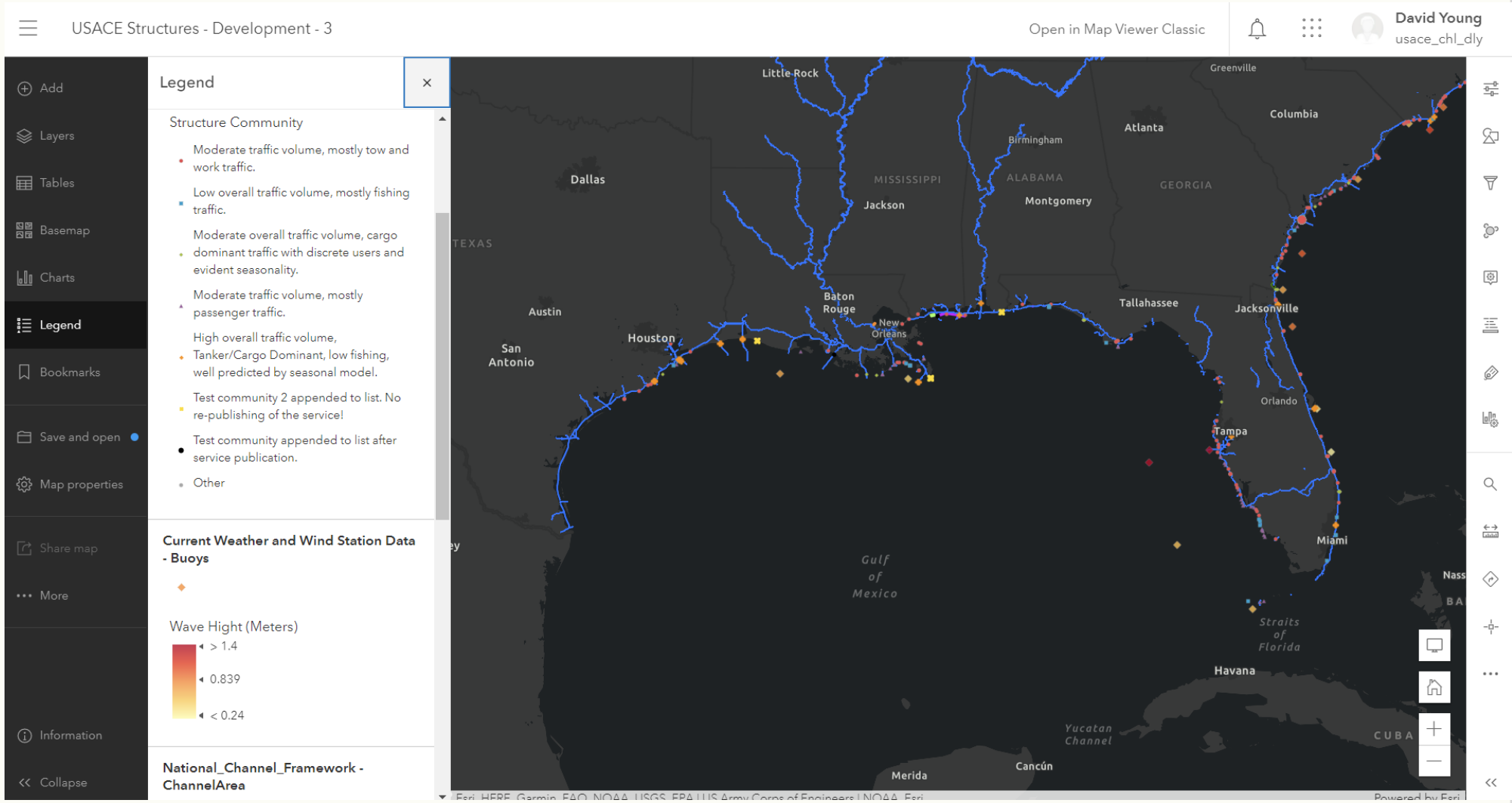
Construction of Map Viewer (1)

- Demo from CofC.
- Charlene is constructing in-house map viewer.
  - https://usace.maps.arcgis.com/apps/mapviewer/index.html?webmap=59cdf756765a4ef3ac576c70024840b8



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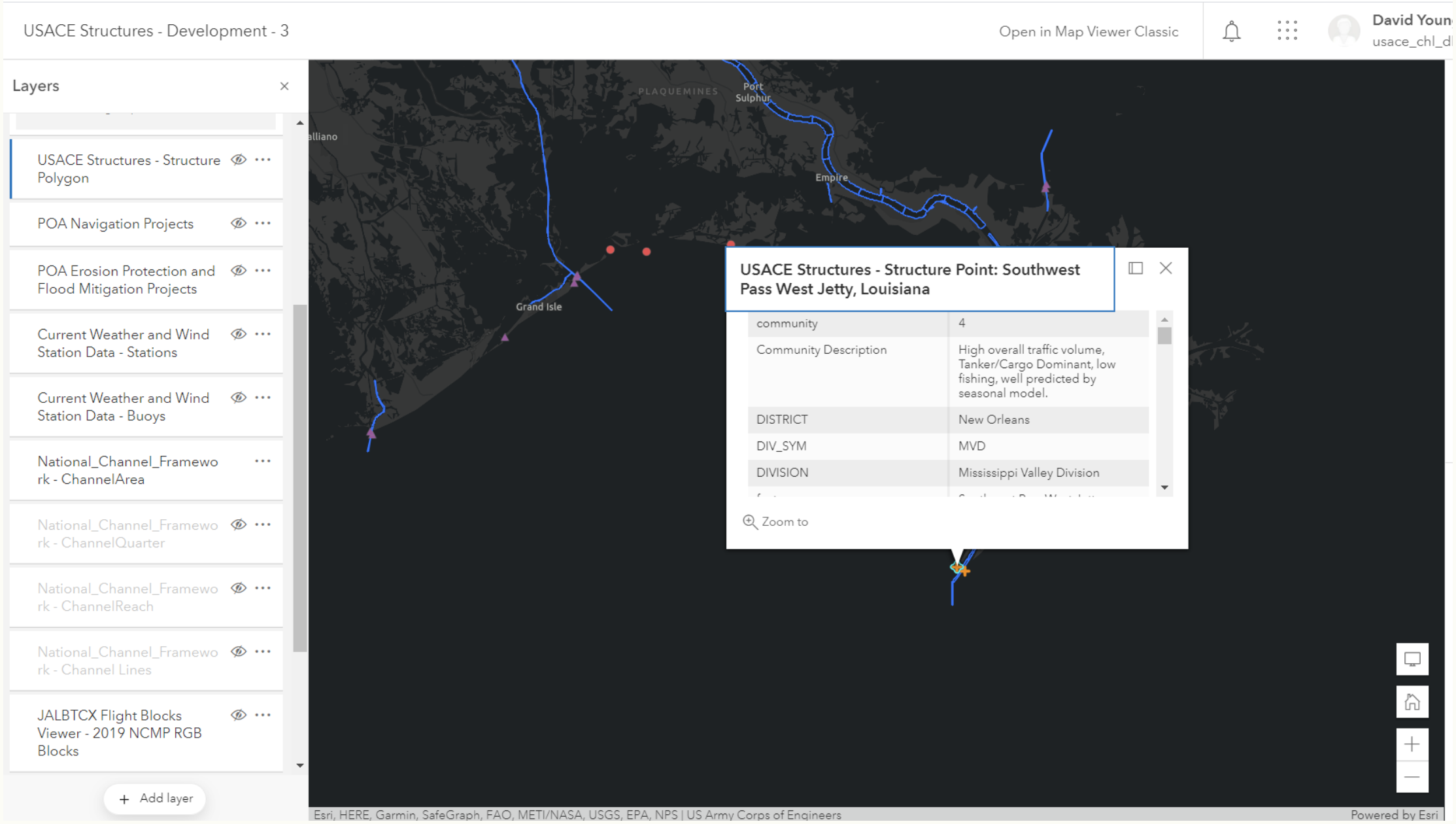

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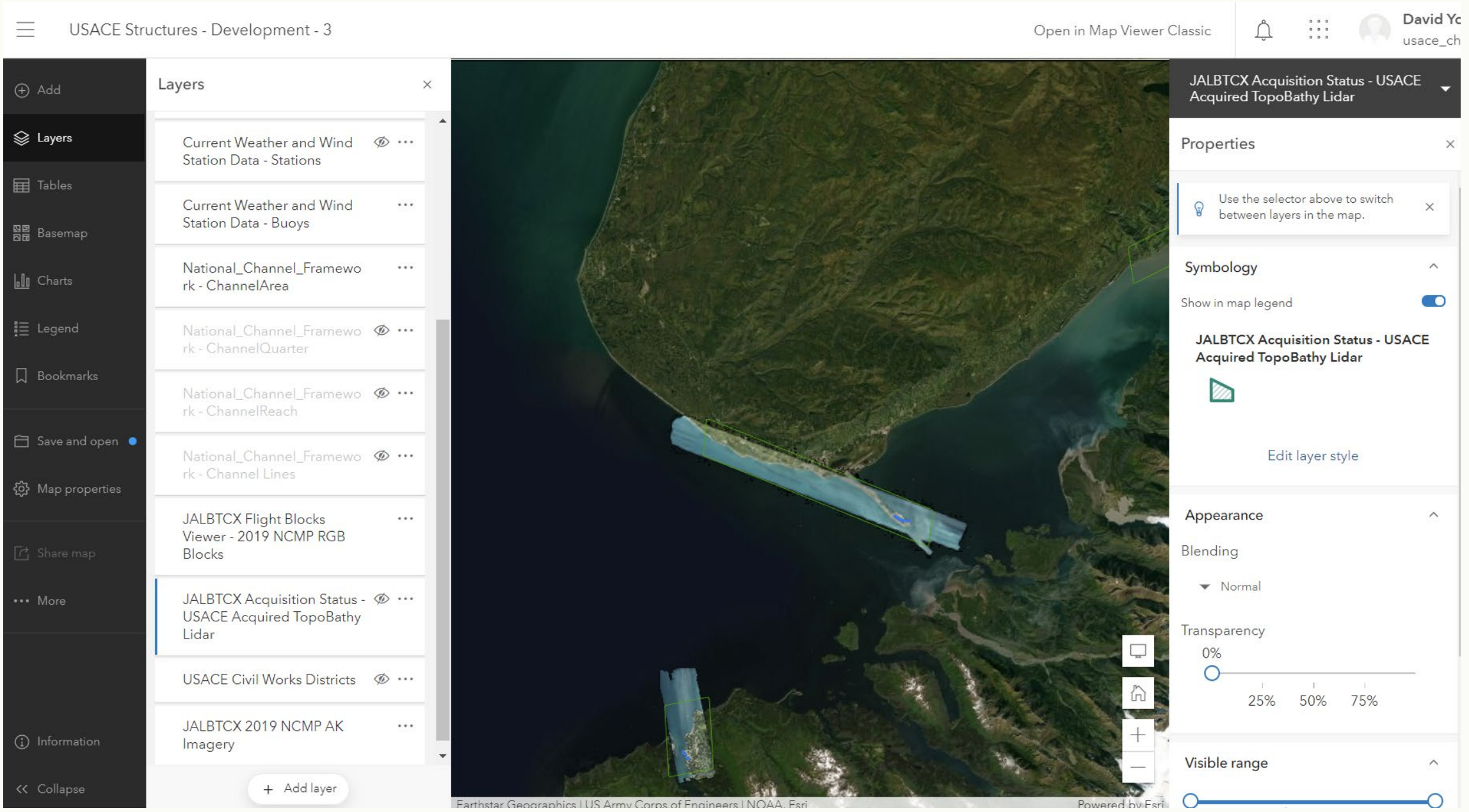

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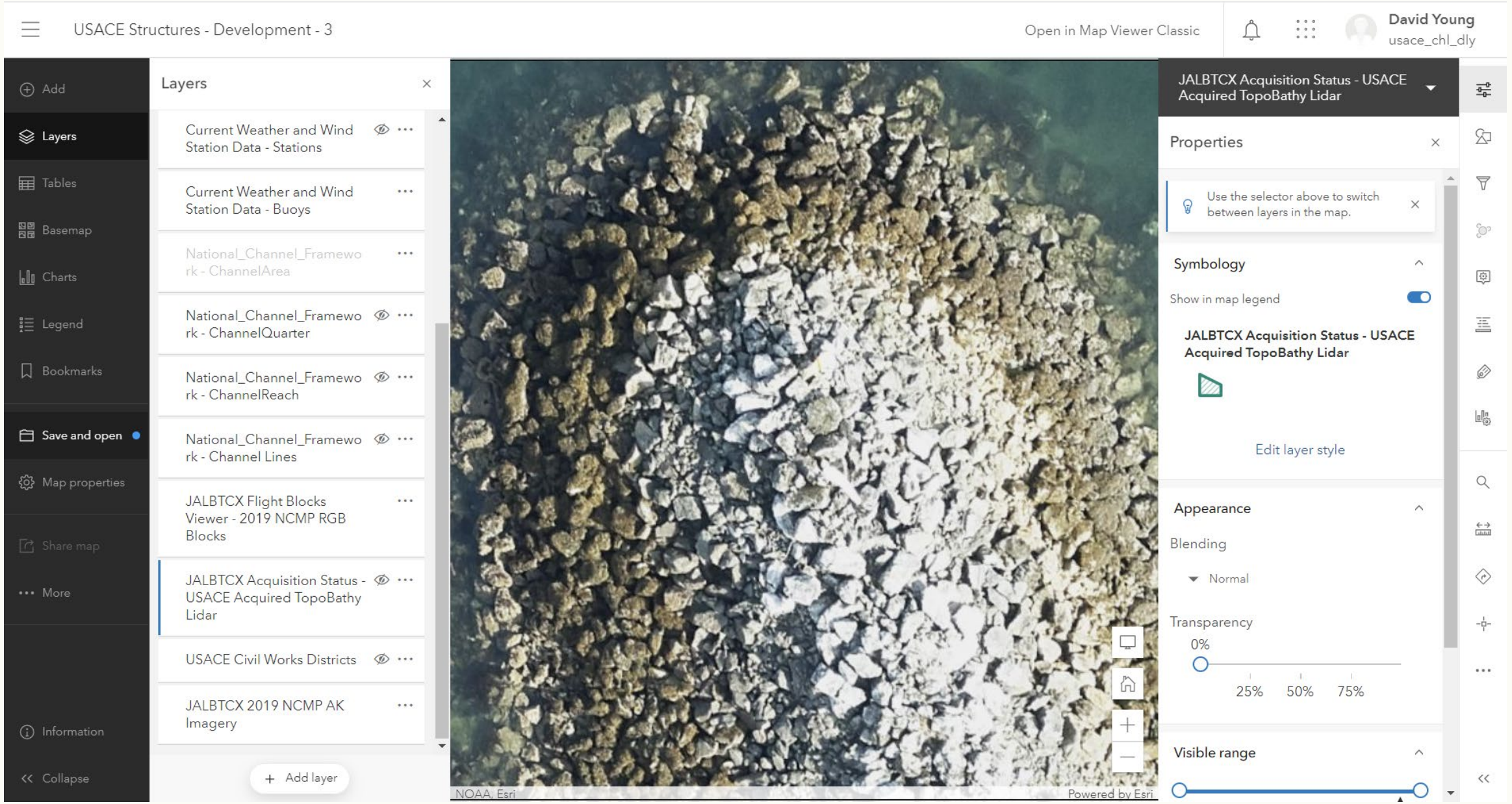

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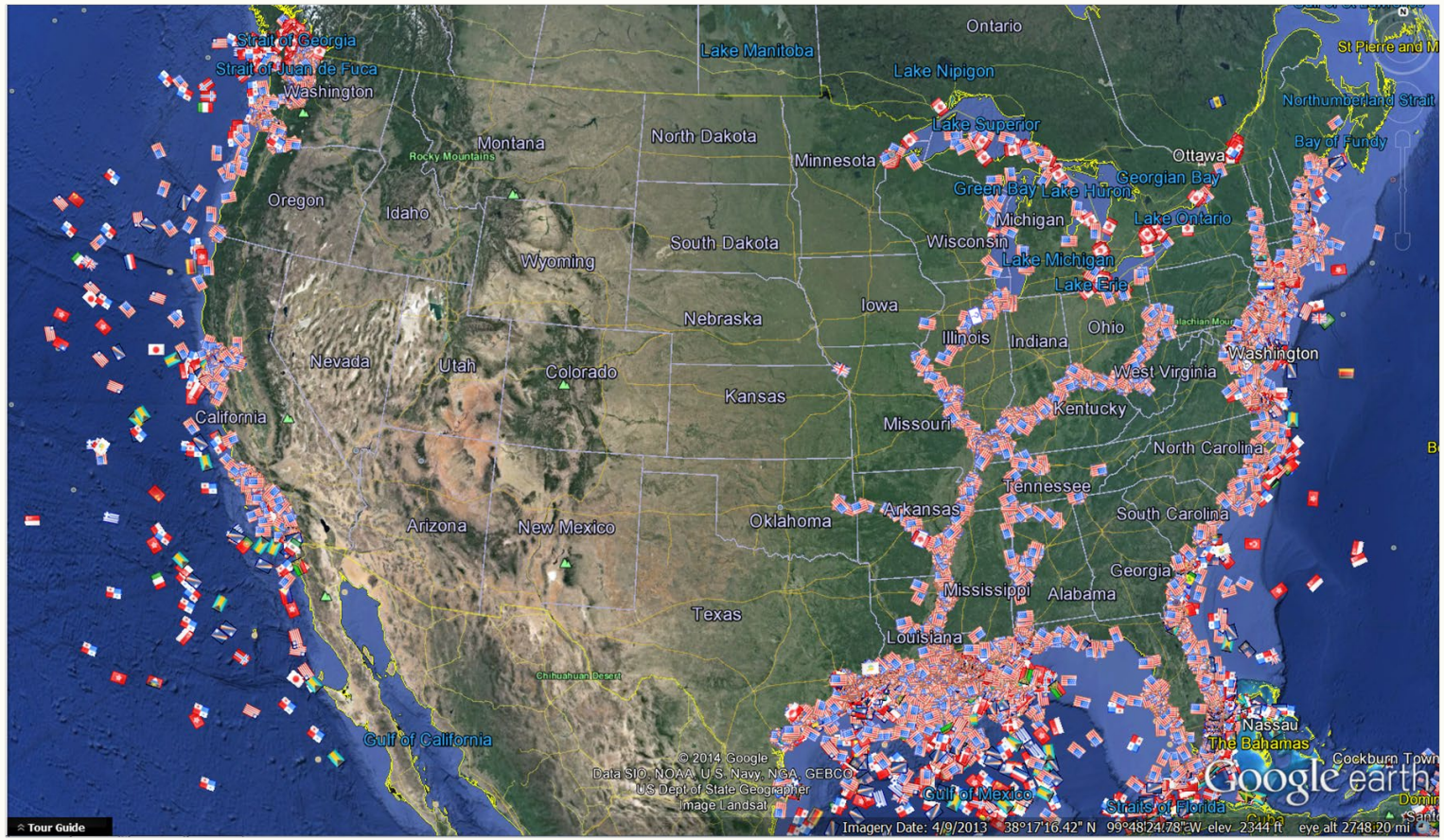
Automation

- Auto-acquire NOAA Tide Gage Data.
- Auto-match structures to WIS stations, NOAA stations.
- Migrate community detection to Python scripts (Candice)
  - Each Structure gets a score for 20 features
  - Pearson Correlation of Navigation Structures (865x865 dense matrix)
  - r-Neighborhood pruning (865x865 sparse matrix)
  - Label Propagation Community Detection Algorithm



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Summary

FY21 Major Advances in Capability

- Major improvements to metrics.
  - Environmental Conditions.
  - Structure Condition/Consequence.
- Map viewer for data products.
- Automation of multiple processes.

FY21 Major Products & Collaborations

- ArcGIS Map Viewer
- District/Division Webinar (4/14/2021)
- CIRP TD (7/27/2021)
- CofC College of Computing
- Outstanding Journal Publication at FY21 CHL Town Hall.

Planned Outyear Products/Advances

- Rerun with more structures, more years of data.
- Additional automation.
- Prepare for transition to cloud – migrate to gitlab.
- 2nd Journal Publication.