

Joint Airborne Lidar Bathymetry Technical Center of Expertise: Environmental Products

US Army Engineer Research and Development Center,
Molly Reif: Environmental Laboratory (EL)

Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX), Kiln, Mississippi

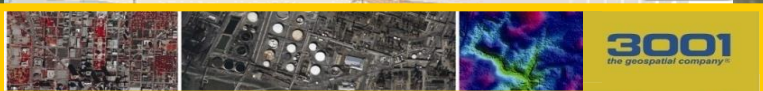


US Army Corps of Engineers
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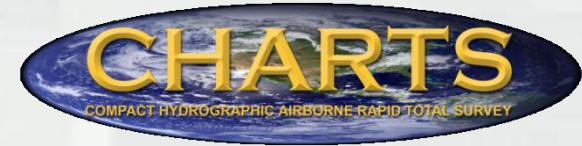


Joint Airborne Lidar Bathymetry
Technical Center of eXpertise

Joint Airborne Lidar Bathymetry Technical Center of Expertise



CHARTS



System Specifications

3,000 Hz Pulse Rate (hydro)

20,000 Hz Pulse Rate (topo)

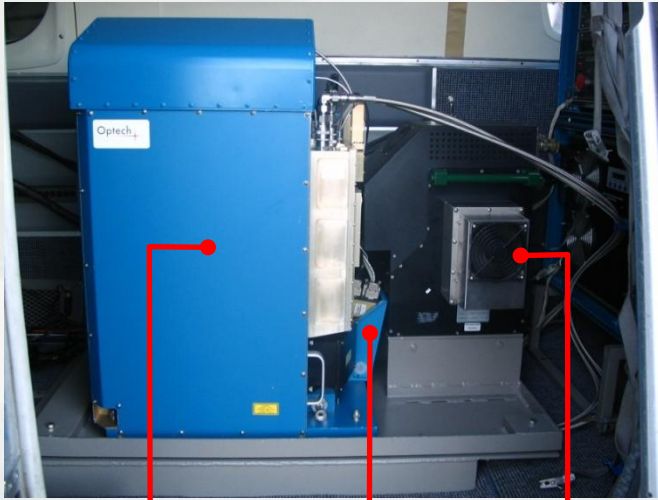
1 Hz Digital camera (~35 cm pixel)

CASI-1500 Hyperspectral Imager

1500 cross-track pixels

380 – 1050 nm wavelength

1 m pixel w/ 36 spectral bands



Optech SHOALS-3000

Integrated Laser DuncanTech-4000 RGB
System camera

Itres CASI-1500
Hyperspectral
Imager



Bottom Aircraft Port



SHOALS-3000
Operator Console

CASI-1500
Operator Console



Applanix DSS 322

•22.2 megapixel (5436 X 4092)

•~ 5 cm / pixel (at 400m)

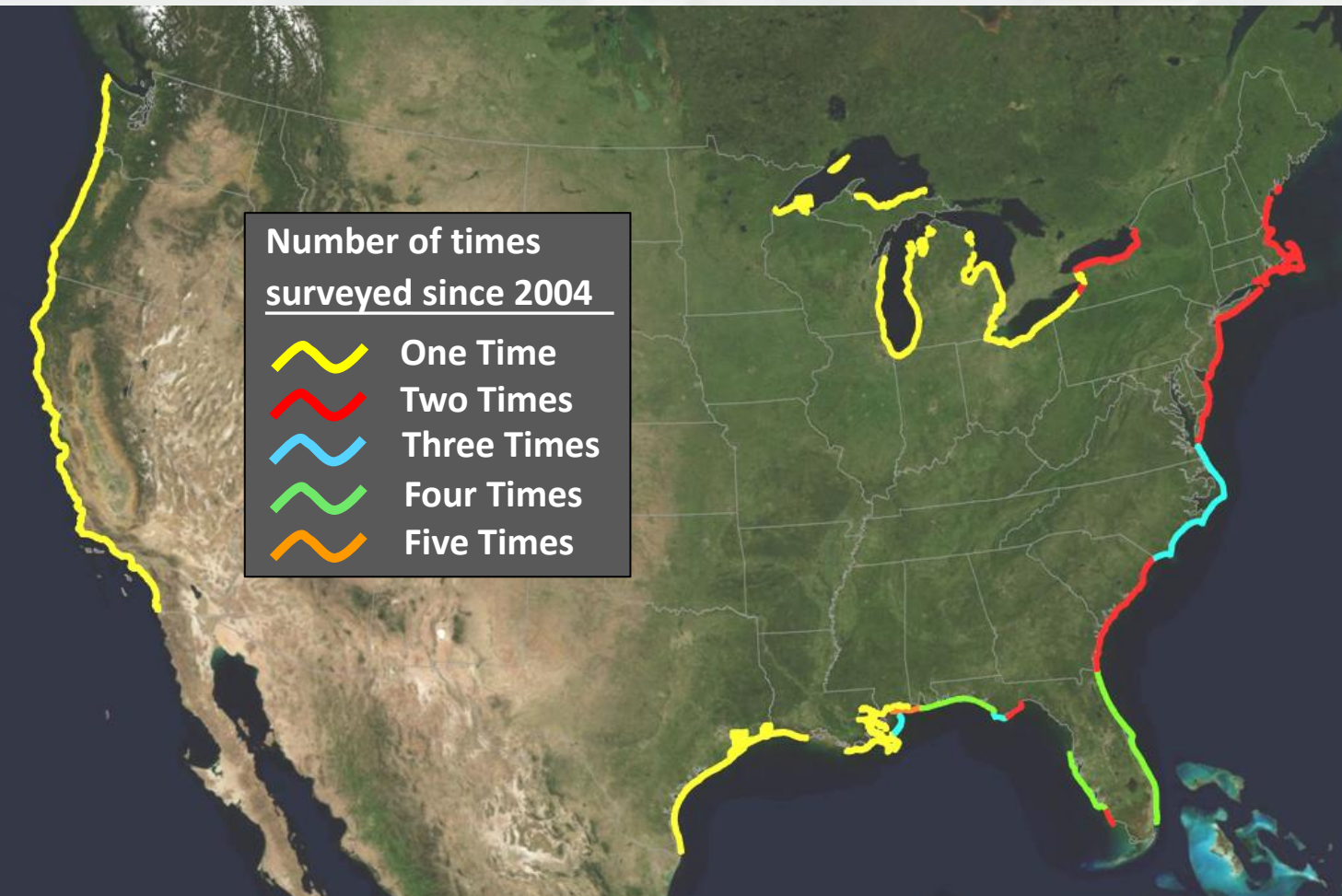
•Color (VIS) or Color IR (CIR)

•Includes POS / AV



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National Coastal Mapping Program



- Funded by USACE Headquarters

- Initiated FY2004

- Collect lidar elevation and imagery data in support of engineering and research

- Focus on sandy shorelines



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USACE NCMP Acquisition Scheme

Topographic Lidar

500 m onshore

1 m postings

200% coverage

Low tide

Bathymetric Lidar

1000 m offshore or to
laser extinction

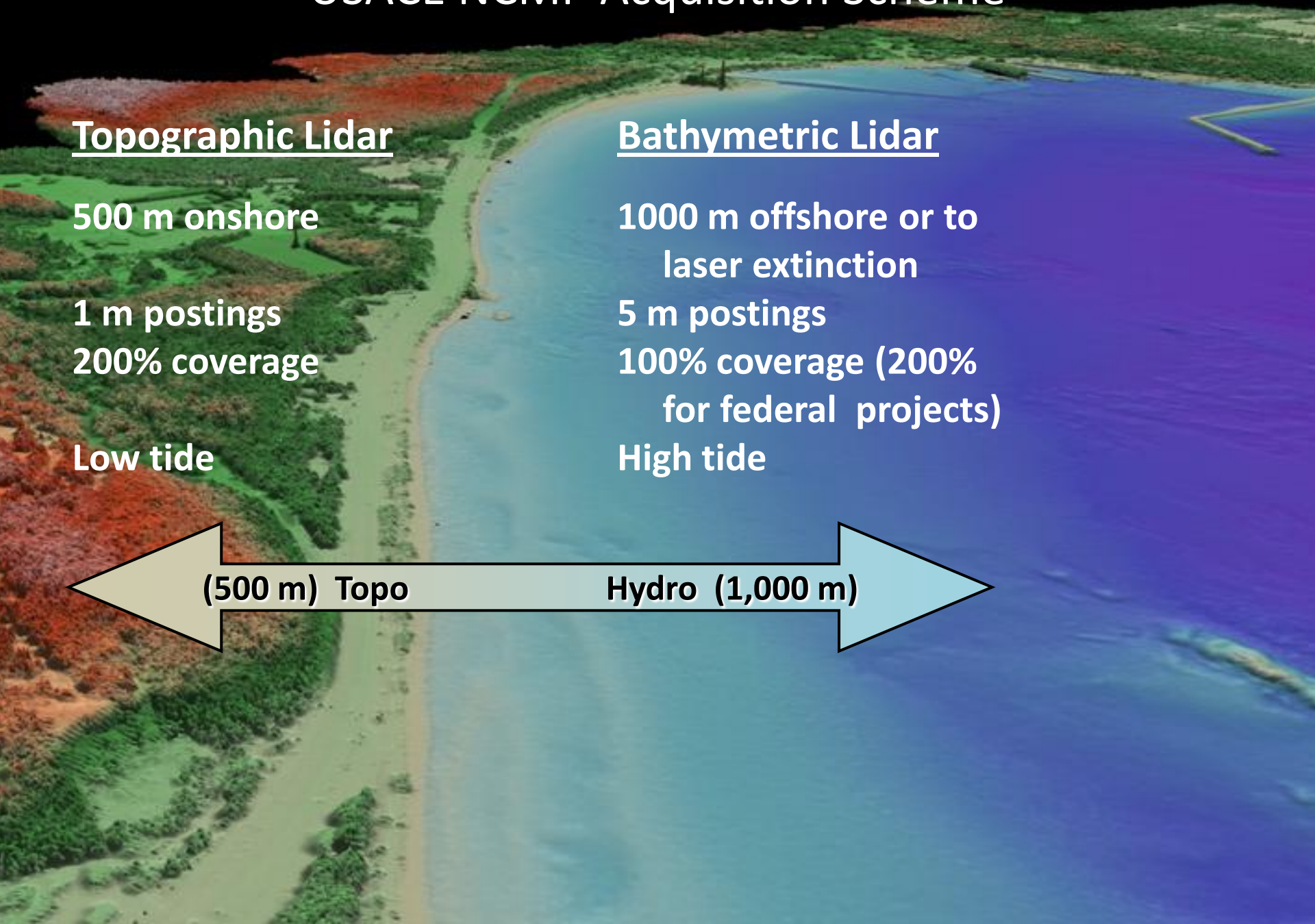
5 m postings

100% coverage (200%
for federal projects)

High tide

(500 m) Topo

Hydro (1,000 m)



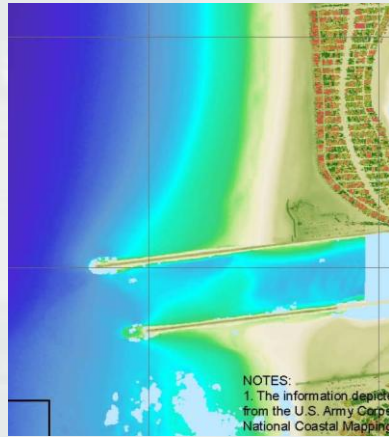
NCMP Product Evolution

2004



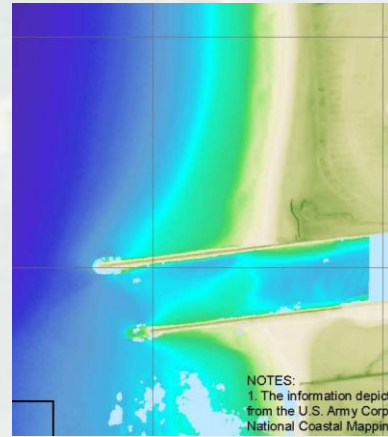
- ASCII xyz
- NAVD88 0 Shoreline
- RGB Mosaics

2005



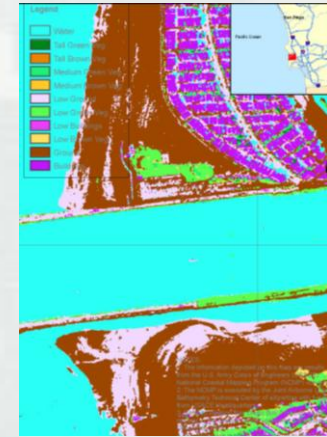
- Bathy/Topo DEM

2006



- LAS Format Topo
- Bare Earth DEM

2007-2009



- Hyperspectral Mosaics
- Laser Reflectance
- Land Cover Classification

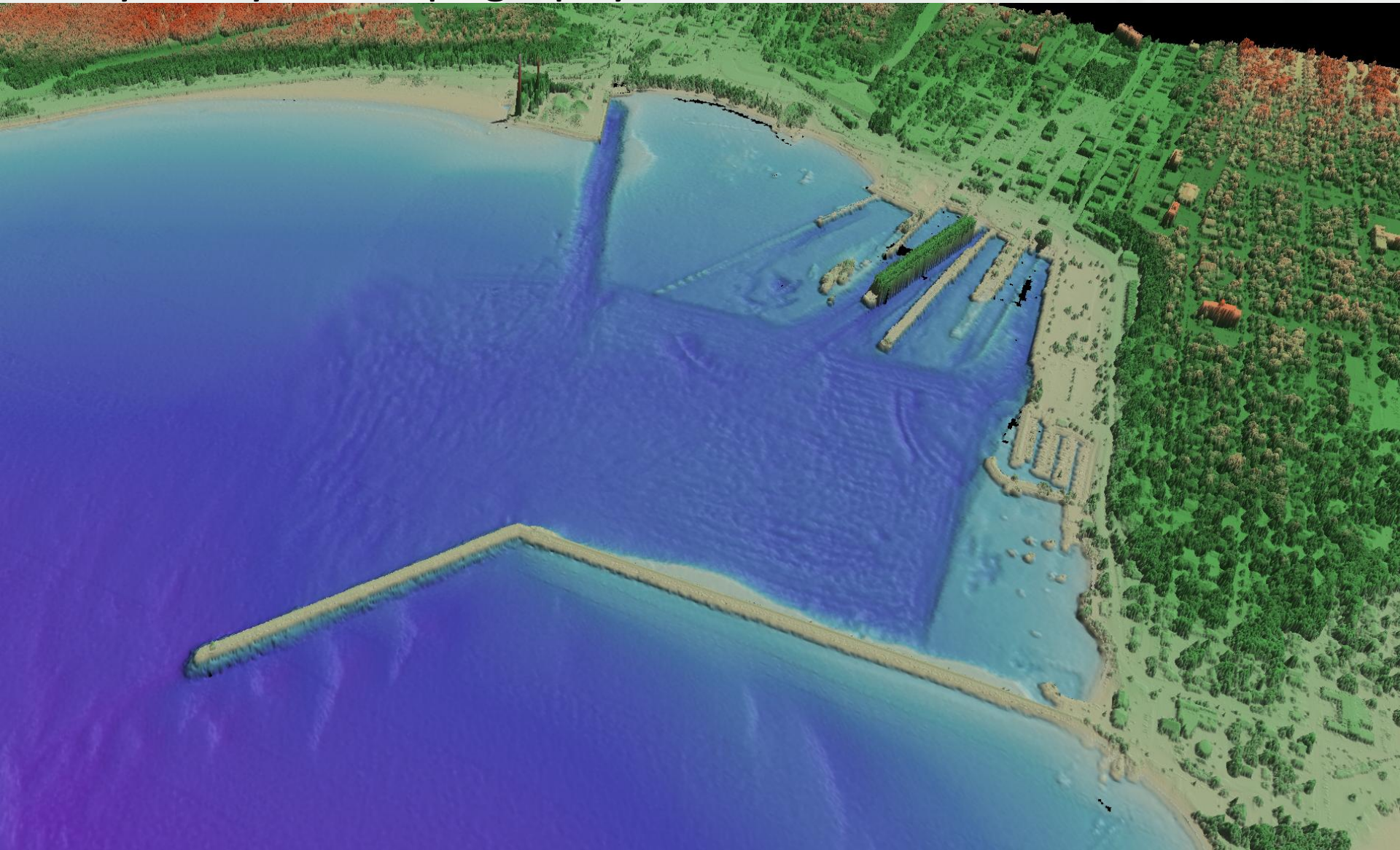


Geographic Coordinates
NAVD88 Vertical Datum or IGLD85

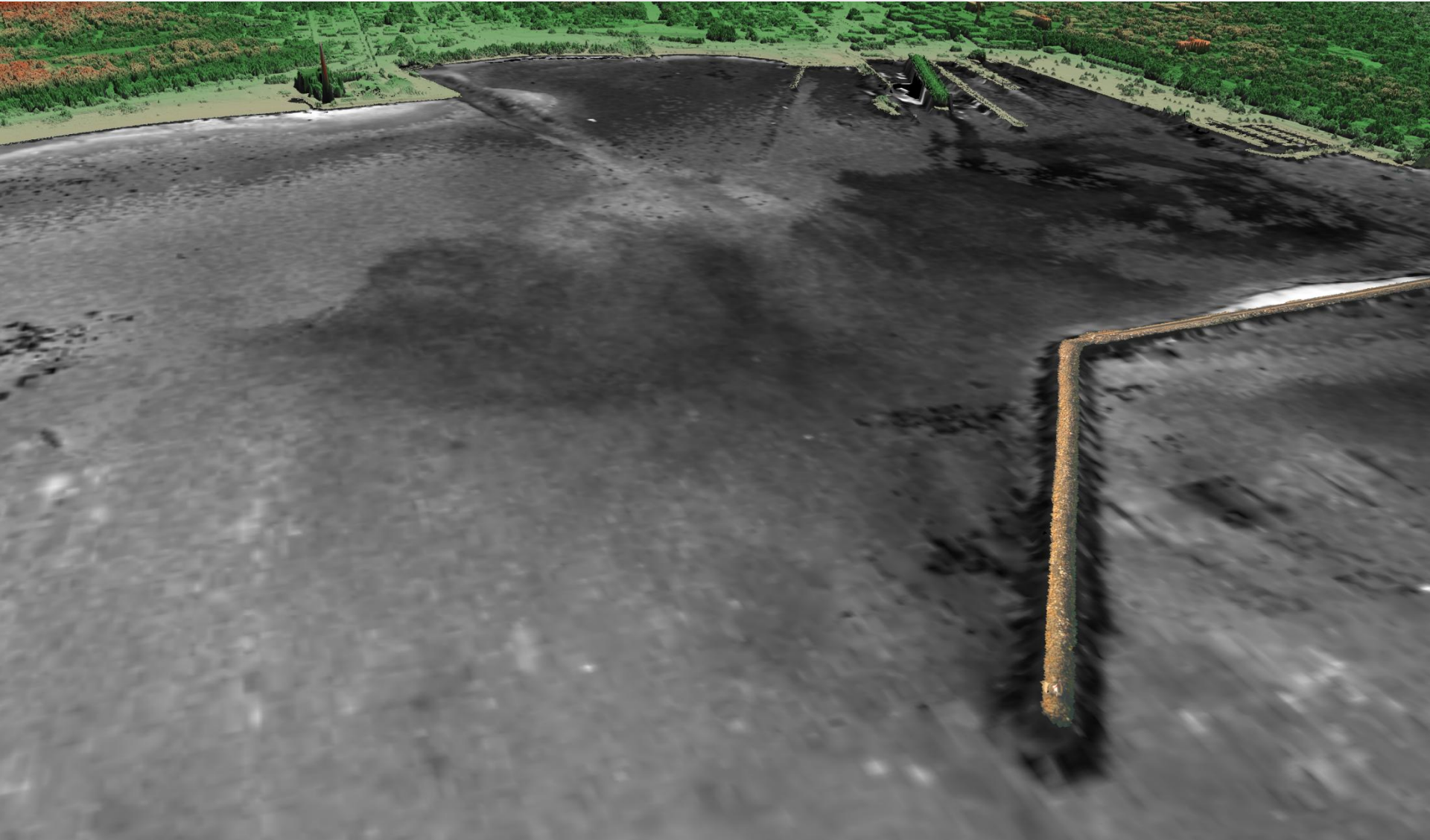


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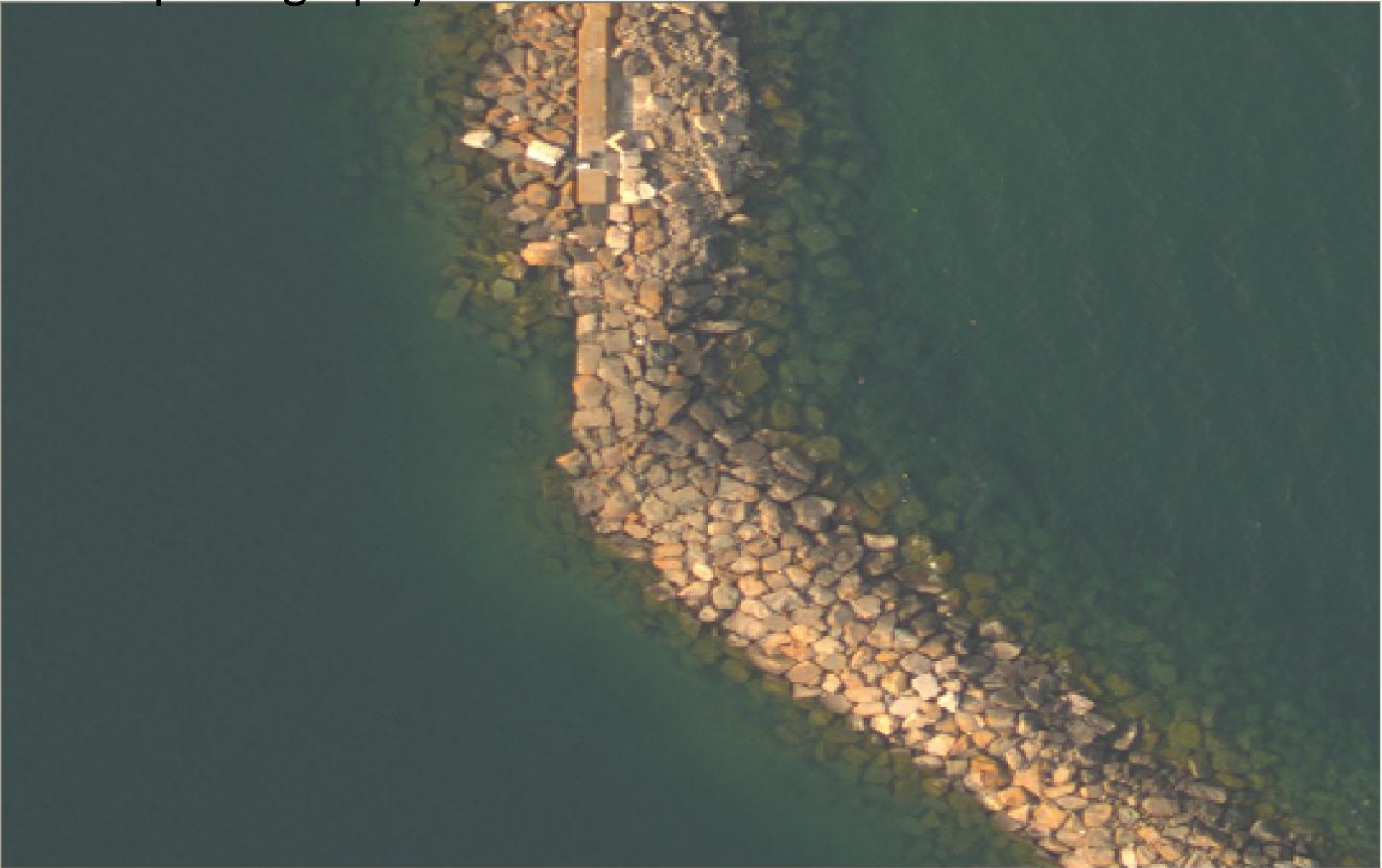
Bathymetry and topography



Laser imagery



Aerial photography



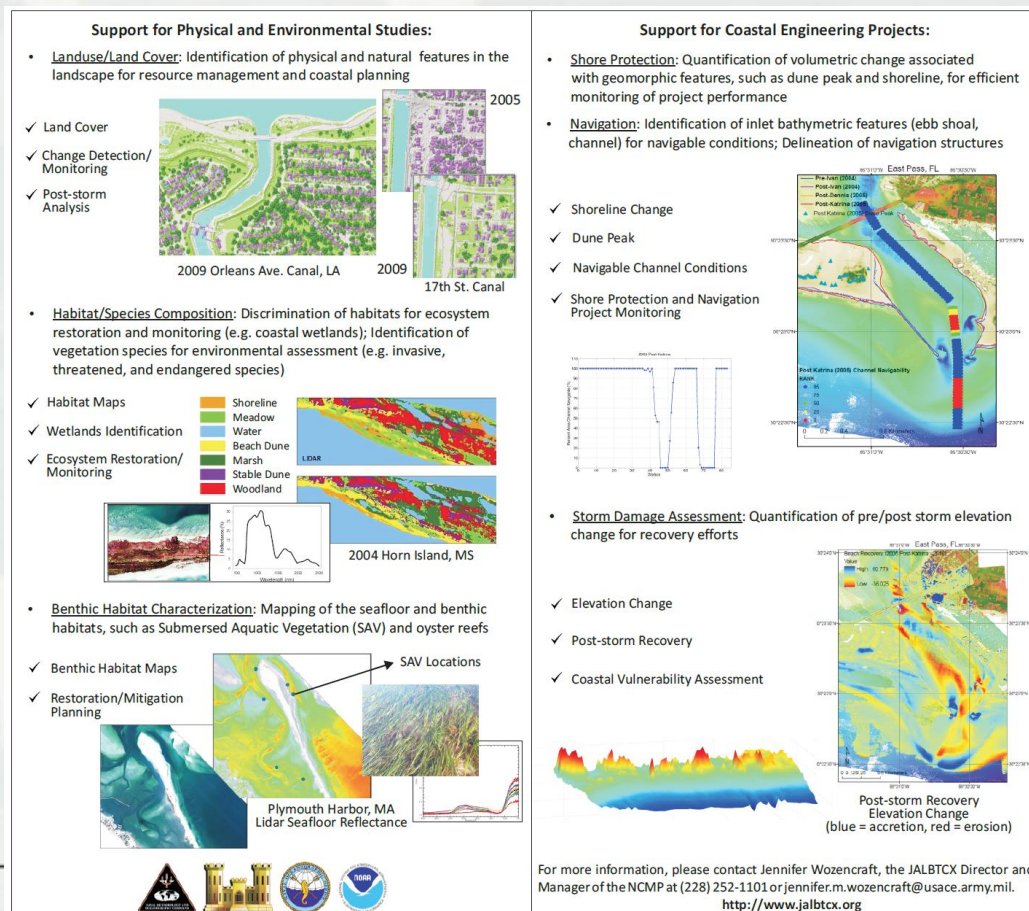
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EL and JALBTCX

- **GOAL:** identify/expand environmental data products, utilizing (1) imagery resources of JALBTCX and (2) environmental expertise in EL to address environmental/geospatial needs of the coastal districts.

- Environmental Applications:

- Site Characterization
- Environmental Monitoring
- Habitat Identification
- Ecosystem Restoration Planning
- Emergency Response/Recovery



Hyperspectral and Lidar Fusion

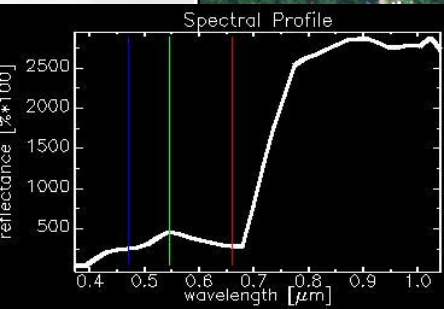
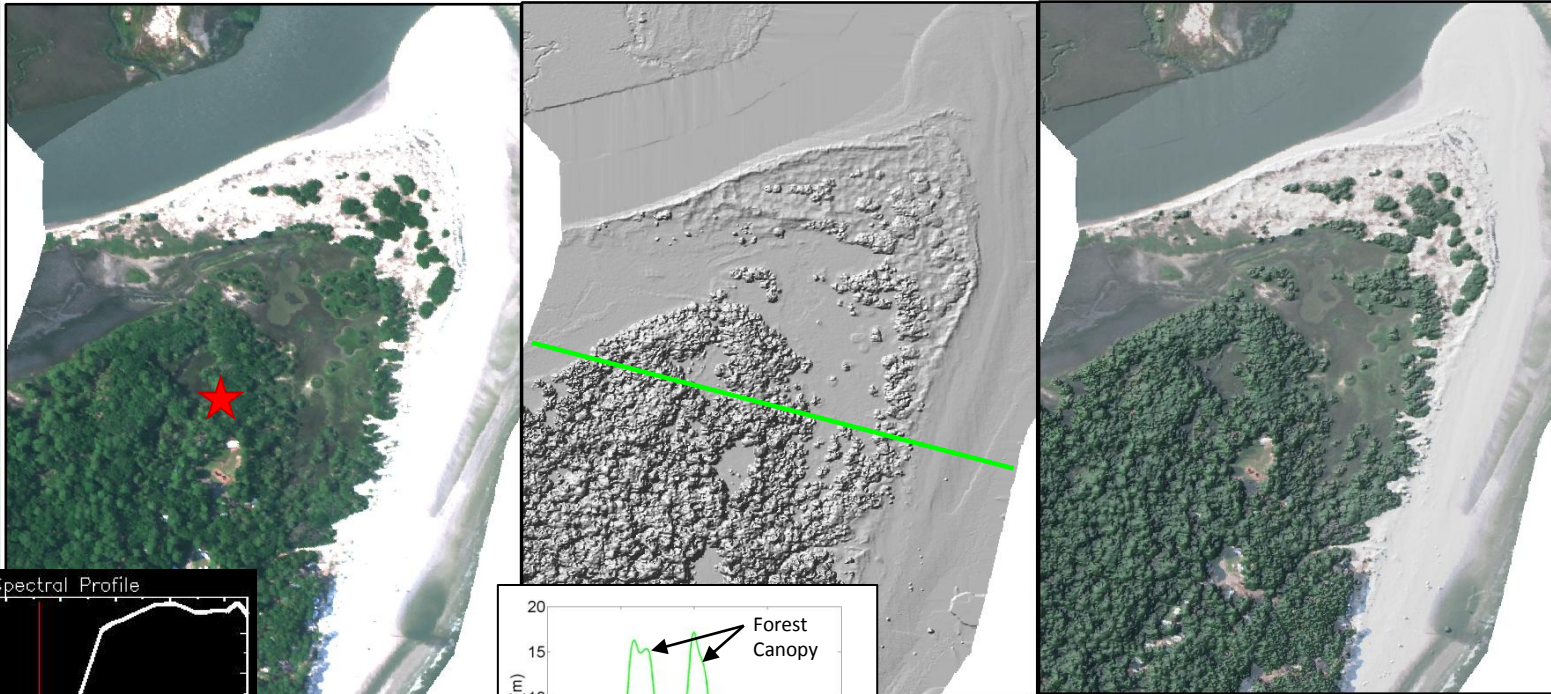
- Target features **spectrally** with hyperspectral and **structurally** with lidar through image fusion

Northern tip of Hunting Island, SC, 2010

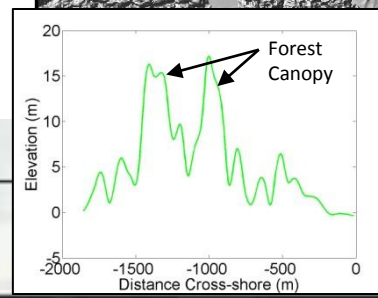
CASI hyperspectral, RGB

1m topo lidar hillshade

Fusion of hyperspectral and lidar



Forest
Spectra

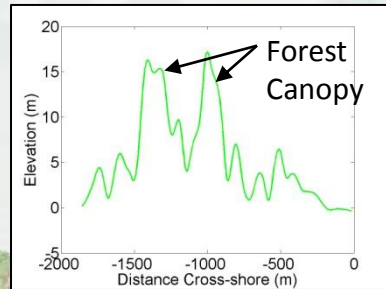


Elevation
profile

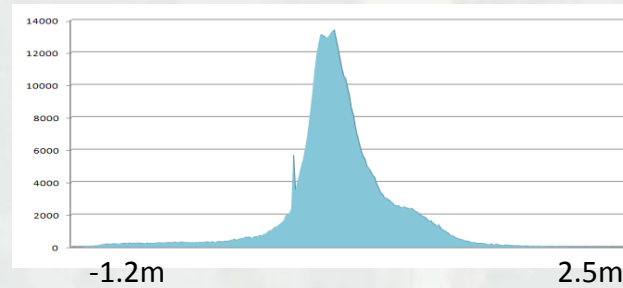


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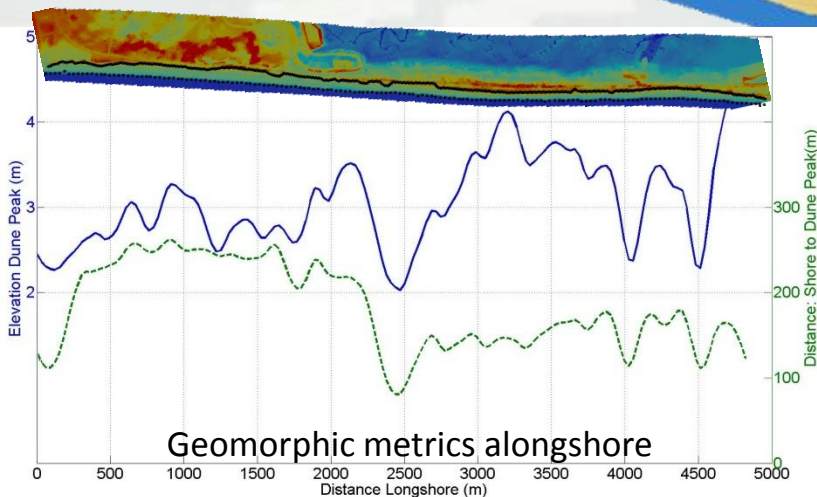
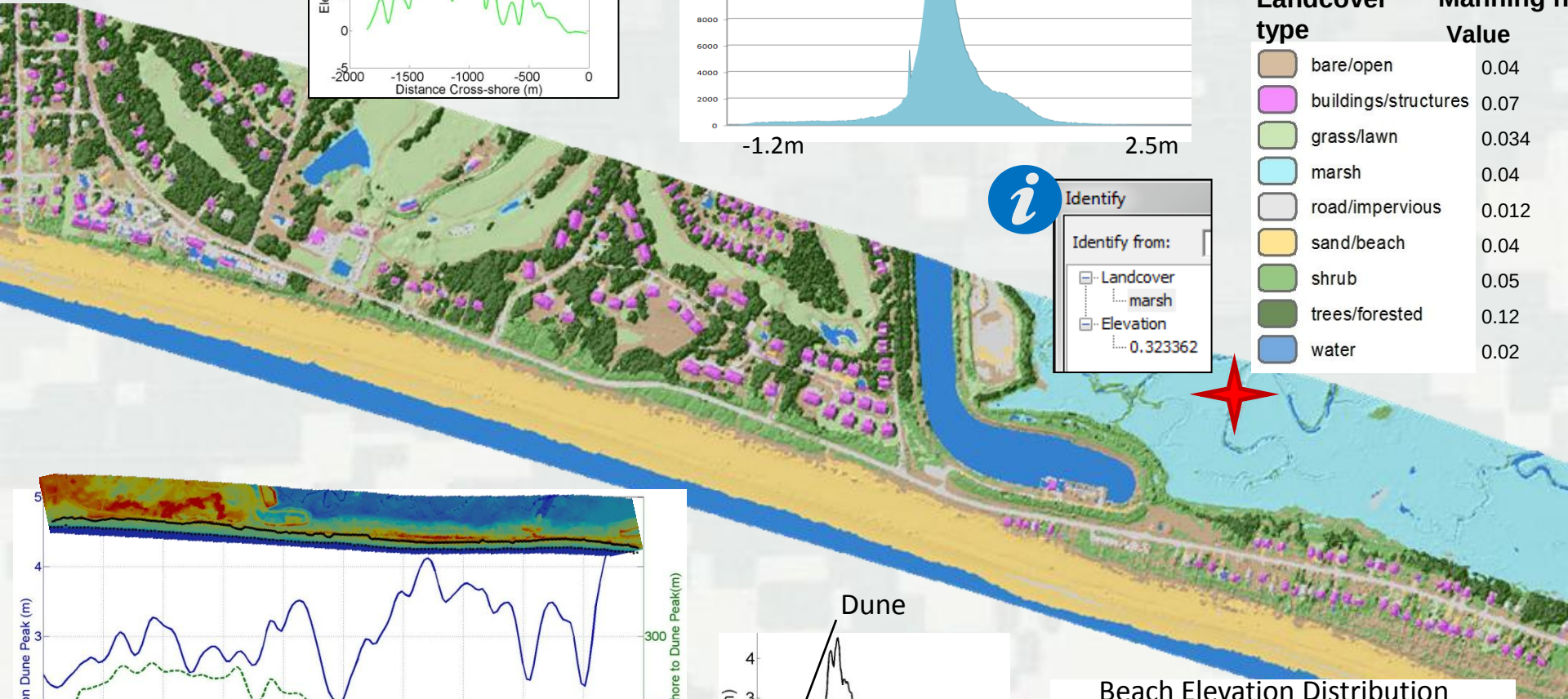
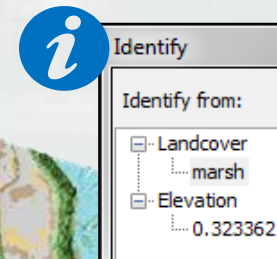
Coastal land cover classification



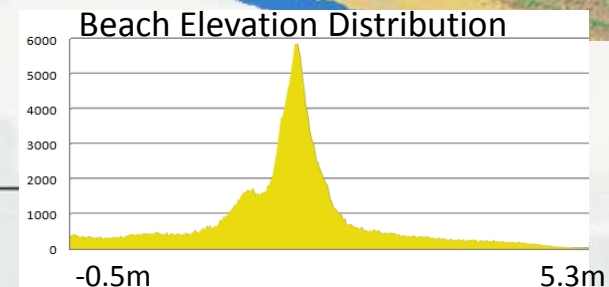
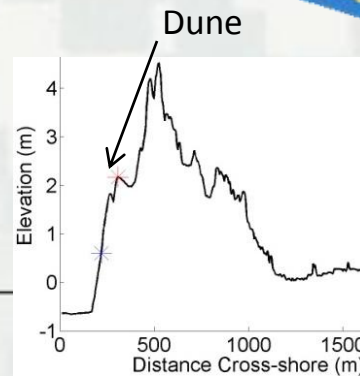
Marsh Elevation Distribution



Landcover type	Manning n Value
bare/open	0.04
buildings/structures	0.07
grass/lawn	0.034
marsh	0.04
road/impervious	0.012
sand/beach	0.04
shrub	0.05
trees/forested	0.12
water	0.02



Geomorphic metrics alongshore



Invasive species detection

- Spectrally and structurally target species of interest
- Emphasize changes in composition, structure and function in ecosystems caused by invasives



Times Beach, Buffalo NY, 2007

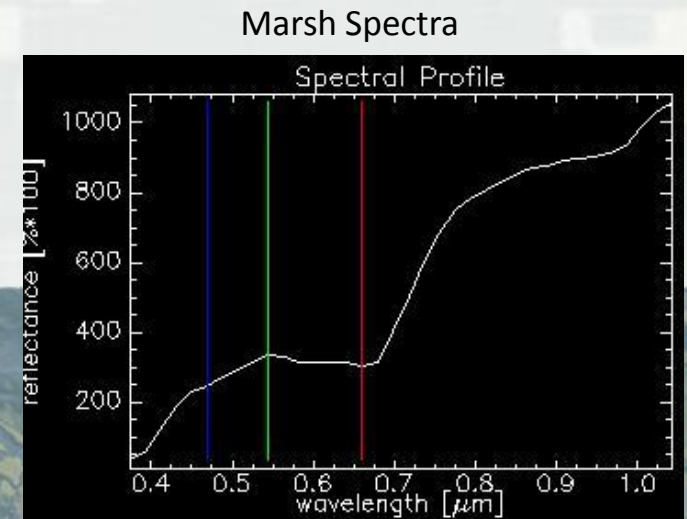
Emergent marsh dominated by *phragmites*



Wetlands Characterization

- Mapping Wetland Habitats
 - Spectrally and structurally target wetland species
 - Emphasize species pattern characterization and zonation related to elevation gradients
 - Wetland condition assessment

Edisto Island, SC, 2010; south of Jeremy Inlet



Dredging Operations and Environmental Research Work Unit:



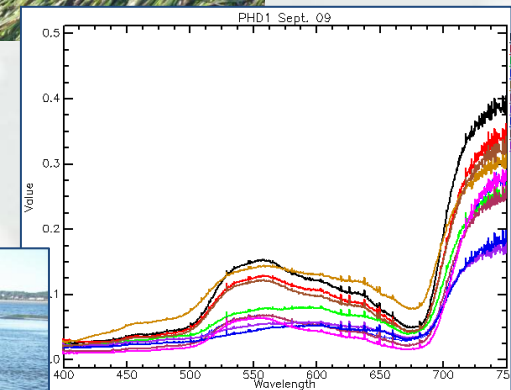
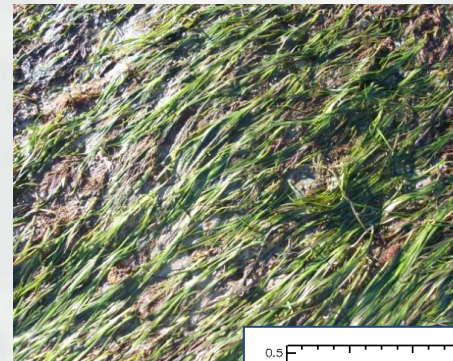
Use of Airborne Lidar and Hyperspectral Data to Detect and Discriminate SAV Species at Corps Dredging Sites

Purpose: evaluate and demonstrate the use of fused airborne hyperspectral and bathymetric lidar data to detect and discriminate species of estuarine SAV and macroalgae in two representative small-craft dredged harbors

Background: Dredging impacts to SAV vary by species; CWA lists SAV as a Special Aquatic Site; Mapping species is important for:

- Planning dredging operations
- Mitigating ecological damage
- Monitoring SAV

PI: Bruce Sabol, EL



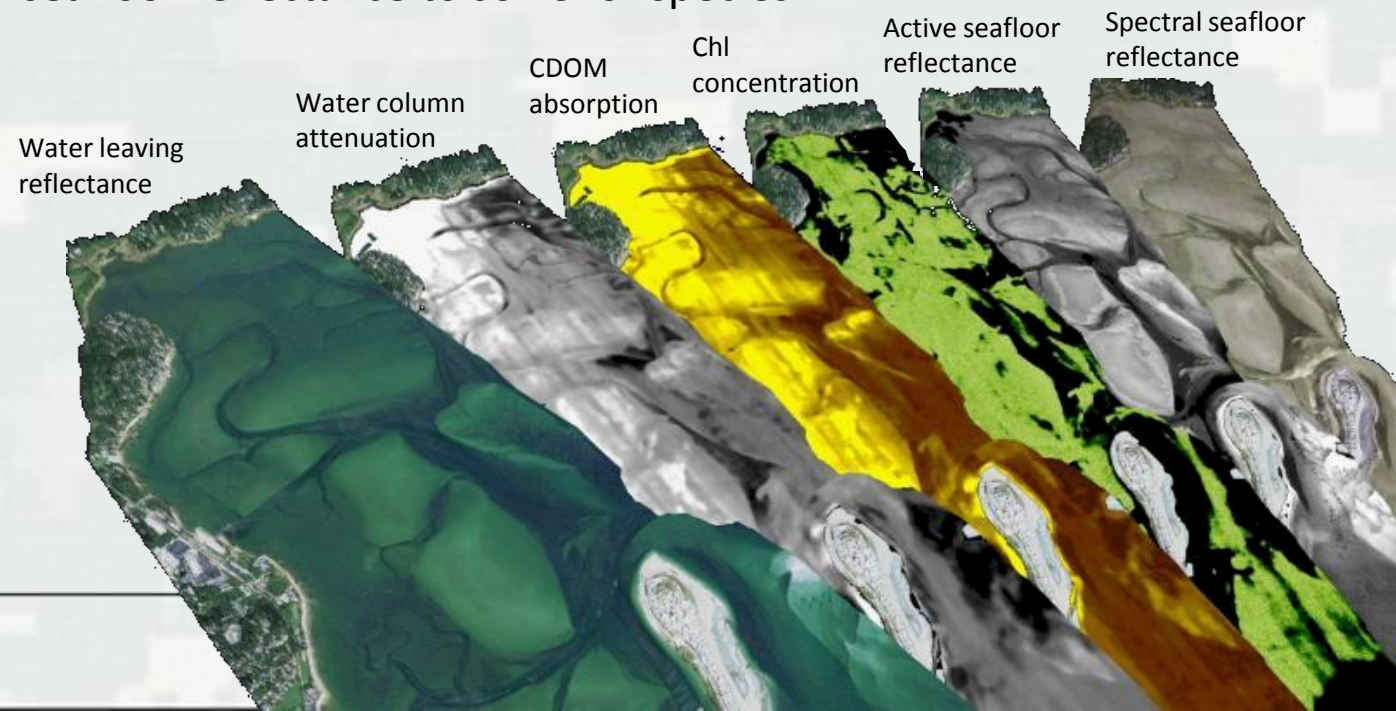
Submersed Eelgrass spectra,
Plymouth Harbor, MA



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Image Processing Methods: Overall Approach

- Coastal Zone Mapping and Imaging Lidar (CZMIL) Data Processing System (DPS)
 - DPS with *Spectral Optimization* to characterize seafloor and water column
 - * Spectral curve fitting approach using radiative transfer theory to invert the hyperspectral image with lidar depth as a constraint for modeling water column constituents and estimating bottom reflectance
 - Classification of seafloor reflectance to solve for species

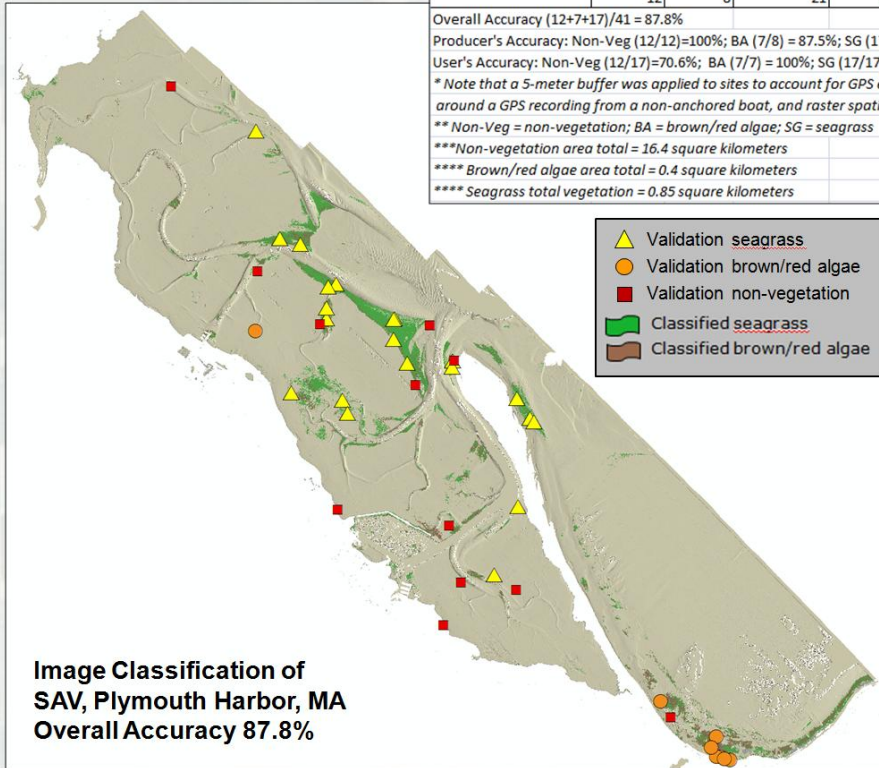


Results

Spectral Angle Mapper Classification Results: Optimized Bottom Reflectance

Classified Image	Ground Truth		Row total
	Non-Veg	Site BA	
Non-Veg	12	1	17
class 1 brown/red algae	0	7	7
class 2 seagrass	0	0	17
	12	8	21
			41

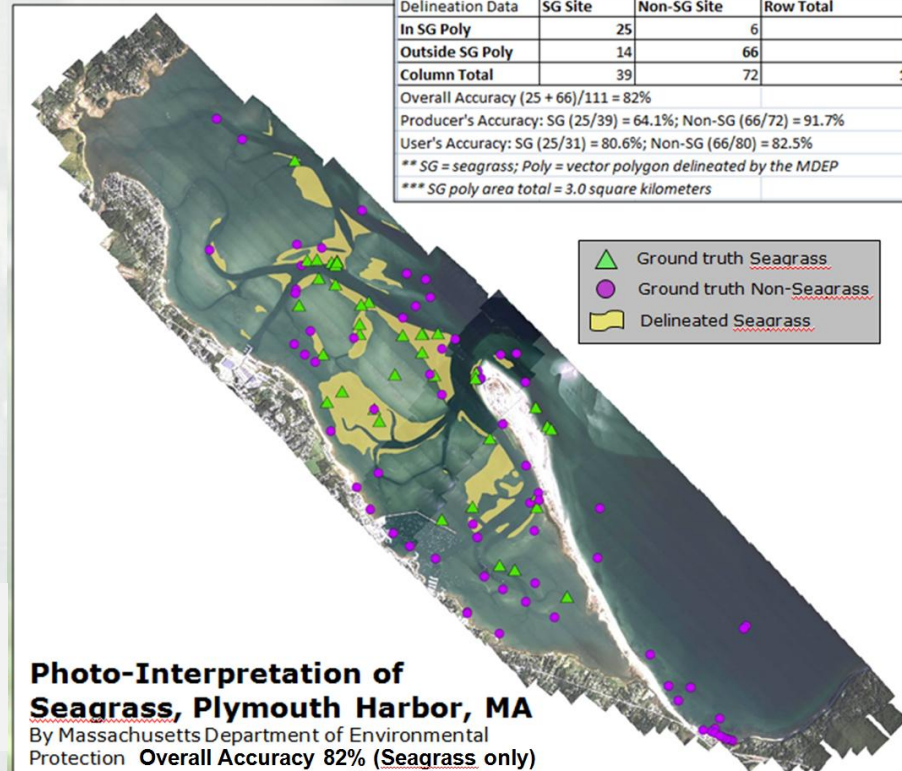
Overall Accuracy $(12+7+17)/41 = 87.8\%$
 Producer's Accuracy: Non-Veg $(12/12) = 100\%$; BA $(7/8) = 87.5\%$; SG $(17/21) = 81\%$
 User's Accuracy: Non-Veg $(12/17) = 70.6\%$; BA $(7/7) = 100\%$; SG $(17/17) = 100\%$
 * Note that a 5-meter buffer was applied to sites to account for GPS error (sampling locations around a GPS recording from a non-anchored boat, and raster spatial resolution accuracy (2-meters)
 ** Non-Veg = non-vegetation; BA = brown/red algae; SG = seagrass
 *** Non-vegetation area total = 16.4 square kilometers
 **** Brown/red algae area total = 0.4 square kilometers
 ***** Seagrass total vegetation = 0.85 square kilometers



Air-Photo Classification Results

PLYMOUTH HARBOR			
Delineation Data	Training Data		Row Total
	SG Site	Non-SG Site	
In SG Poly	25	6	31
Outside SG Poly	14	66	80
Column Total	39	72	111

Overall Accuracy $(25 + 66)/111 = 82\%$
 Producer's Accuracy: SG $(25/39) = 64.1\%$; Non-SG $(66/72) = 91.7\%$
 User's Accuracy: SG $(25/31) = 80.6\%$; Non-SG $(66/80) = 82.5\%$
 ** SG = seagrass; Poly = vector polygon delineated by the MDEP
 *** SG poly area total = 3.0 square kilometers



Data Access

The screenshot displays the JALBTCX website interface. At the top, the logo "JALBTCX" is prominently featured, followed by the tagline "Joint Airborne Lidar Bathymetry Technical Center of Expertise". Navigation buttons for "Home", "CHARTS", "News", "Contact Us", and "Field Support" are located in the header. Below the header, a banner image shows a twin-engine aircraft flying over a body of water, with a green laser beam illuminating the water's surface. The main content area is divided into two sections. On the left, a "Coverage Map" displays a bathymetric map of a coastal area, with a color scale indicating depth. The map includes a compass rose, a scale bar (0 to 2 miles), and map coordinates: "Map Coords: X = -87.1191, Y = 41.6366". On the right, the "SHOALS Viewer" section provides instructions on how to view bathymetry/topographic data, including a list of themes: "NCMP Coverage" and "Planned". The footer contains a row of logos, including the U.S. Army Corps of Engineers, and a copyright notice: "© 2011 All Rights Reserved • Joint Airborne Lidar Bathymetry Technical Center of Expertise & U.S. Army Corps of Engineers".

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Joint Airborne Lidar Bathymetry Technical Center of Expertise

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Coverage Map

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Add data

Server Selector

SHOALS Viewer
To view CHARTS bathymetry/topographic data, select one of the themes from the list below.

NCMP Coverage
Planned

Map Coords: X = -87.1191, Y = 41.6366

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View CHARTS
bathymetric/
topographic data

www.jalbtcx.org



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Thank you!



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