

USACE National Coastal Mapping Program: Data, Tools, and Applications

Charlene Sylvester

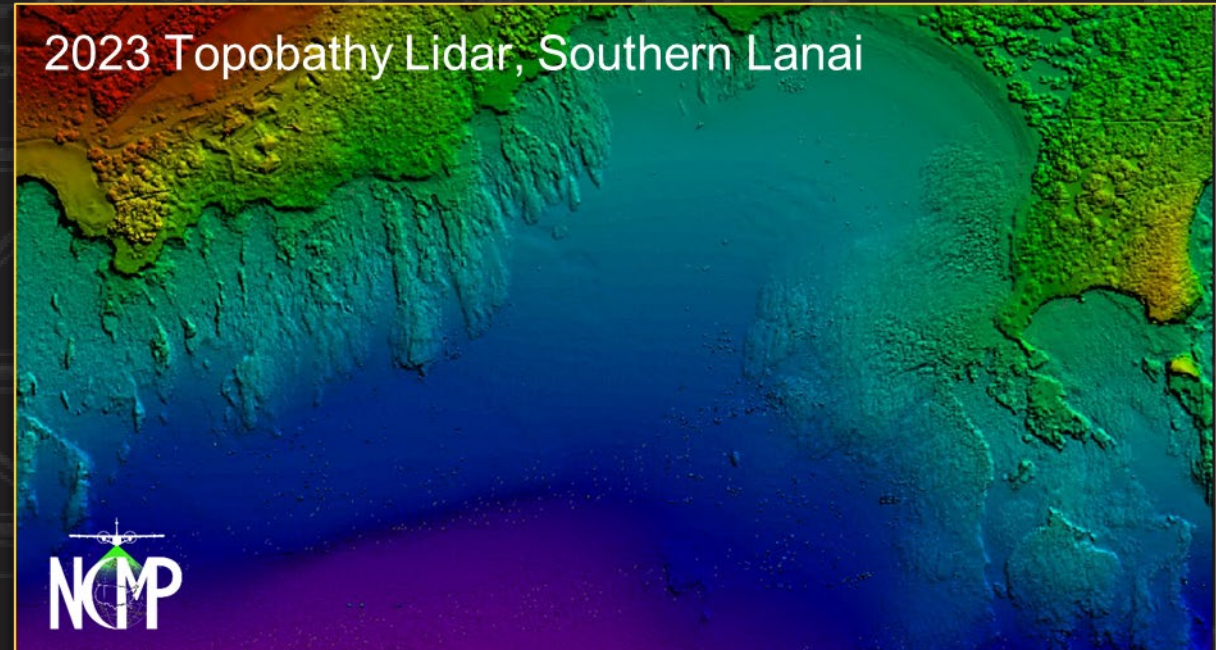
Acting National Coastal Mapping Program R&D Manager
Research Physical Scientist, US Army Engineer Research and
Development Center, Coastal & Hydraulics Laboratory

30 June 2026

Coastal Inlets Research Program Technical Discussion



2023 Topobathy Lidar, Southern Lanai



U.S. ARMY



US Army Corps
of Engineers®



I-ATLAS

Interagency Airborne Technology for Lidar Analysis and Surveying





NATIONAL COASTAL MAPPING PROGRAM TEAM



USACE



Mobile District

Spatial Data Branch



Chris Macon

Operations Manager



Nick Johnson

Lidar Technical Lead



Heath Harwood

Imagery Technical Lead



Jennifer Brizzolara

Production Manager



David White

Special Projects Manager



Environmental Laboratory

Geospatial Data Analysis Team



Molly Reif

Team Lead and Research Geographer



Sam Jackson

Research Forester



Christina Saltus

Research Geographer



Coastal and Hydraulics Laboratory

Coastal Engineering Branch



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THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL



Ship and Cat Islands, MS, 2020

Jennifer.M.Wozencraft@usace.army.mil

UNCLASSIFIED



U.S. ARMY

I-ATLAS

Interagency Airborne Technologies for Lidar, Analysis, and Surveying



@Stennis International Airport, Kiln, MS

- An evolution of 28-year JALBTCX partnership among USACE, Navy, NOAA, USGS, and most recently, NGA and USCG
- Focuses on collaborative operations, research, and development in coastal mapping, charting, engineering, and science to meet partner agency missions
- Supports and leverages work across government, industry, and academia to advance airborne lidar bathymetry, coastal mapping technologies, and applications for the nation

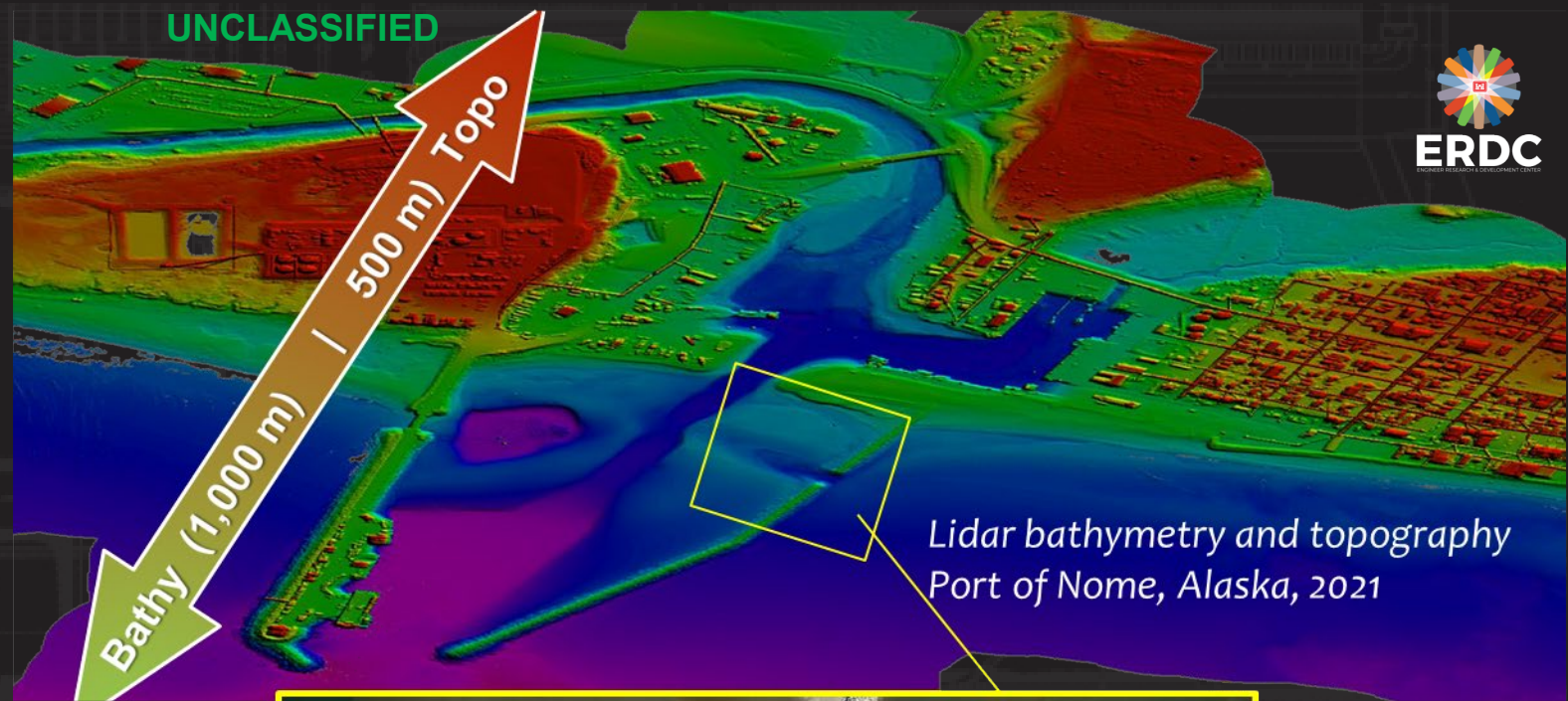


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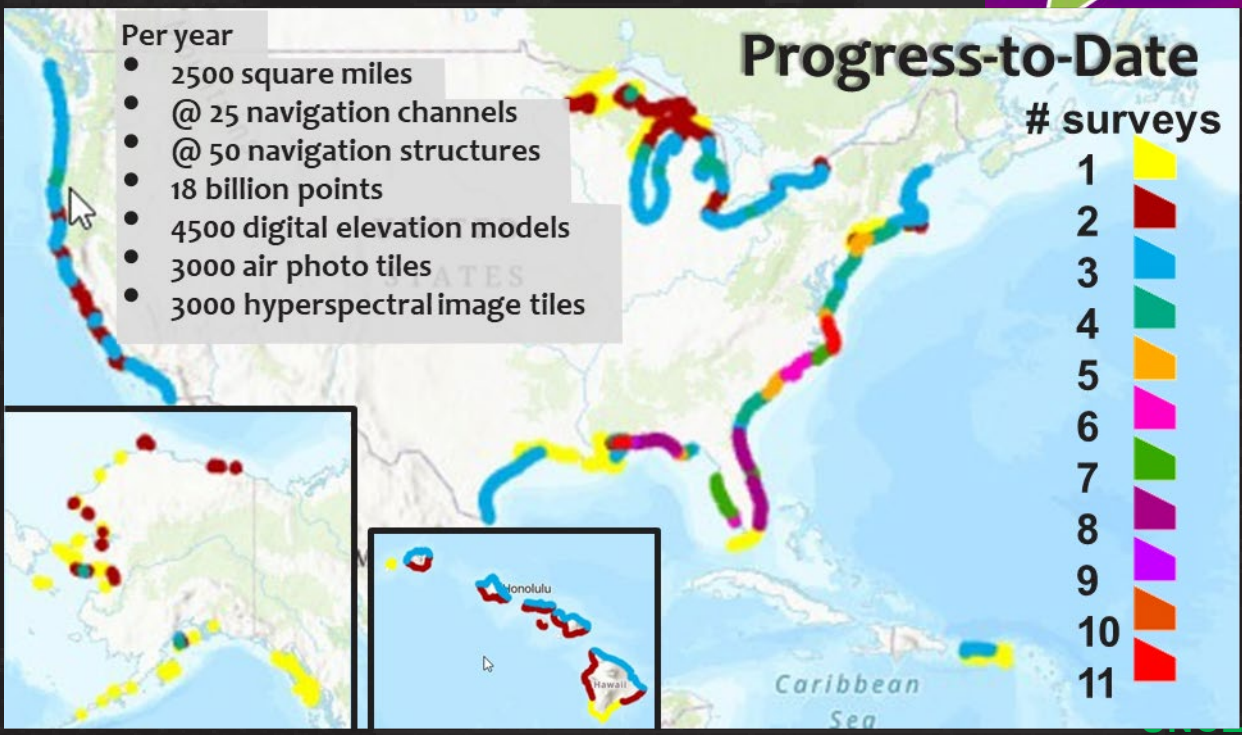


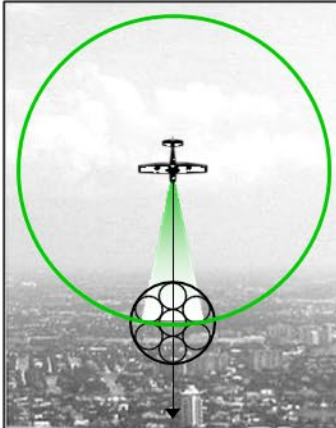
NATIONAL COASTAL MAPPING PROGRAM

- Develops regional, repetitive, high-resolution, high-accuracy elevation and imagery data for measuring sediment volume change and identifying sediment transport pathways
- Fulfills data requirements for management of sediment and projects at a regional, or watershed scale



Lidar bathymetry and topography
Port of Nome, Alaska, 2021





Coastal Zone Mapping and Imaging Lidar

3rd generation coastal mapping and tactical charting system developed with JALBTCX

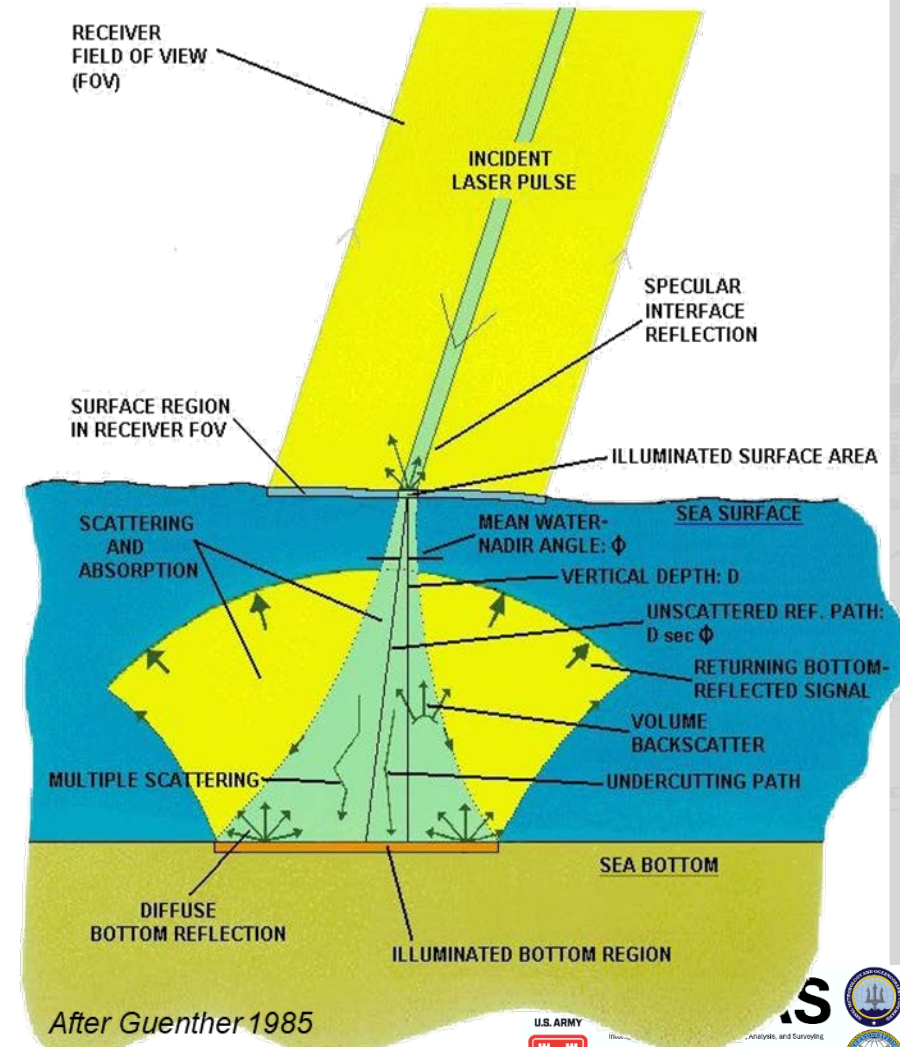
Collects bathymetry up to 60 m
15 cm 1 σ precision bathymetry
QL2 topography
5 cm aerial photography (PhaseOne)
1-m, 48-band hyperspectral imagery (Itres Casi-1500)*

400 m

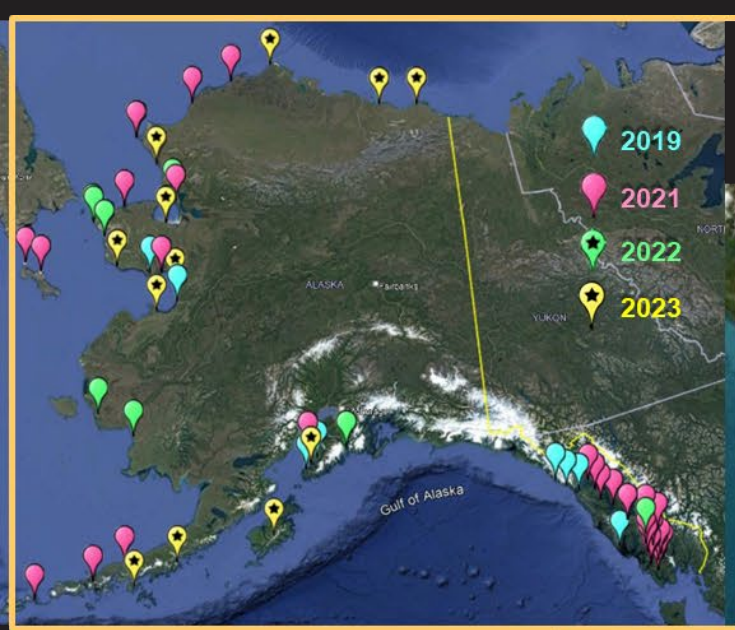
Dia: 290m



US Army Corps of Engineers

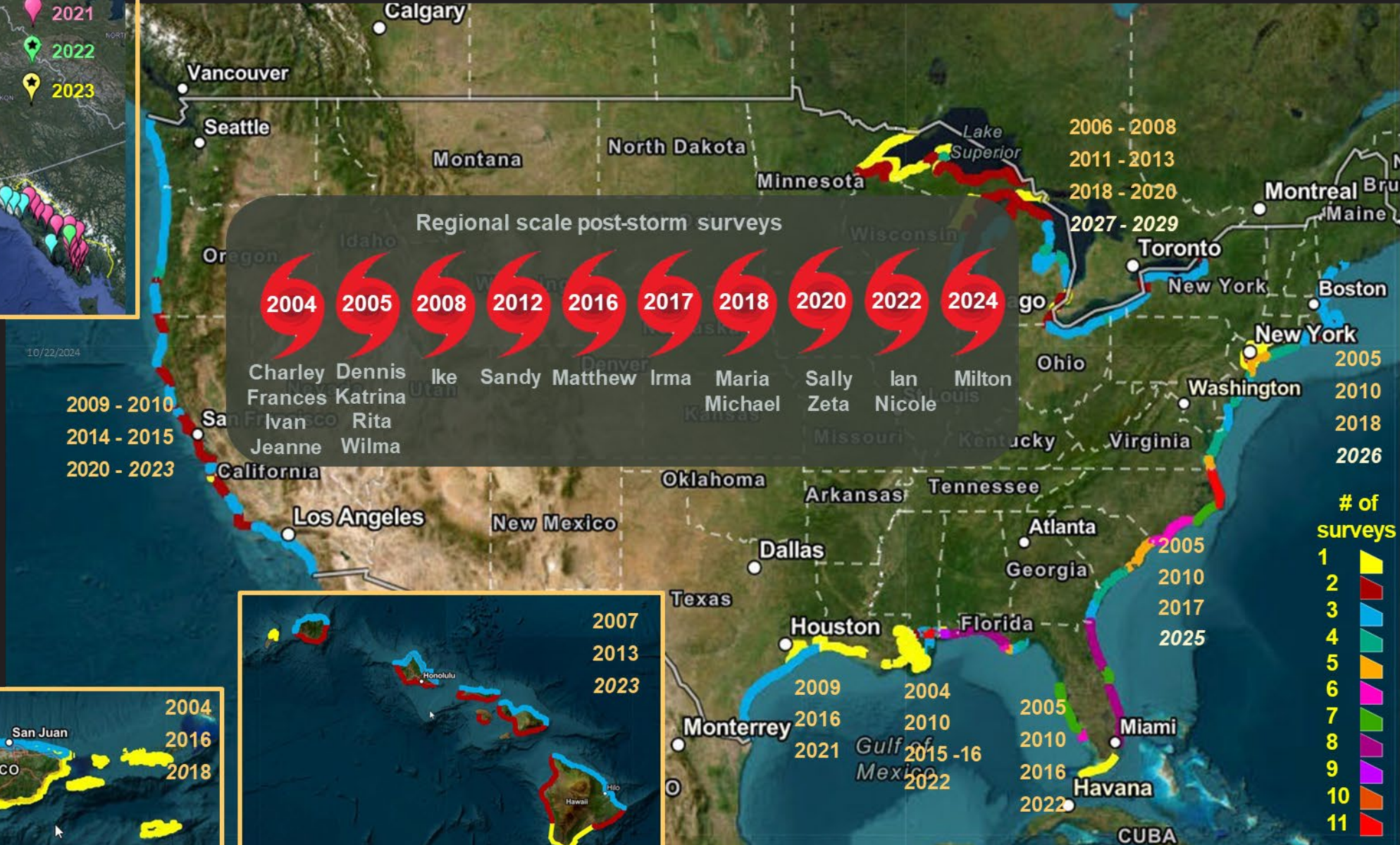


NCMP DATA COLLECTION



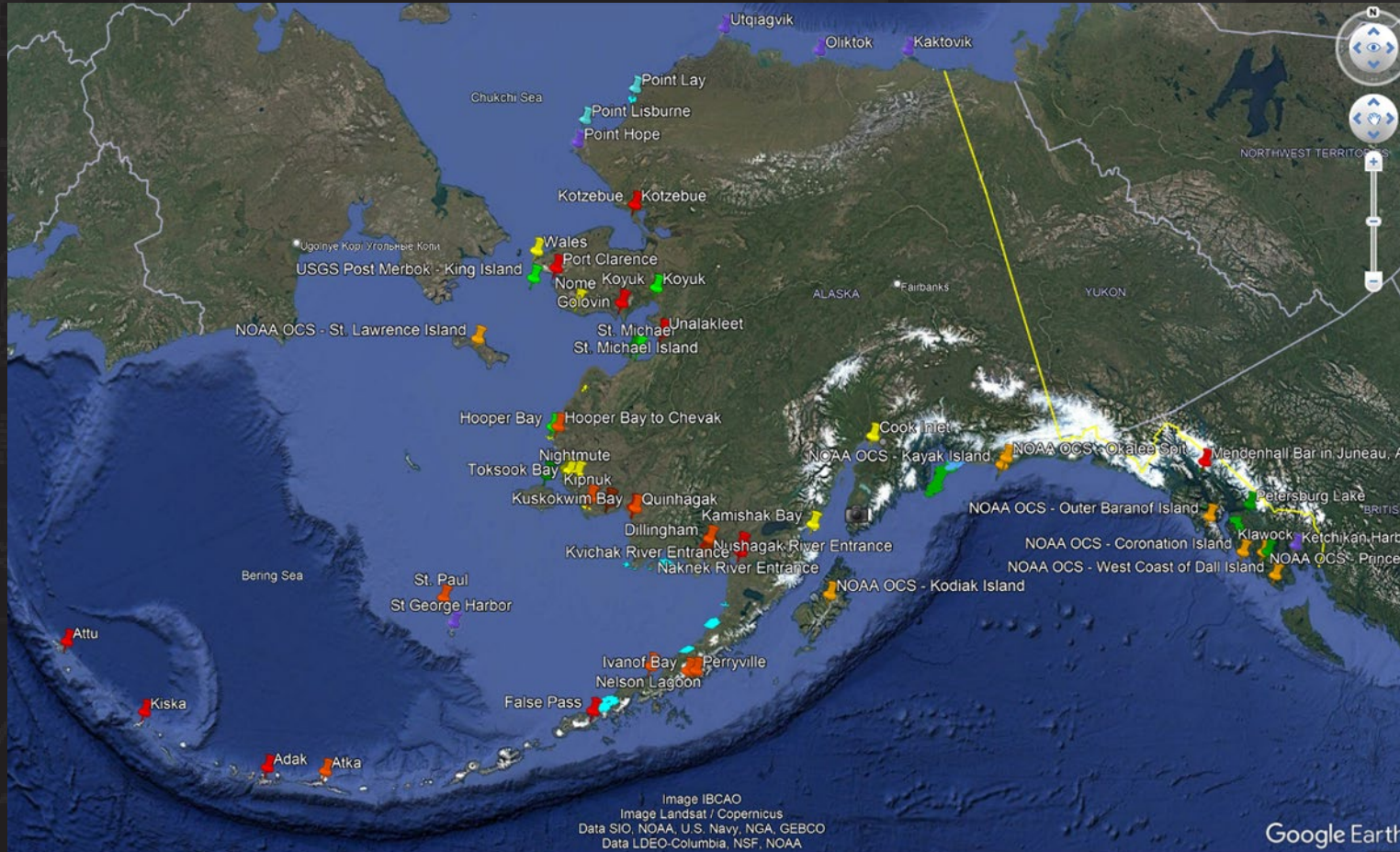
JALBTCX surveys supporting military efforts

- Kwajalein 2023
- Wake Island 2023
- Mediterranean 2025
- Pacific 2026

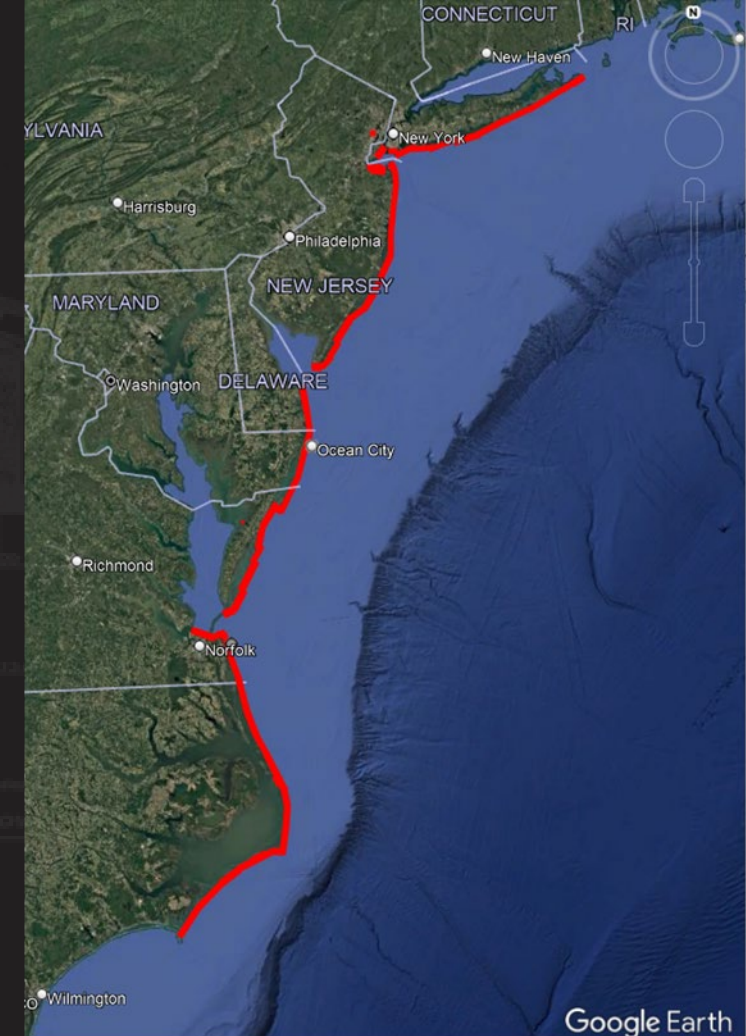




NATIONAL COASTAL MAPPING PROGRAM 2026



AK – Requirements gathered from USACE, USGS, NOAA, NRCS, USFWS, USFS, AK DNR Dept. Geological and Geophysical Surveys



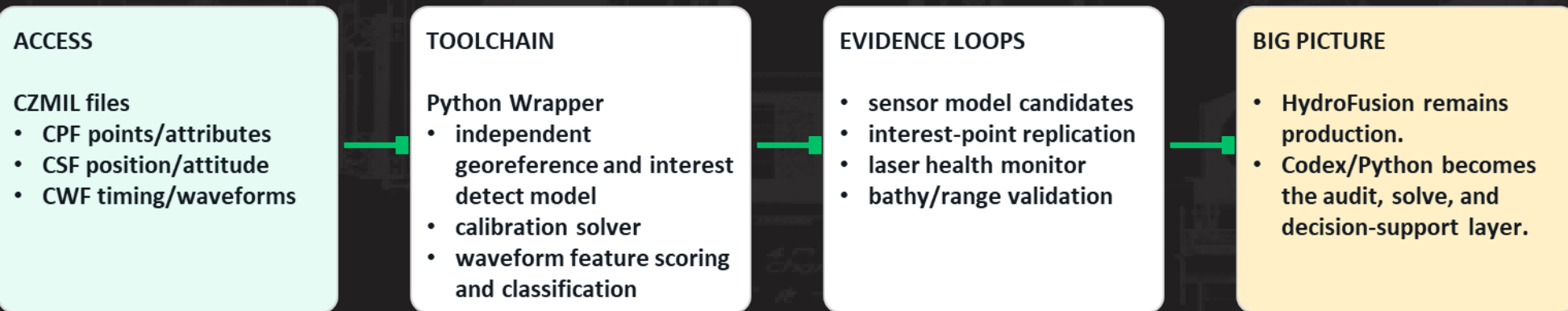
Cape Lookout, NC – Montauk Point, NY



DATA PRODUCTION IMPROVEMENTS

Codex and CZMIL access turned one-off questions into repeatable tools.

Access to CZMIL's native data files via Codex and Python to create tools that improve production, quality, and confidence.



Tools unlocked by access

- **Calibration** recompute XYZ, solve X/Y misalignment and range offsets
- **Monitoring** mission T0 plots, pulse power and deviation, cumulative history
- **Classification** waveform features , position, and native attributes all available
- **Validation** ground/TIN/control checks, tie-plane RMS, runway reference, custom LAS
- **Packaging** portable app/EXE path, repeatable reports, candidate write-back

PATH FORWARD

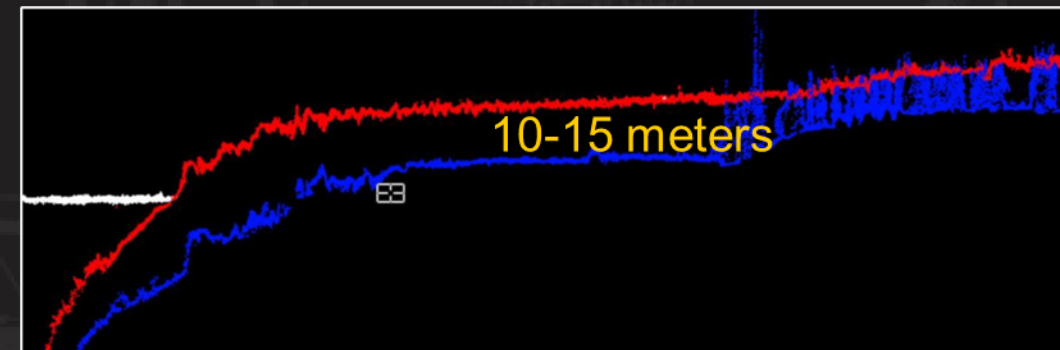
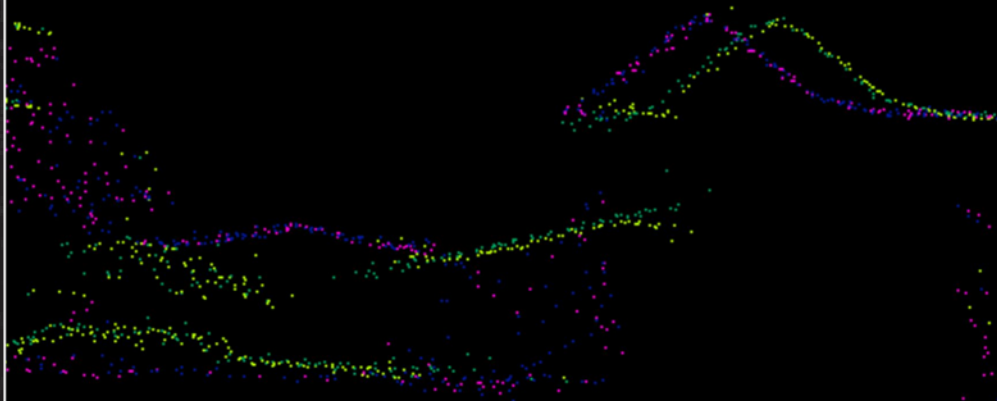
1. Standardize the access package and file readers.
2. Combine georeference and interest point models to work on independent in-air range solution
3. Move to solving water surface and in-water angles and range.
4. Package repeatable review products for field + calibration teams.
5. Close the loop with Hydro fusion write-back and documented acceptance tests.



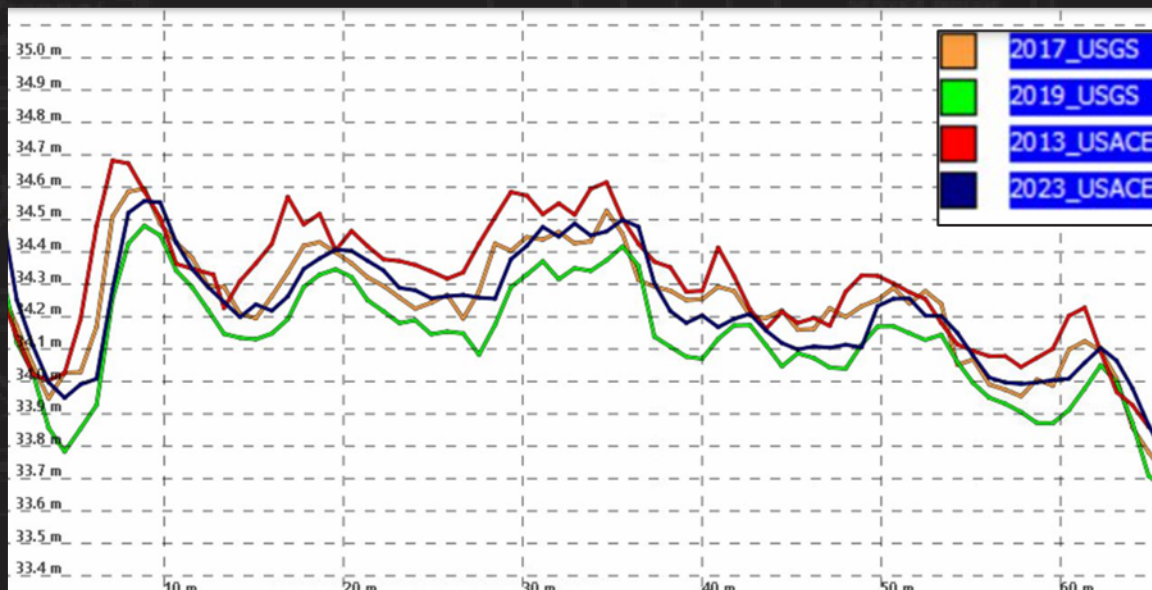
DATA PRODUCTION TROUBLESHOOTING

2013-2023 Comparison flags a potential calibration or navigation shift prior to use in applications.

Big Island fixed-lava profiles show an apparent ~1.5 m southward offset.



Fixed lava reference profiles



- Apparent ~1.5 m horizontal shift **2013** vs **2023** in the southern direction
- Calibration/navigation caution before moving into the applications.

Kilauea Lower East Rift USGS Info (~5m of fault slip seaward):
<https://www.youtube.com/watch?v=85WXeY4U56g>
<https://www.usgs.gov/media/images/lava-flow-thickness-2018>



NATIONAL COASTAL MAPPING PROGRAM PRODUCTS



Foundational lidar and imagery products for coastal planning, navigation, infrastructure, environmental monitoring, and hazard mitigation

USACE APPLICATIONS

1 Regional Sediment Management

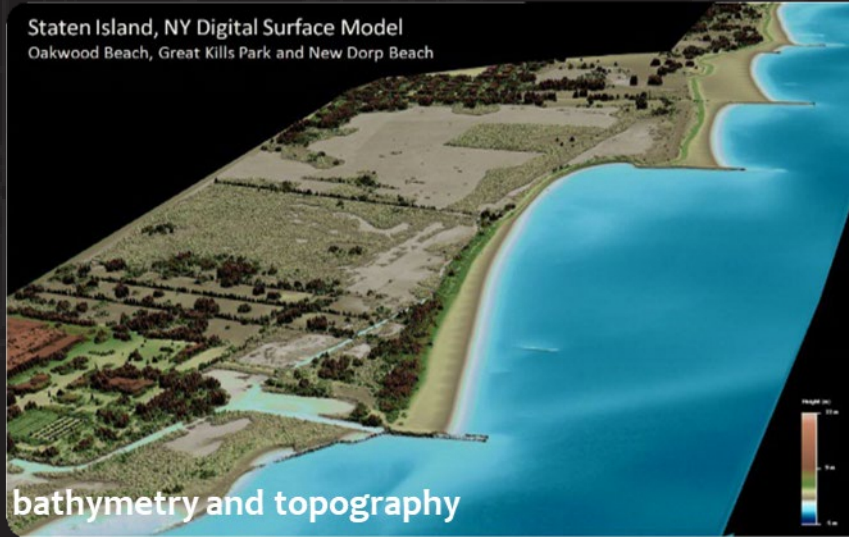


- Regional sediment budgets
- Regional context for sediment management
- Integration with RSM-SBAS (Sediment Budget Analysis System)

2 Infrastructure and Asset Management



- Measure and monitor coastal infrastructure (e.g., engineered beaches)
- Coastal structure condition assessment to inform O&M priorities
- Data for modeling structure performance



4 Beneficial Use and Nature-Based Features



- Data for monitoring of sensitive habitats and species (e.g., wetlands, SAV, sea turtles)
- Design and monitoring of beneficial use sites and natural and nature-based features

3 Navigation & Channel Operations



- Baseline information to inform operational changes (e.g., deepening)
- Coastal navigation channel condition assessments (e.g., shoaling analysis)
- Navigation channel impacts to adjacent beaches
- Base data layer for the USACE Navigation Portal

5 Planning, Modeling, and Response



- Updated topography and bathymetry to drive coastal models
- Rapid-response products to support the emergency management mission
- Regional data for Rapid Planning and Coastal Comprehensive Studies

OTHER AGENCY USES

NOAA

- Nautical chart updates
- Tsunami modeling
- Public dissemination

USGS

- Coastal hazard studies
- Operational storm forecasts
- Coastal Studies

FEMA

- Flood hazard mapping
- Eligibility for public assistance

NPS

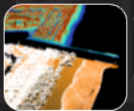
- Monitor national parks



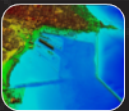
Products and Tools

I-ATLAS Interagency Airborne Technologies for Lidar, Analysis, and Surveying

NCMP DATA AND PRODUCTS



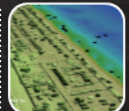
Classified LAS Point Clouds



Topobathy Digital Surface Models



"Bare Earth" Elevation Models



NAVD88 0-m Contour



5-cm GSD True-color Image Mosaics



Hyperspectral Image Mosaics (VNIR, 1-m, 48-band)

ACCESS TO NCMP DATA



Office for Coastal Management
DIGITALCOAST

NOAA Digital Coast
Data Access Viewer



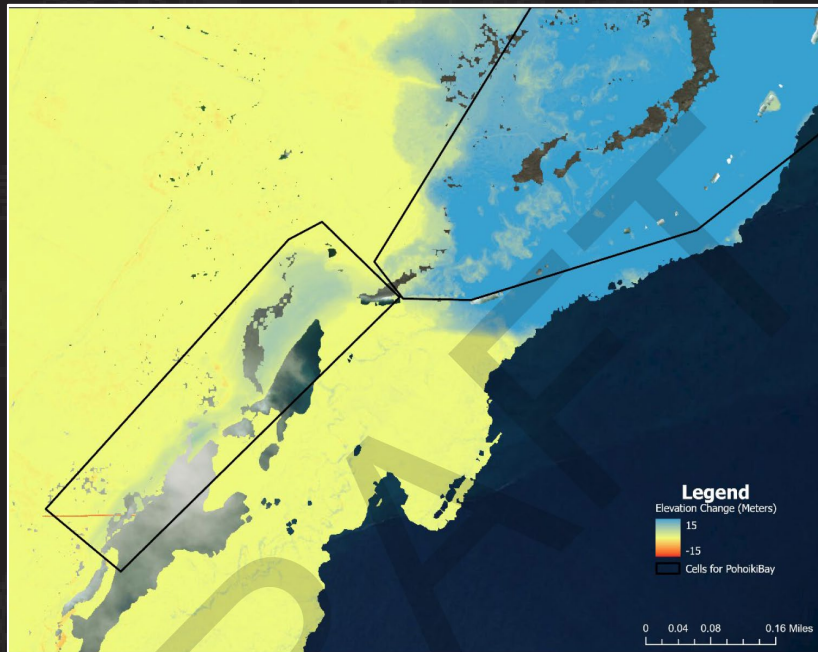
USACE Geospatial Repository
and Data Management System



POHOIKI BAY

Pohoiki Bay, Hawaii - Hydrodynamic Analysis, Sediment Budget, and Coastal Modeling

The 2023-2013 comparison supports volume change and sediment-budget analysis for channel planning.



- Data supports sediment budgets, hydrodynamic modeling, and dredging-frequency planning.

~345k m³ sediment deposited



Proposed channel

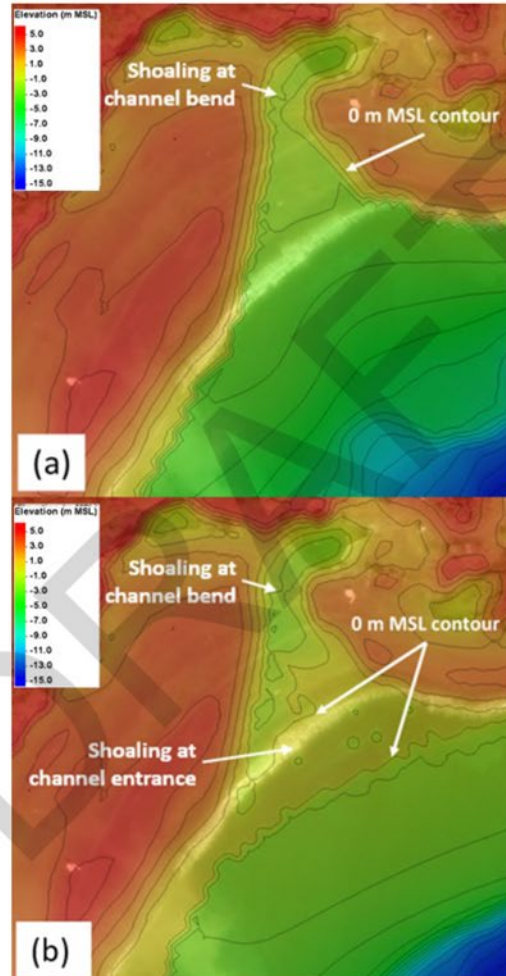




MODELING RESULT

Pohoiki Bay, Hawaii - Hydrodynamic Analysis, Sediment Budget, and Coastal Modeling

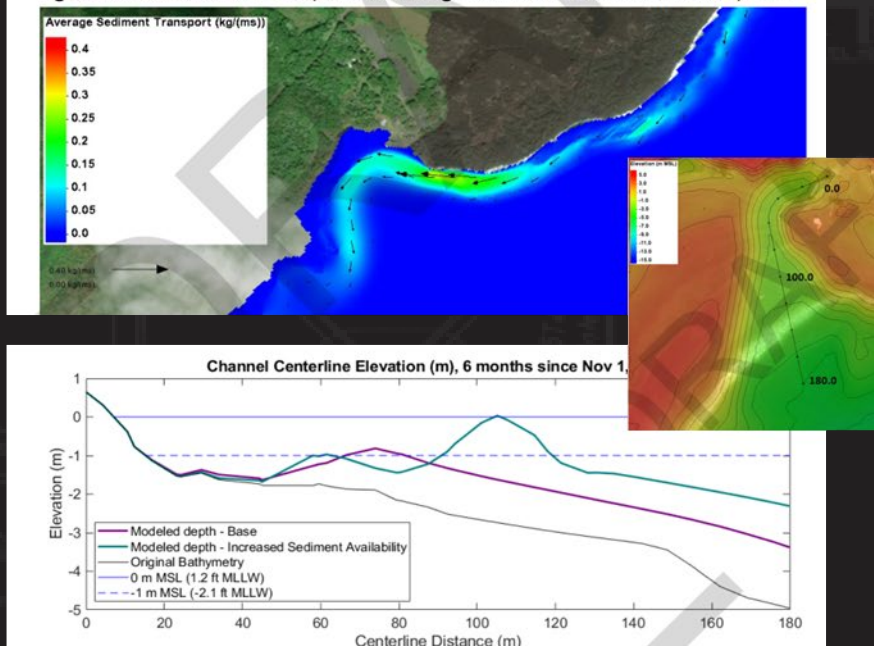
Figure 5-14. Model elevation after the one-year simulation for (a) the base case and (b) the increased sediment availability simulation.



Maintenance is estimated at 5,500 cy of dredging three times per year; jetties and cobble placement could reduce maintenance.

- Support for base model estimates
- Shoaling exceeds navigable depth in 4-5 months

Figure 5-2. Model sediment transport rates averaged over the nine-month simulation period.



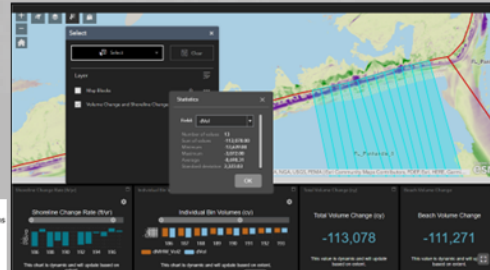


NCMP R&D PRODUCTS

Management of Navigation, Coastal Storm Risk Management, and Ecosystem Restoration projects regionally requires regional-scale datasets and consistent metrics for planning, operations and maintenance, monitoring, and decision support.

Sediment Volume Change

- Context for Regional Sediment Management
- Quantities for regional sediment budgets and sediment budget tools
- Post-storm quantities for beach restoration



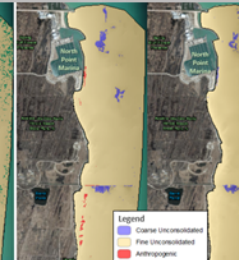
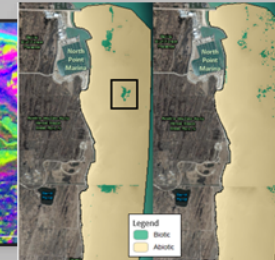
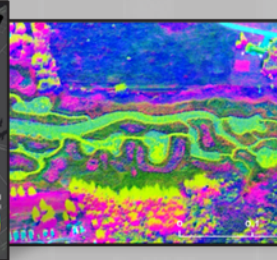
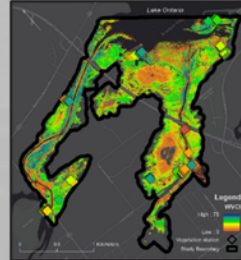
Scan for NCMP
Volume Change
Web Application

Coastal Wetland and Benthic Mapping

- Data fusion approach combining imagery and lidar
- Integrate NCMP data with routinely collected field data by partners
- Address lack of nearshore habitat data for management activities

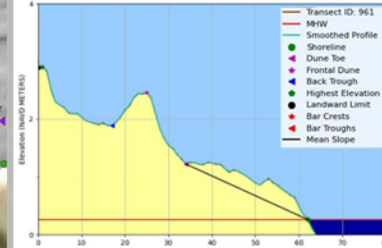
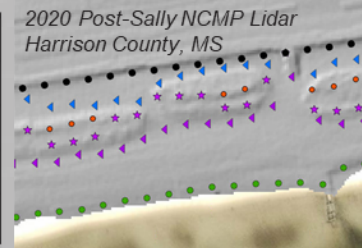
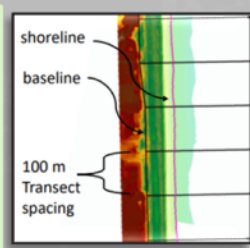


Scan for
publication



Geomorphic Characterization and Metrics

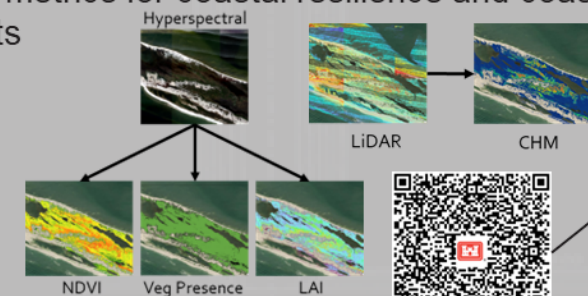
- Transect-based extraction of dune crest and toe, bluff top and toe, shoreline, sand bar crest and trough at regional scale
- Consistent beach metrics for data-informed decisions and management



Coastal Vegetation Mapping

- Extraction of high-priority dune vegetation metrics from lidar and hyperspectral imagery
- Provides repeatable metrics for coastal resilience and coastal storm risk management projects

Methods:
Jackson et al., 2023
Suir et al., 2023





NCMP Toolbox



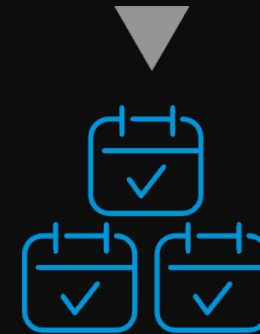
Quick Response

- Generate and edit baseline and transects
- Quantify shoreline and volume change
- Standardized mapping



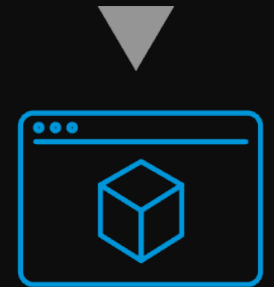
Coastal Engineering

- Profile metrics
- Coastal Engineering Resilience Index



Multiple Dataset

- Multiple years
- Quantify trends



Modeling

- CSHORE



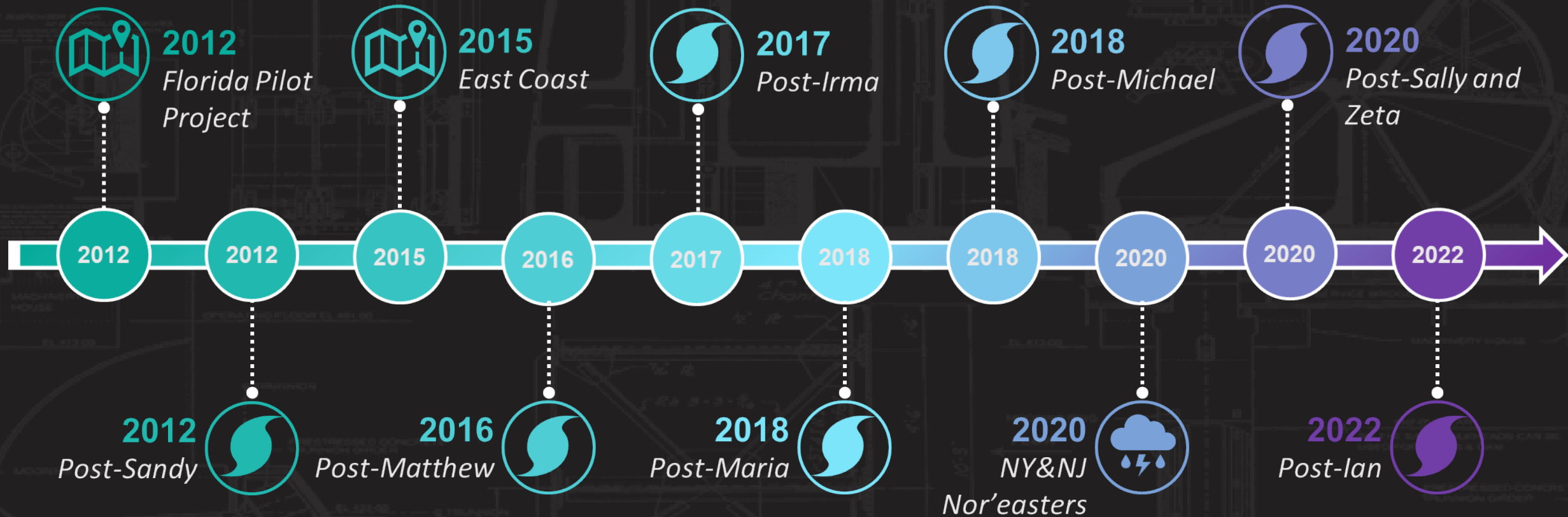
Documentation and training:
<https://www.cirpwiki.info/wiki/I-ATLAS>



NCMP QUICK RESPONSE TOOLBOX



Advancing GIS solutions for actionable intelligence to inform Storm Response and Infrastructure Resilience



Hard-copy Maps

ESRI ArcView
(C++, VB Code)



Automated Code

Matlab and ESRI
Data-Driven Pages



Web Services

ArcGIS Server and
Web App Builder



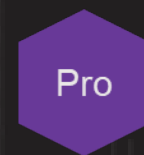
GIS Toolboxes

ESRI ArcGIS
ArcMap



Web Dashboard

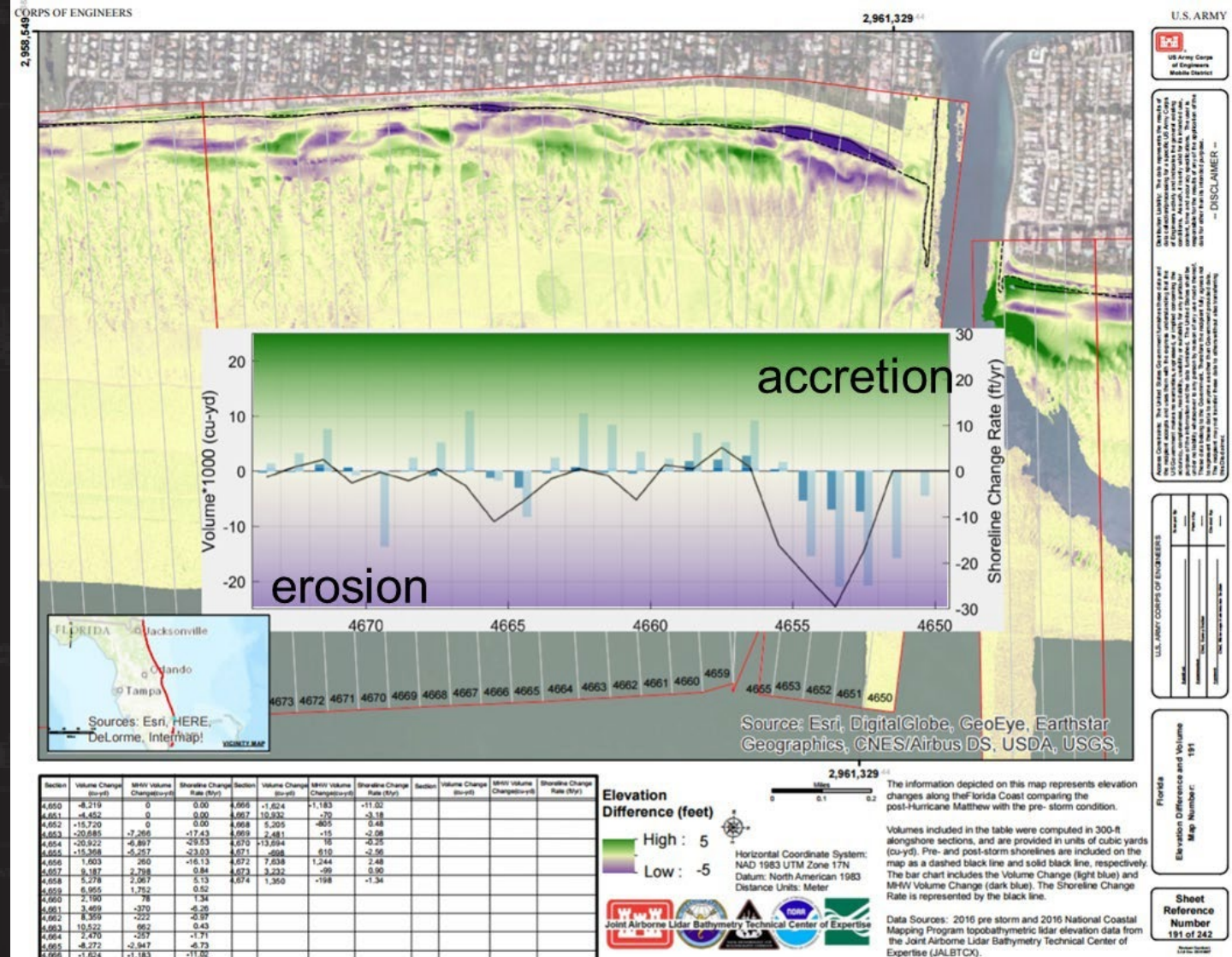
ESRI Experience
Builder



Toolbox Modernization

ESRI ArcGIS Pro
and Multi-dataset

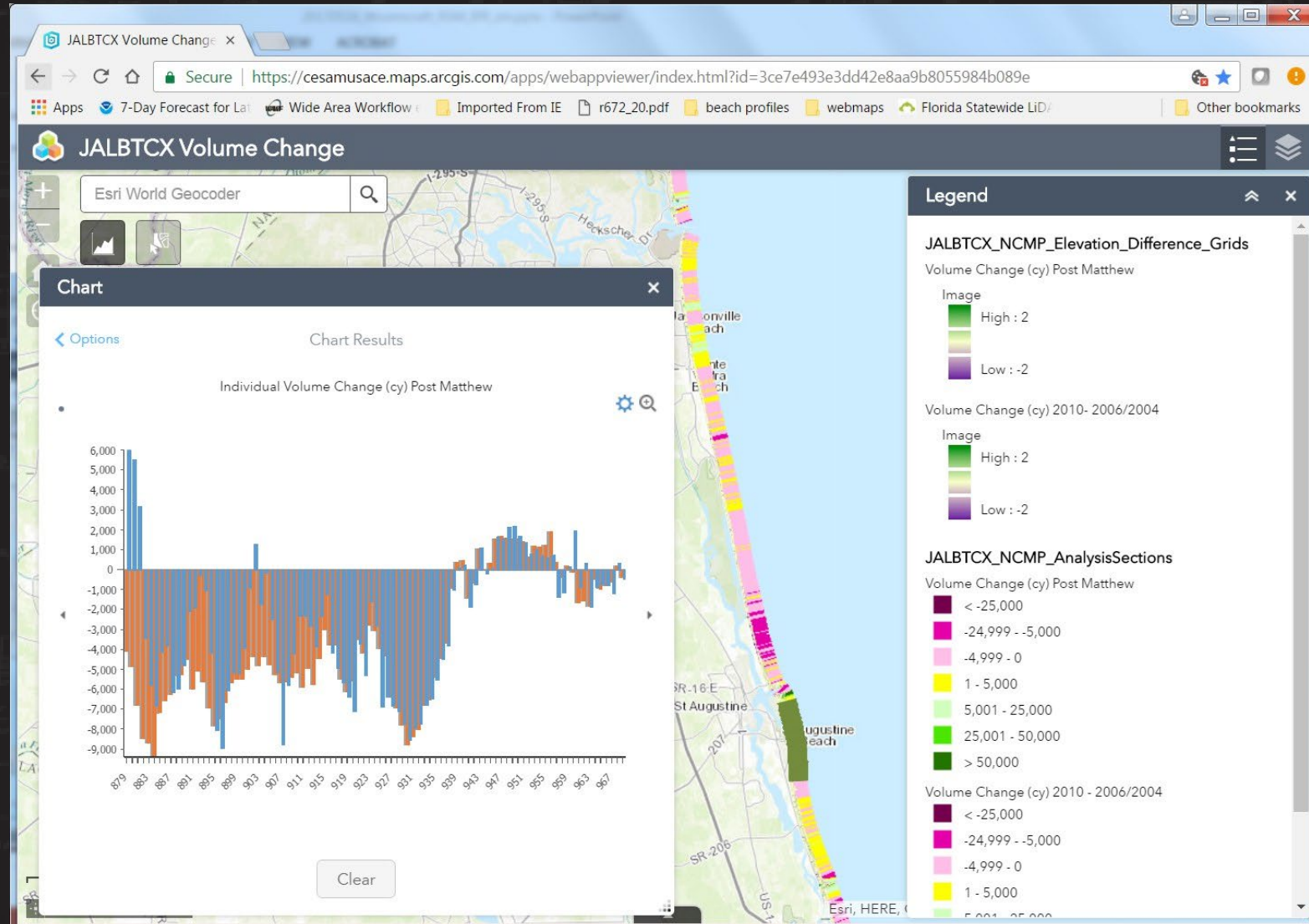
Evolving Solutions and Expanding Capabilities





NCMP QUICK RESPONSE TOOLBOX - VOLUME

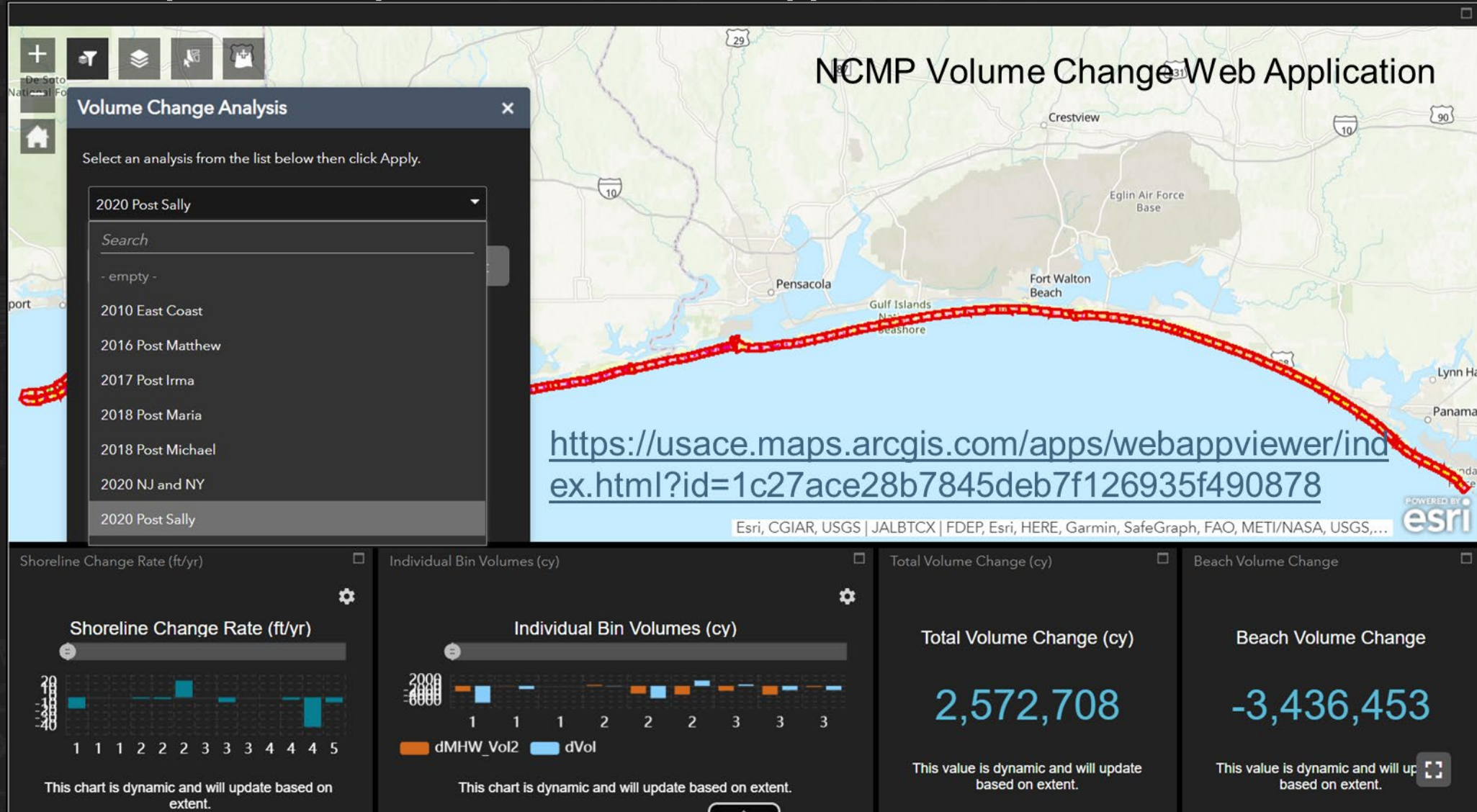
From static maps to interoperable services and apps





NCMP QUICK RESPONSE TOOLBOX – WEB APP

From static maps to interoperable services and apps





SEDIMENT BUDGET UPDATE FOR THE MISSISSIPPI COASTAL IMPROVEMENTS PROGRAM, MSCIP

UNCLASSIFIED



Creation of a baseline sediment budget using modern approaches to support adaptive management of the Mississippi Barrier Islands

- Sediment placement of over 15.3 million cubic meters (20 million cubic yards) planting of over 300,000 native dune species to restore Ship Island
- Modern sediment budget created using the the Sediment Budget Analysis System (SBAS) to support monitoring and inform adaptive management actions
- 15+ lidar datasets since 1998, collected by I-ATLAS and partners
- Volumes for sediment budgets derived with NCMP Rapid Response Toolbox

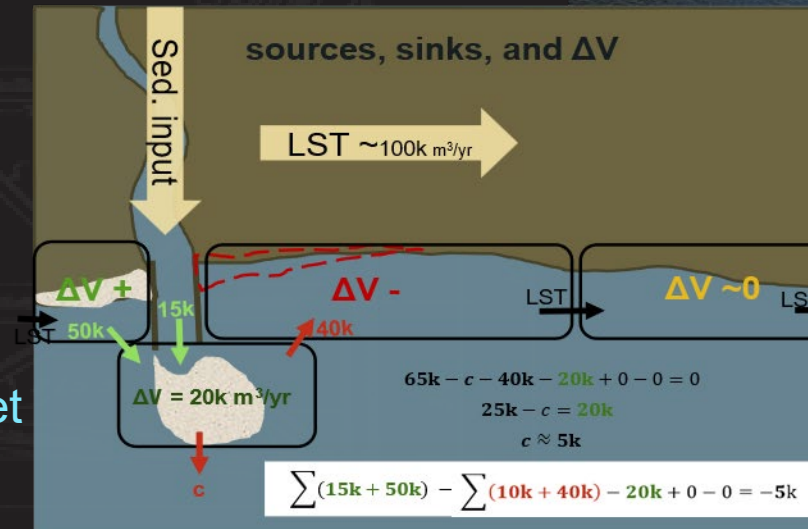


Images courtesy of Mobile District



Milestones:

- ✓ Baseline post-construction sediment budget
- 2025 sediment budget
- 2030 sediment budget



Conceptual sediment budget accounting for sediment sources, sinks, fluxes, and transport directions.

Graphics courtesy of Scott Spurgeon and Mobile District

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PROFILE METRICS AND COASTAL ENGINEERING RESILIENCE INDEX (CERI)

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Legend

2018 NCMP Elevation
NAVD88, meters

CERI values
● 3.1-10
● 2.5-3.0
● 0.4-2.5



Northern Gulf of Mexico, Post-Hurricane Sally 2020

high resilience

low resilience

$$\text{CERI} = a + b + c + d + e$$

Protective Elevation
(PE) factor

Protective Width
(PW) Factor

Wave Run-Up
(WR) Factor

Volume Density
(VD) Factor

Crest Freeboard
(CF) Factor

- Shoreline
- ▲ Dune Toe
- Beach Slope
- ▲ Back Trough
- ★ Frontal Dune

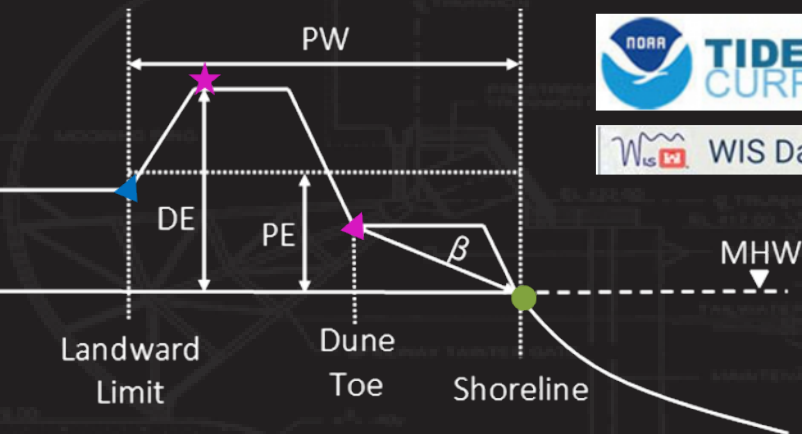
Stockdon et al., 2006



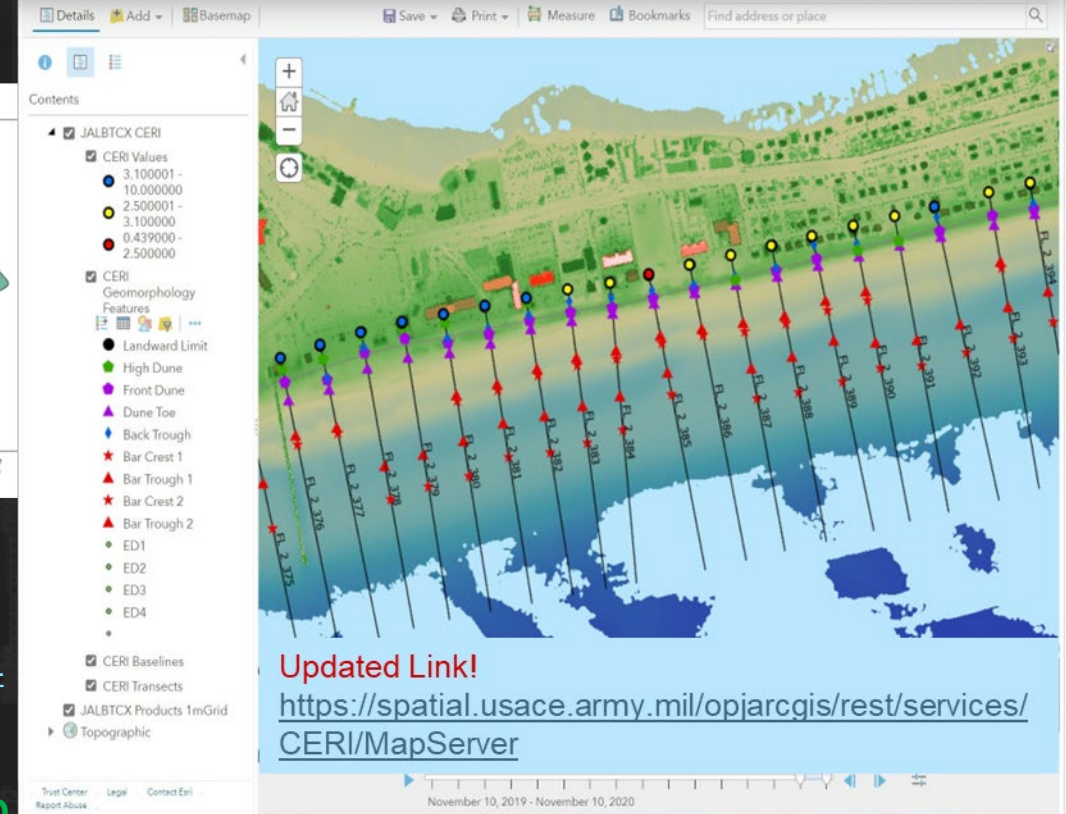
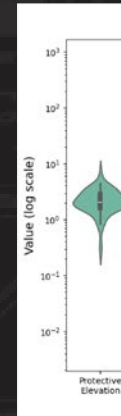
WIS Data Portal



Dong et al., 2018
<https://doi.org/10.9753/icce.v36.papers.30>
Spurgeon et al., 2023
<https://doi.org/10.1061/JWPED5.WWENG-1973>
Shawler et al., 2026
<https://dx.doi.org/10.21079/11681/50256>



Graphics courtesy of Aleks Ostojic and Quin Robertson



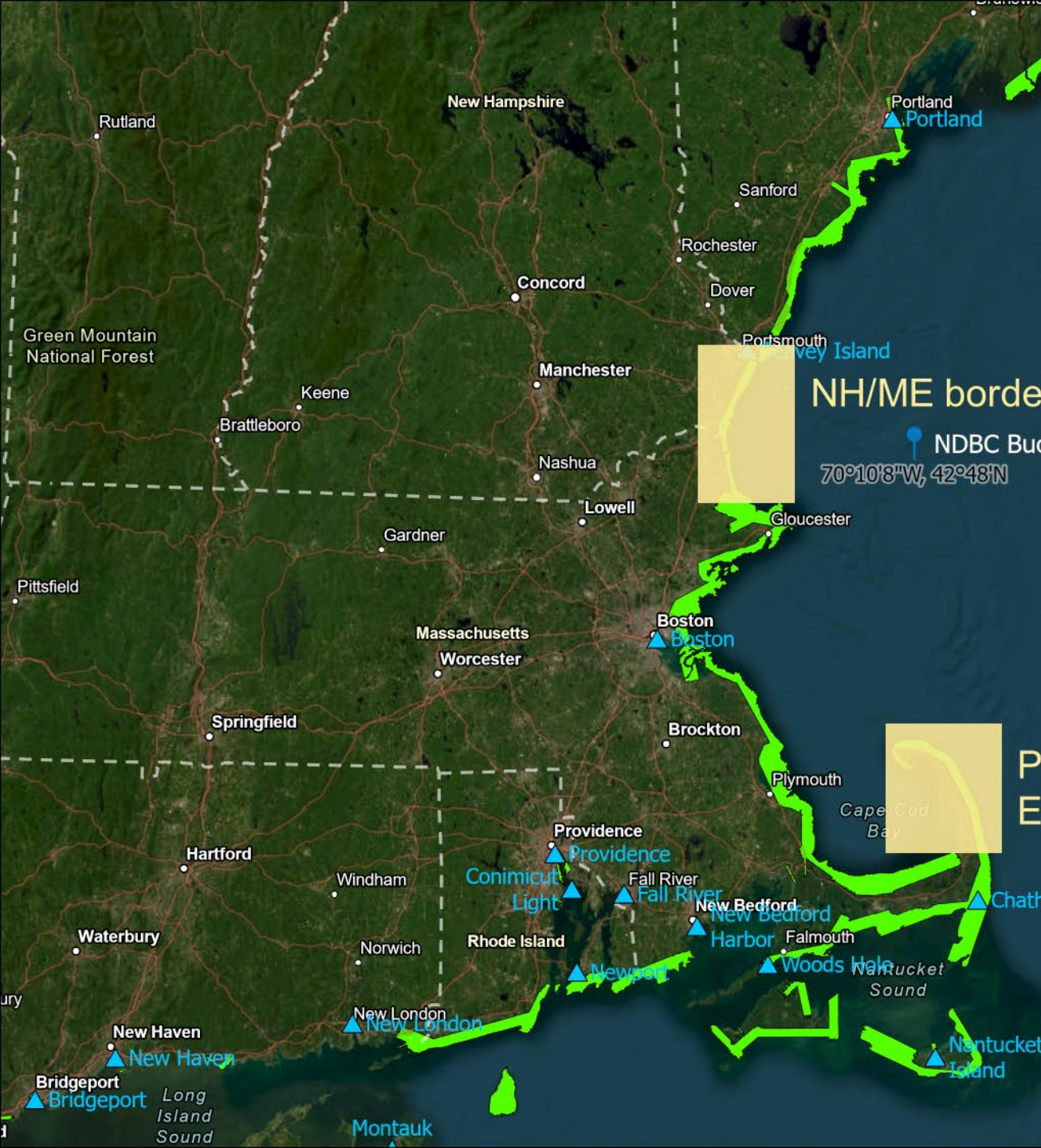
Updated Link!

<https://spatial.usace.army.mil/opjarcgis/rest/services/CERI/MapServer>

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NORTHEAST CERI

Define parameter sets for operational runs at regional scale

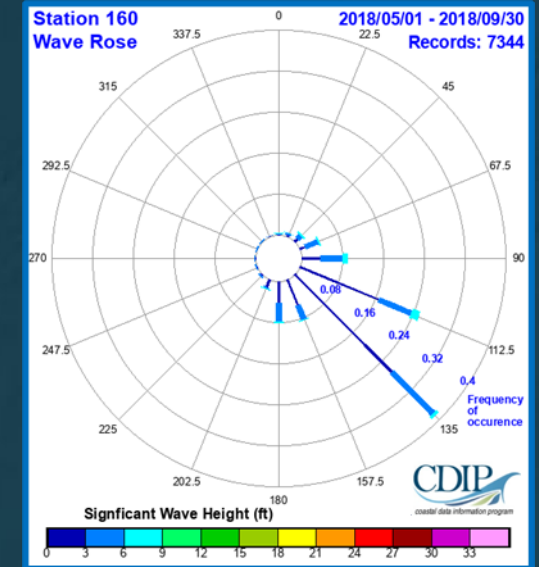


NH/ME border to Plum Island, MA

NDBC Buoy 44098

70°10'8"W, 42°48'N

Provincetown to Eastham, MA



2018 USACE NCMP
Topobathy Lidar
NOAA Water Level
Stations

0 25 50 100 Kilometers



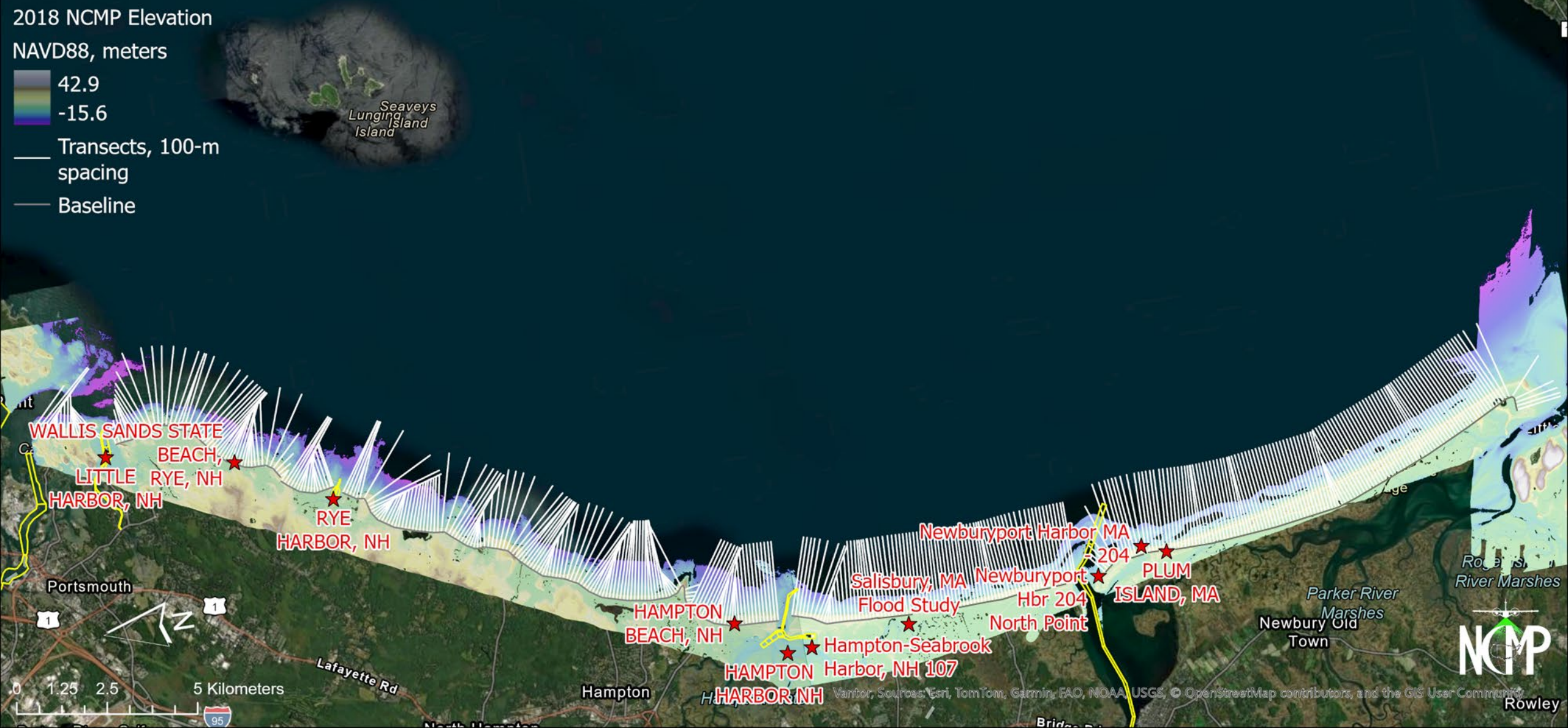
Legend

- ★ USACE Projects
- Federal Navigation Channels
- 2018 NCMP Elevation
NAVD88, meters
- 42.9
- 15.6
- Transects, 100-m spacing
- Baseline

NORTHEAST CERI - TRANSECTS

NH/ME BORDER TO PLUM ISLAND, MA

Halibut Point
State Park
Visitor center

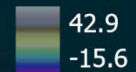


Legend

NORTHEAST CERI - GEOMORPHOLOGY FEATURES

2018 NCMP Elevation

NAVD88, meters

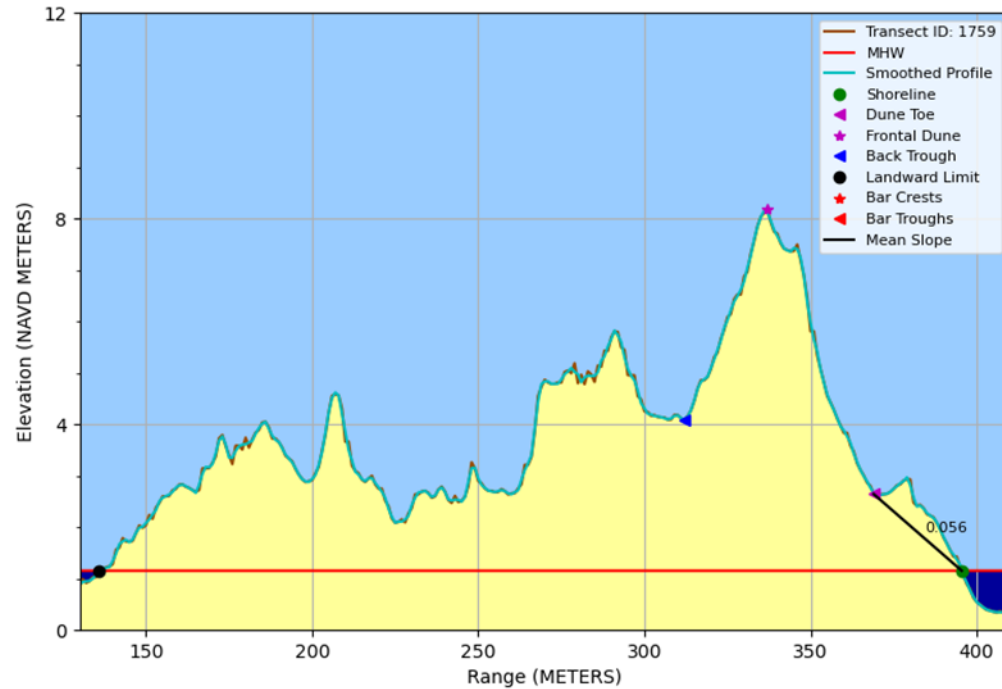


Geomorphol

Type

- ★ BarC1
- ★ BarC2
- ◆ BarT1
- ◆ BarT2
- ◆ BarT3
- ★ FD
- MHW
- ◆ TO
- ✱ BLF
- ▲ BTO

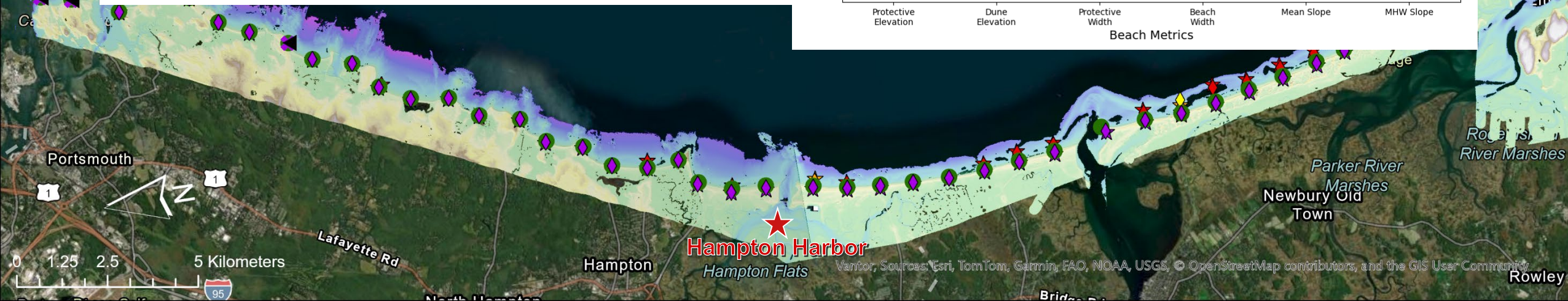
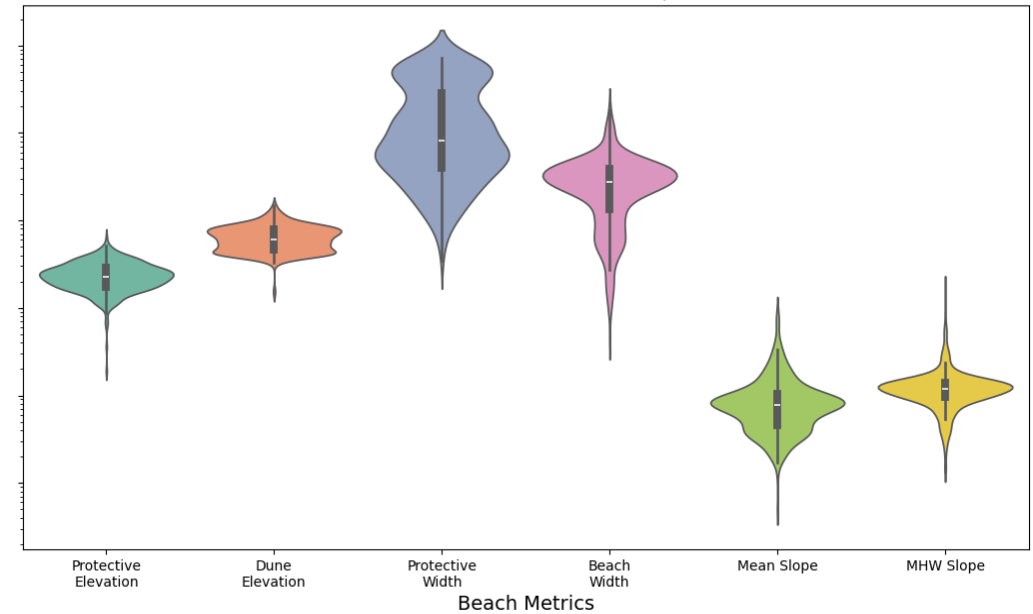
Profile Plots – Visual inspection and quality control



NH/ME BORDER TO PLUM ISLAND, MA

Hampton Point
State Park
Visitor center

NH/ME Border to Plum Island, MA



Legend

2018 NCMP Elevation

NAVD88, meters



CERI Factors, 1-km decimated



Protective Elevation Factor (a)

Volume Density Factor (b)

Protective Width Factor (c)

Crest Freeboard Factor (d)

Wave Run-up Factor (e)

NORTHEAST CERI - CHARACTERISTICS

NH/ME BORDER TO PLUM ISLAND, MA

Halibut Point
State Park
Visitor center

Regional
Characteristic Scales*

PE₀

PW₀

CF₀

WR₀

*95th percentile calculated
from PE, PW, CF, and WR
over all transects

12.4'

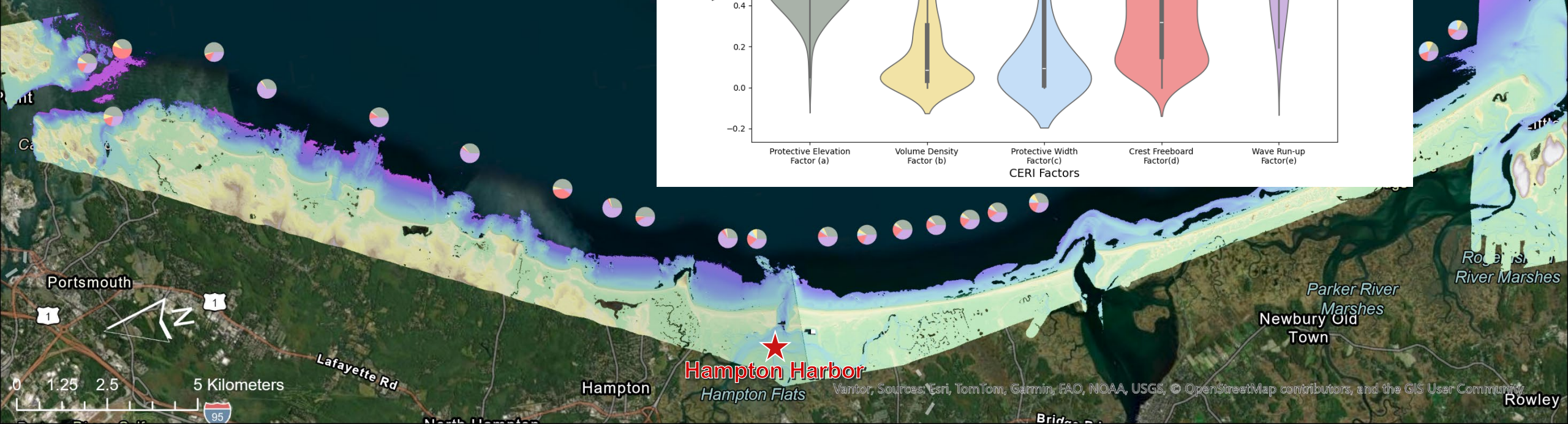
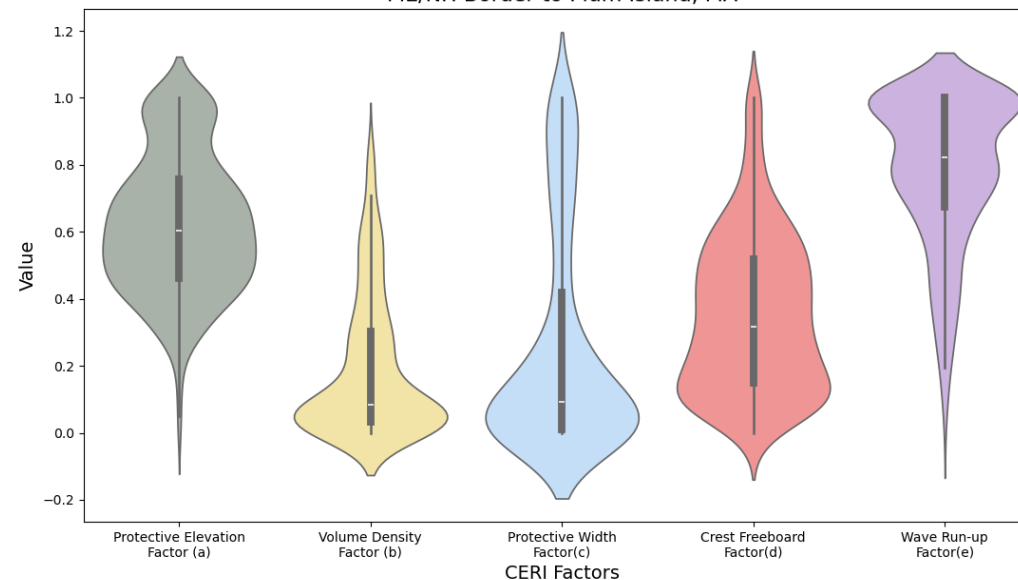
2,016'

29'

8.7'

Island

ME/NH Border to Plum Island, MA



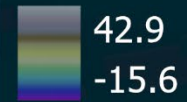
Hampton Harbor
Hampton Flats

Vantor, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

Legend

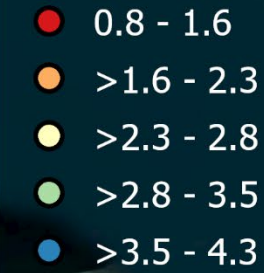
2018 NCMP Elevation

NAVD88, meters



CERI Values

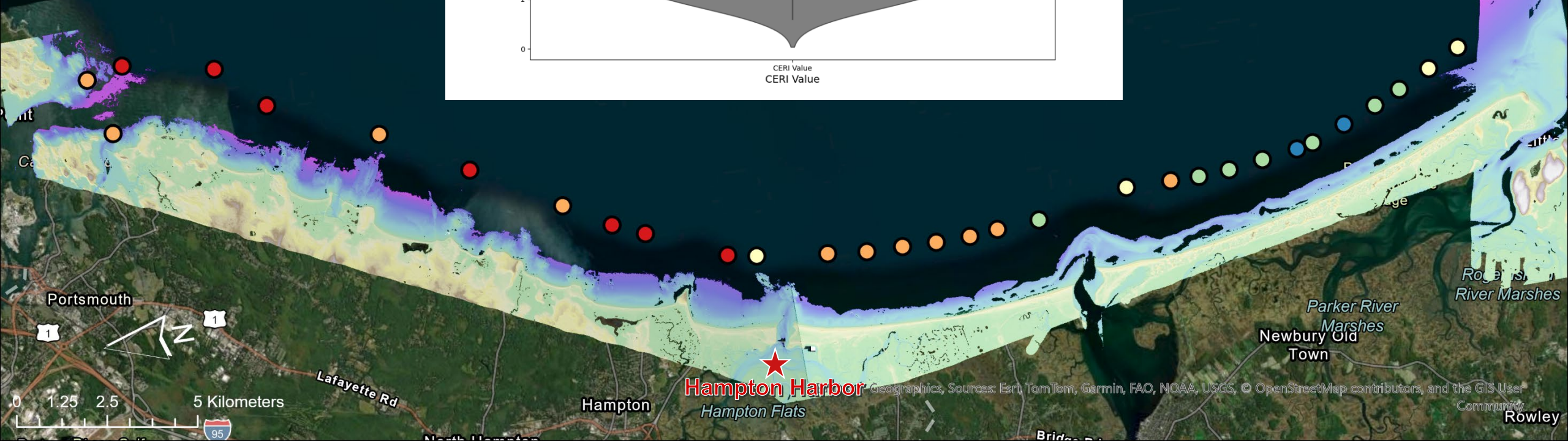
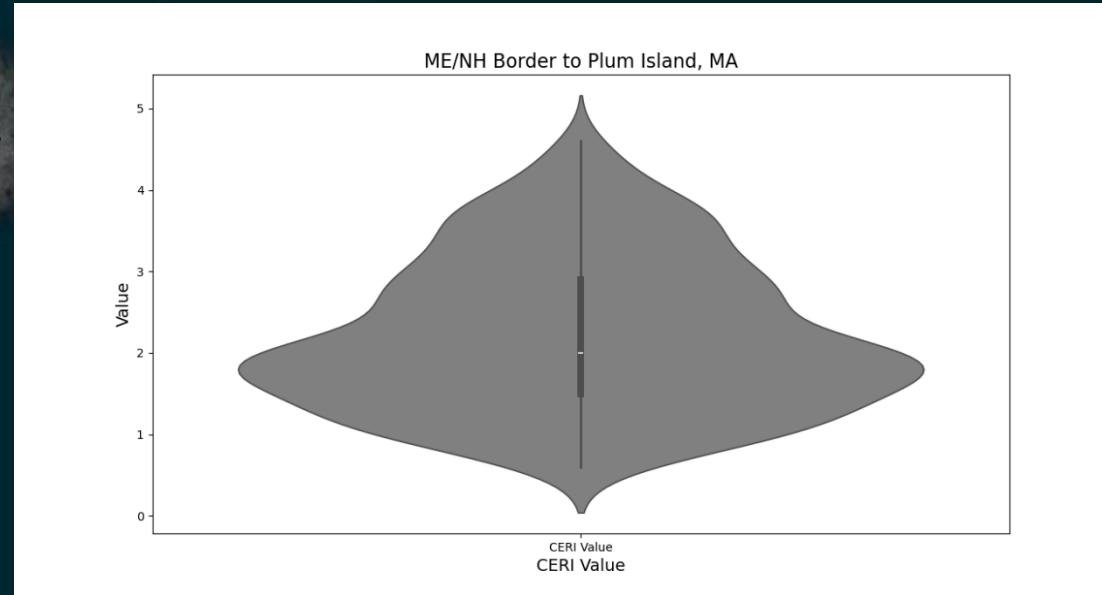
1-km decimated



NORTHEAST CERI - VALUES

NH/ME BORDER TO PLUM ISLAND, MA

Halibut Point
State Park
Visitor center

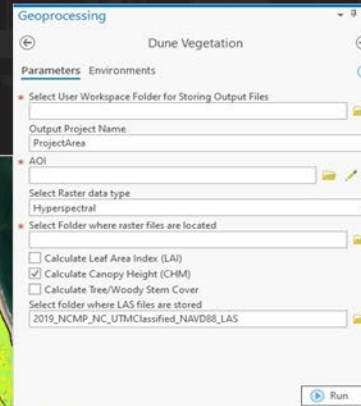




DUNEVEG TOOLBOX

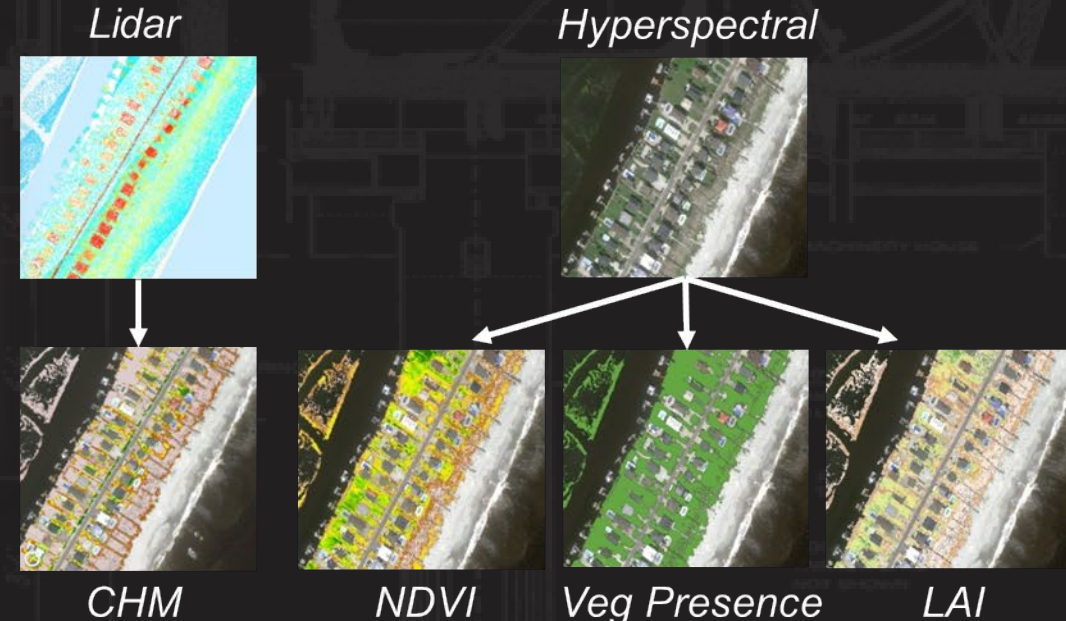
- Limited/lack of vegetation monitoring data to understand influence on erosion potential
- Utilizes NCMP hyperspectral imagery and lidar to automate vegetation metric extraction
- Improves estimation of storm impacts and input into coastal numerical models studying wave dissipation

Multi-Temporal Trend Analysis of Coastal Vegetation Metrics



Toolbox Environment:

- ENVI integration with ArcGIS Pro
- Python, Arcpy, ENVIPy
- ENVI analytics, Band Math Algorithms
- ArcGIS Pro Geoprocessing, Spatial Analyst Extension





NATURE-BASED SOLUTIONS PERFORMANCE METRICS FROM NCMP AND PARTNER DATA

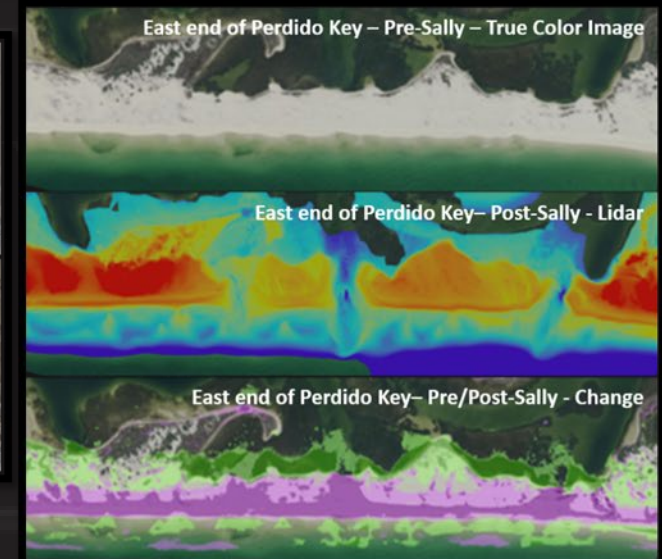
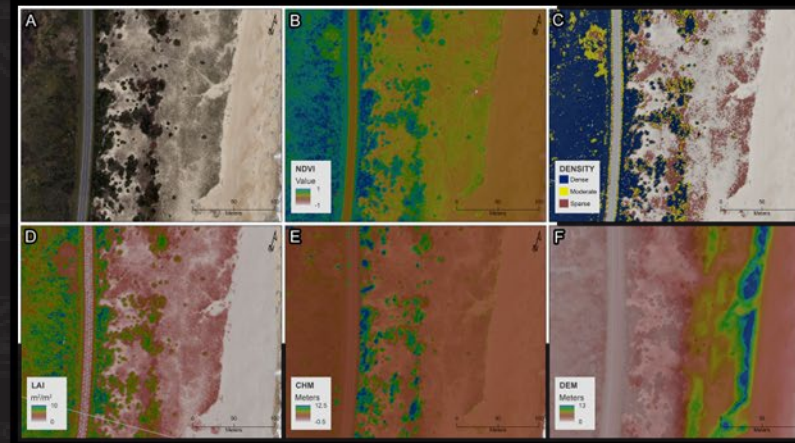
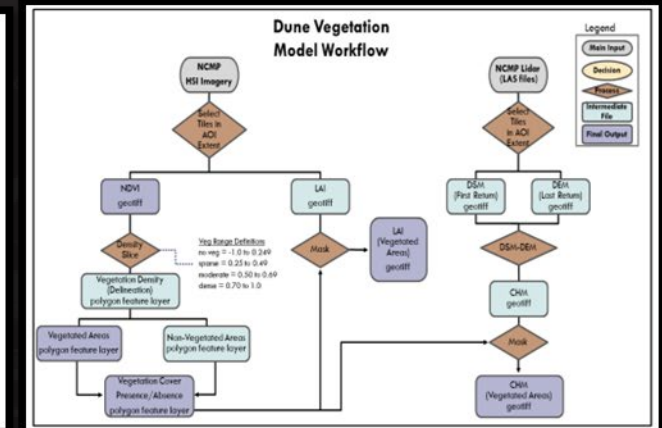
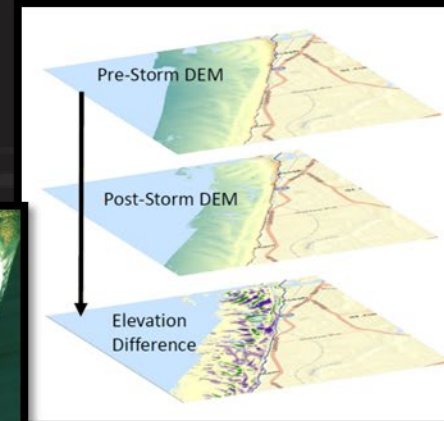


*Investigating the **long-term survivability and failure mechanisms of coastal NBS projects** using **25+ years of coastal remote sensing data** and **implementing geospatial toolbox applications** and other analytical tools.*

- Ship Island Camille Cut Restoration case study and others to be identified

Performance Metrics:

- **Coastal Vegetation Metrics** – NDVI, canopy height, density estimation, LAI, CHM, etc.
- **Morphology and Shoreline Metrics** – shoreline change, volume change, above and below MHW change rates
- **Coastal Feature Extraction Metrics** – feature elevation change and location change, average profile change





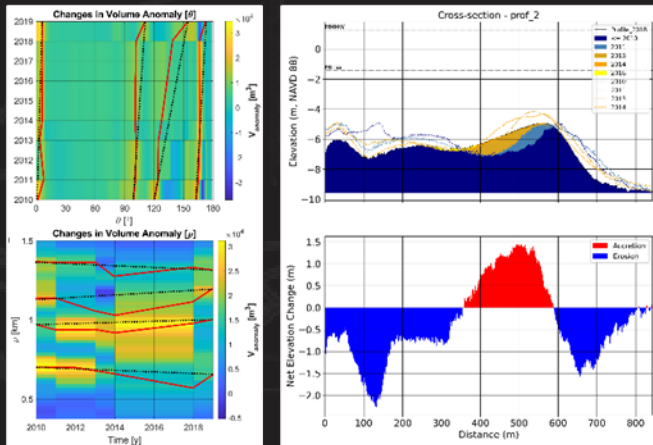
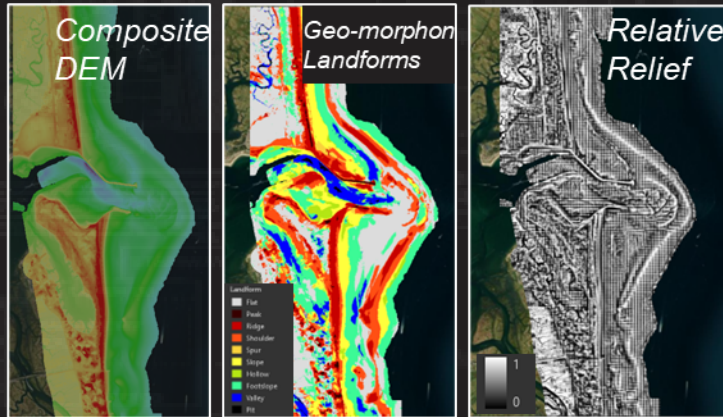
GEOMORPHIC MAPPING WITH NCMP LIDAR



Coastal Inlets Atlas 2.0: A first-of-its-kind database of inlet geomorphic products to inform sediment budgeting and operations and maintenance activities for civil works

Products

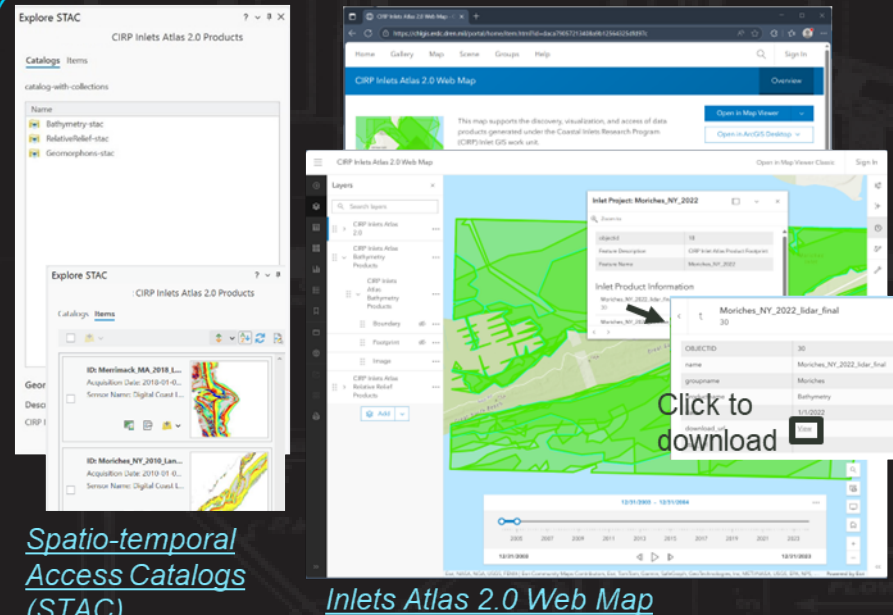
Newburyport Harbor, MA and Merrimack River Inlet



Conformal Mapping

Chronostratigraphic Analysis

Data Access



Spatio-temporal Access Catalogs (STAC)

Inlets Atlas 2.0 Web Map

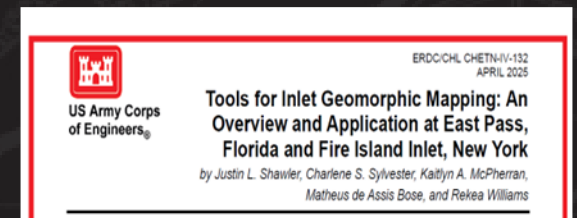
342 Inlets with scalar info

26 Inlets with geomorphic products

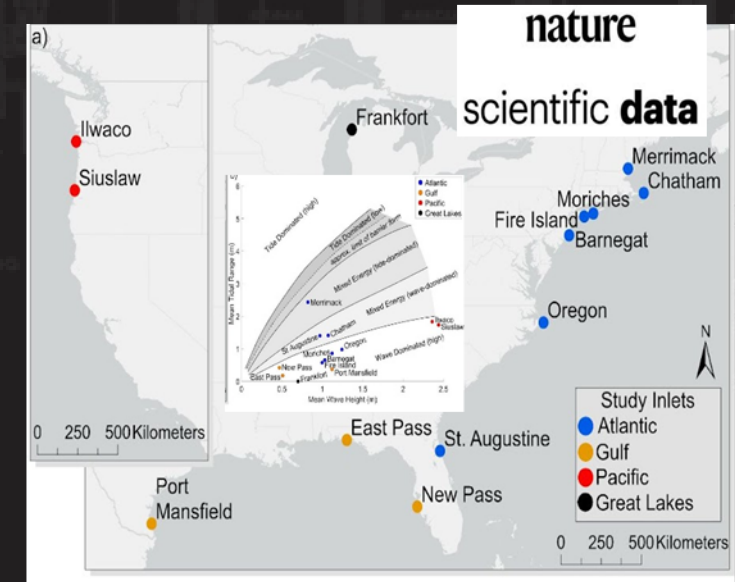
Graphics courtesy of Dr. Kaite McPherran and Inlets Atlas Team

UNCLASSIFIED

Workflows and Publications



<https://hdl.handle.net/11681/49714>



Paper in review, accompanying Zenodo database
<https://zenodo.org/records/17701250>

HAVE AN INLET? WANT ANALYSIS?

Good hydro and bathy lidar data?

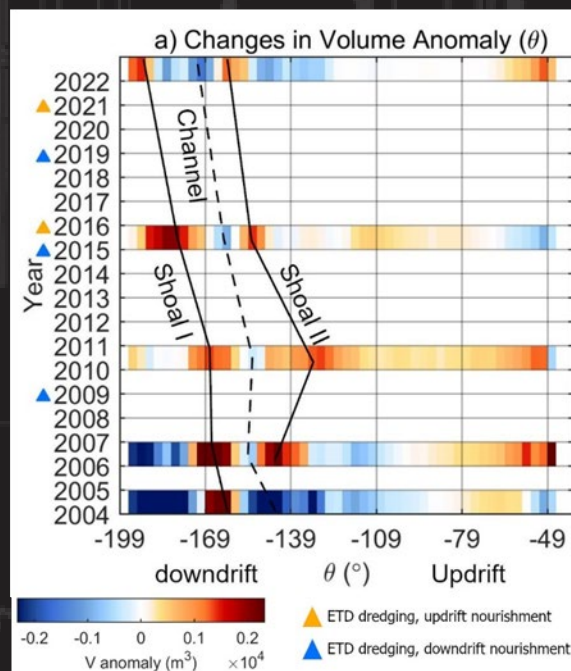
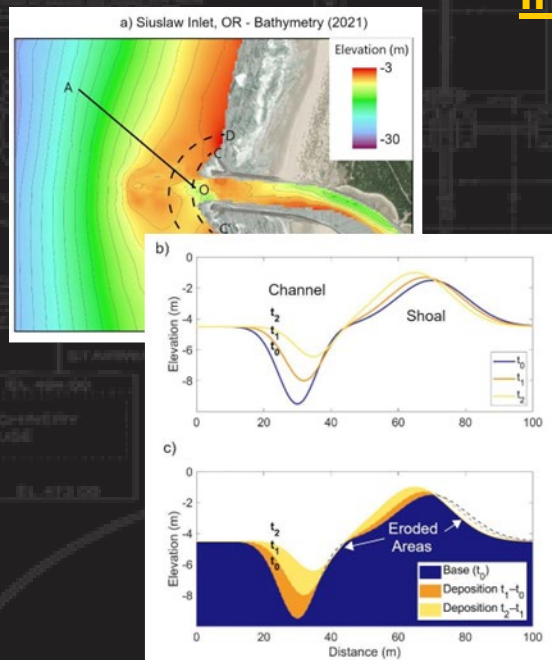
Want to track shoal migration and volume change?

Need data?

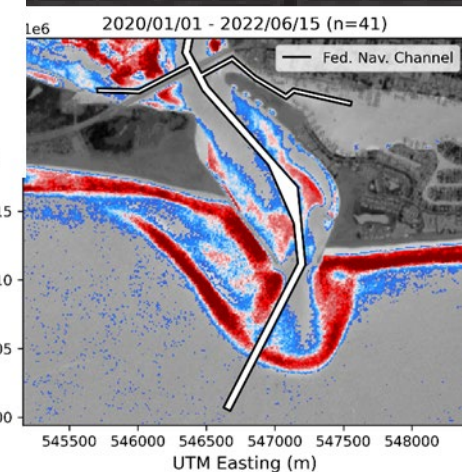
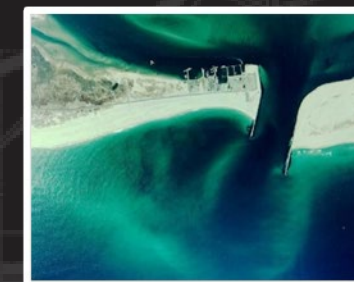
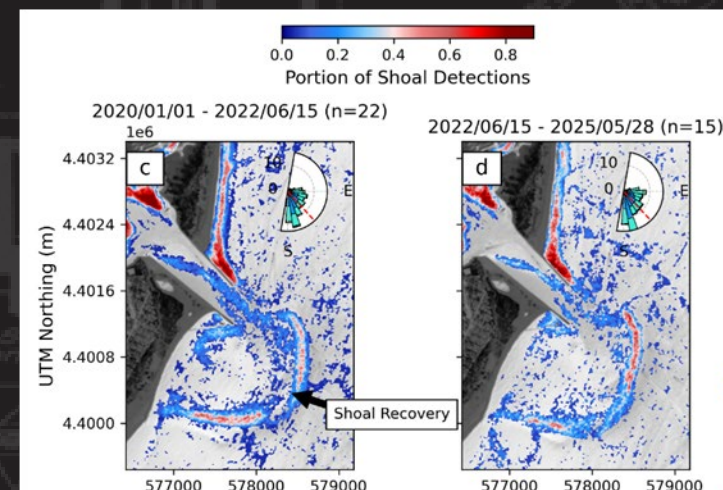
Want to track shoal migration with satellite imagery?



Inlets Atlas



Hazardous Shoals



Contact: kaitlyn.a.mcpherran@usace.army.mil



U.S. ARMY

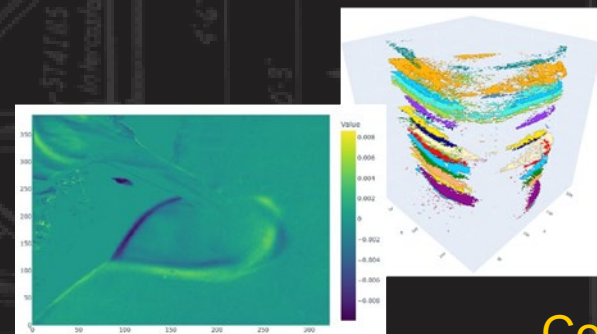


US Army Corps
of Engineers®



ERDC
ENGINEER RESEARCH & DEVELOPMENT CENTER

Options starting
at \$25k



Contact:

Justin.L.Shawler@usace.army.mil



WHAT'S ON OUR LIDAR FOR THIS YEAR



Turning NCMP data into smarter decisions for Navigation, Coastal Storm Risk Management, Ecosystem Restoration, and Emergency Response

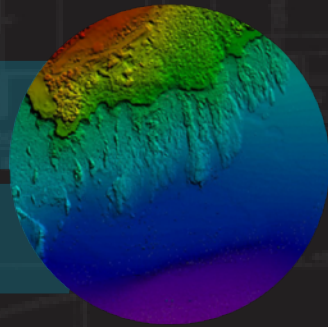
Data Delivery and Updates to Regional Conditions

Provides a critical update to baseline elevations for projects

Data Delivery

Northern Gulf Coast

HI, AK, TX, CA
Priority Areas



New Data

Alaska Mapping



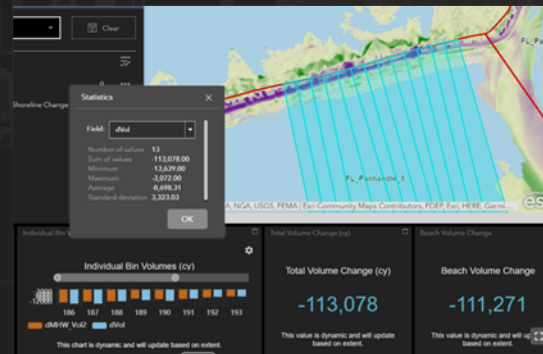
Cape Lookout, NC to Montauk Point, NY*

New York District
Reimbursables

*8 years since last NCMP

Nationwide Datasets of Sediment Volume and Shoreline Change

Filling a key knowledge gap and capability for storm response



Products

*Most-recent NCMP

Baselines and transects at 10-m spacing

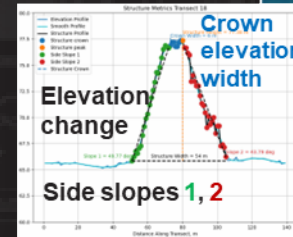
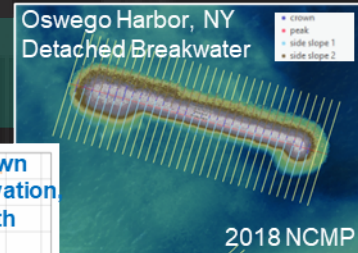
Sediment volume and shoreline change* at 100-m spacing

Tools for automated DEM download and MHW interpretation

New Metric Developments for USACE Projects

Supports operational condition assessments of coastal structures

Jupyter Notebook



Screening-level Metrics

Provides high-resolution land cover using NCMP lidar and imagery for coastal models

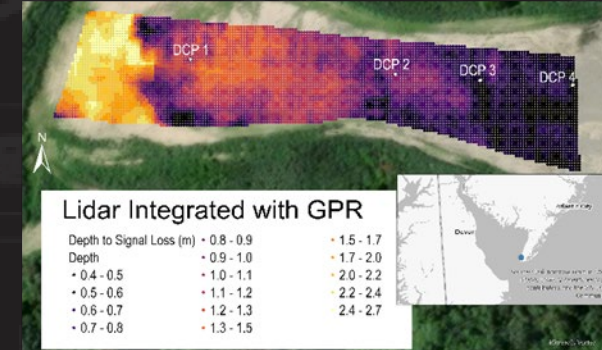


Review of current high-res approaches

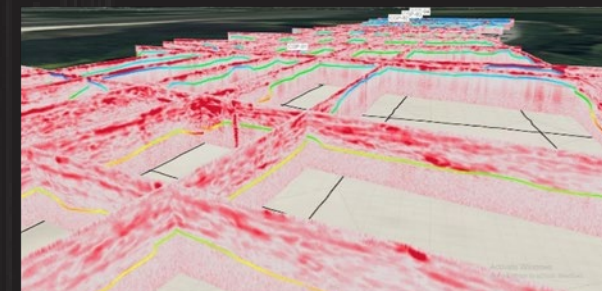
Conceptual toolbox design and roadmap

Data Fusion with Lidar and Ground Penetrating Radar

Provides novel sediment volume maps for civil works projects



GPR penetration depth approximates sand pile "bottom"; lidar is the "top"





THANK YOU! QUESTIONS?



USACE



Mobile District

Spatial Data Branch



Environmental Laboratory

Geospatial Data Analysis Team



Coastal and Hydraulics Laboratory

Coastal Engineering Branch



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Operations Manager



Nick Johnson

Lidar Technical Lead



Heath Harwood

Imagery Technical Lead



Jennifer Brizzolara

Production Manager



David White

Special Projects Manager



Molly Reif

Team Lead and Research Geographer



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Research Forester



Christina Saltus

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I-ATLAS Director and NCMP PM



Charlene Sylvester

Research Physical Scientist



Scott Spurgeon

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Ashley Elkins

Research Civil Engineer



Brooke Walker

Research Physical Scientist



Justin Shawler

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Research Physical Scientist



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Sean McGill

Research Physical Scientist



Kate Smith

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Ship and Cat Islands, MS, 2020

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