US Army Corps of Engineers Lidar and Navigation

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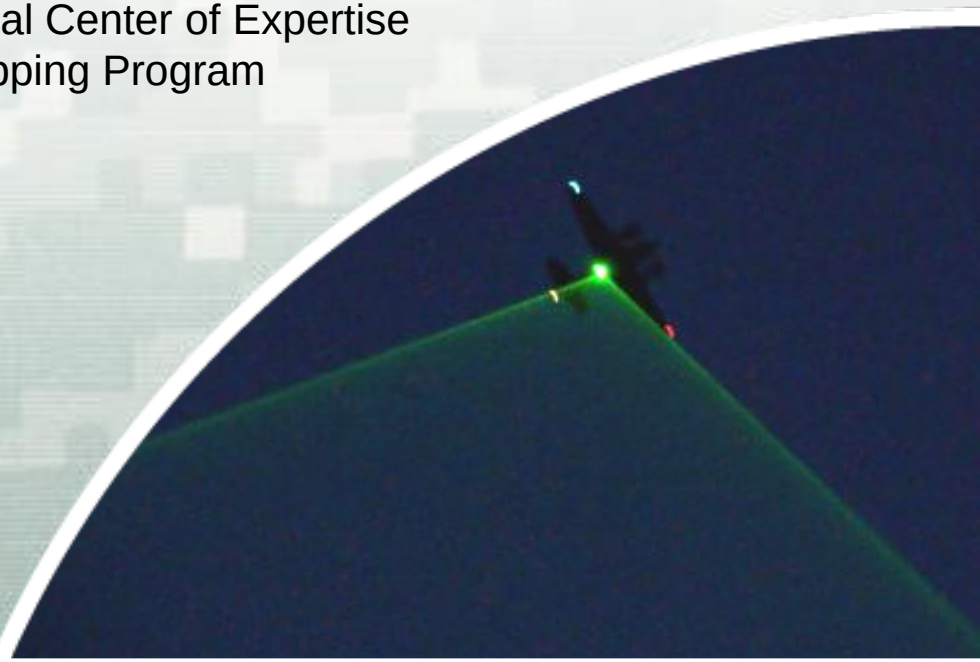
Program Manager, USACE National Coastal Mapping Program

13 February 2014, AAPA H&N meeting

Outline

- Technology
- USACE National Coastal Mapping Program
  - Background
  - Products
  - Applications
- Questions



US Army Corps of Engineers
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Joint Airborne Lidar Bathymetry Technical Center of Expertise

Annual Technical Workshop, 10-11 June 2014, Mobile, AL

OPERATIONS

- Aircraft
- Surveys
- Procedures
- People

RESEARCH AND DEVELOPMENT

- Hardware
- Software
- Data exploitation
- Algorithms

Optech

US Army Corps of Engineers MOBILE DISTRICT

CCOM JHC

US Army Corps of Engineers® Engineer Research and Development Center

NORTHROP GRUMMAN

NAVAL METEOROLOGY AND OCEANOGRAPHY COMMAND

ONR Office of Naval Research

AIRBORNE IMAGING

COASTAL PLANNING & ENGINEERING CPE

Kenn Borek Air Ltd. Anytime, Anywhere ... Worldwide

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

USGS science for a changing world

Dynamic Aviation

NAVAL RESEARCH LABORATORY WASHINGTON, DC

THE UNIVERSITY OF SOUTHERN MISSISSIPPI 1910

itres

UNIVERSITY OF NOTRE DAME

Bowhead

AHAB Airborne Hydrography AB

UGRO

WOOLPERT DESIGN | GEOSPATIAL | INFRASTRUCTURE

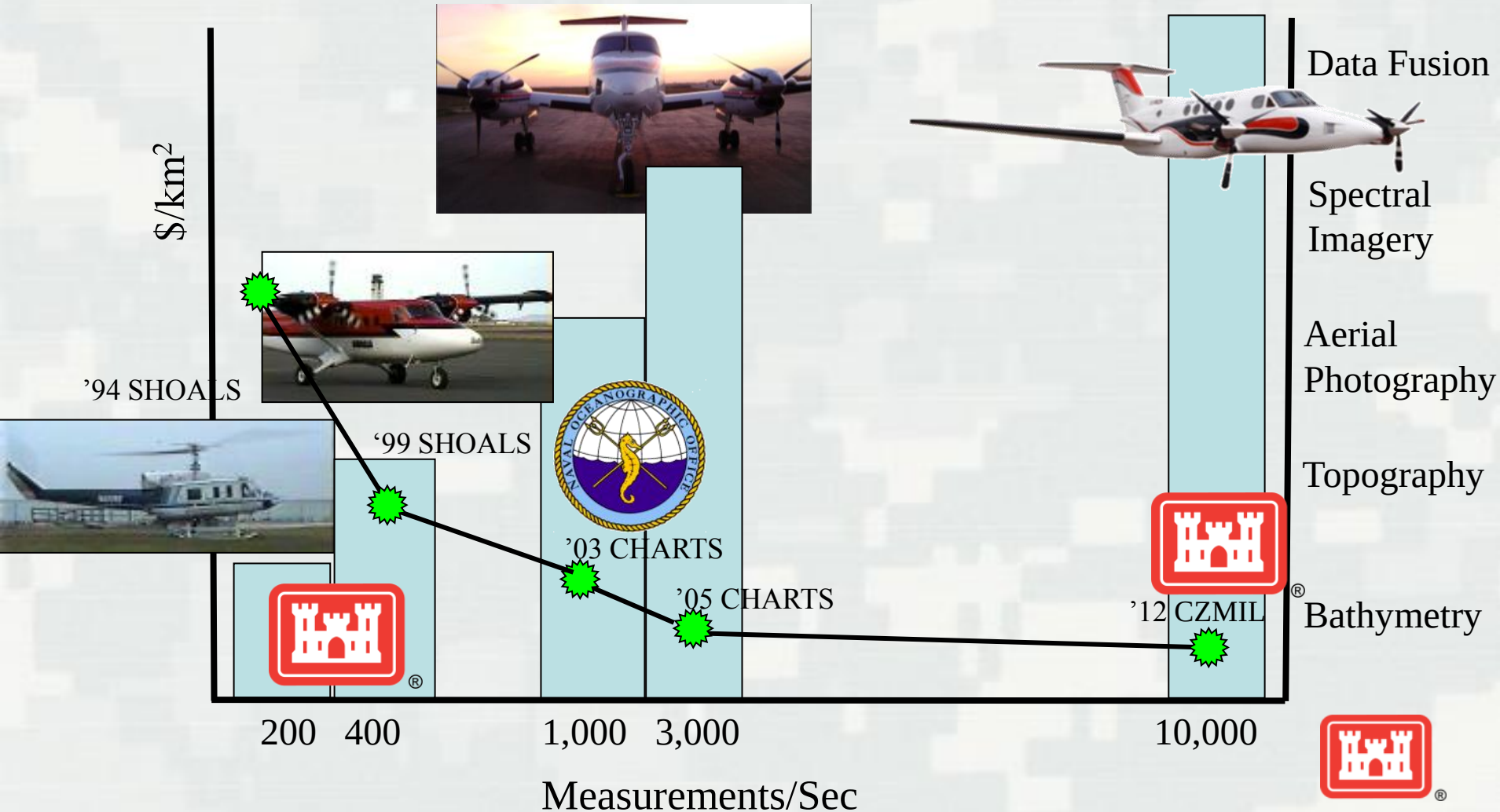
U. S. Naval Research Laboratory Stennis Space Center, MS

Pelydryn

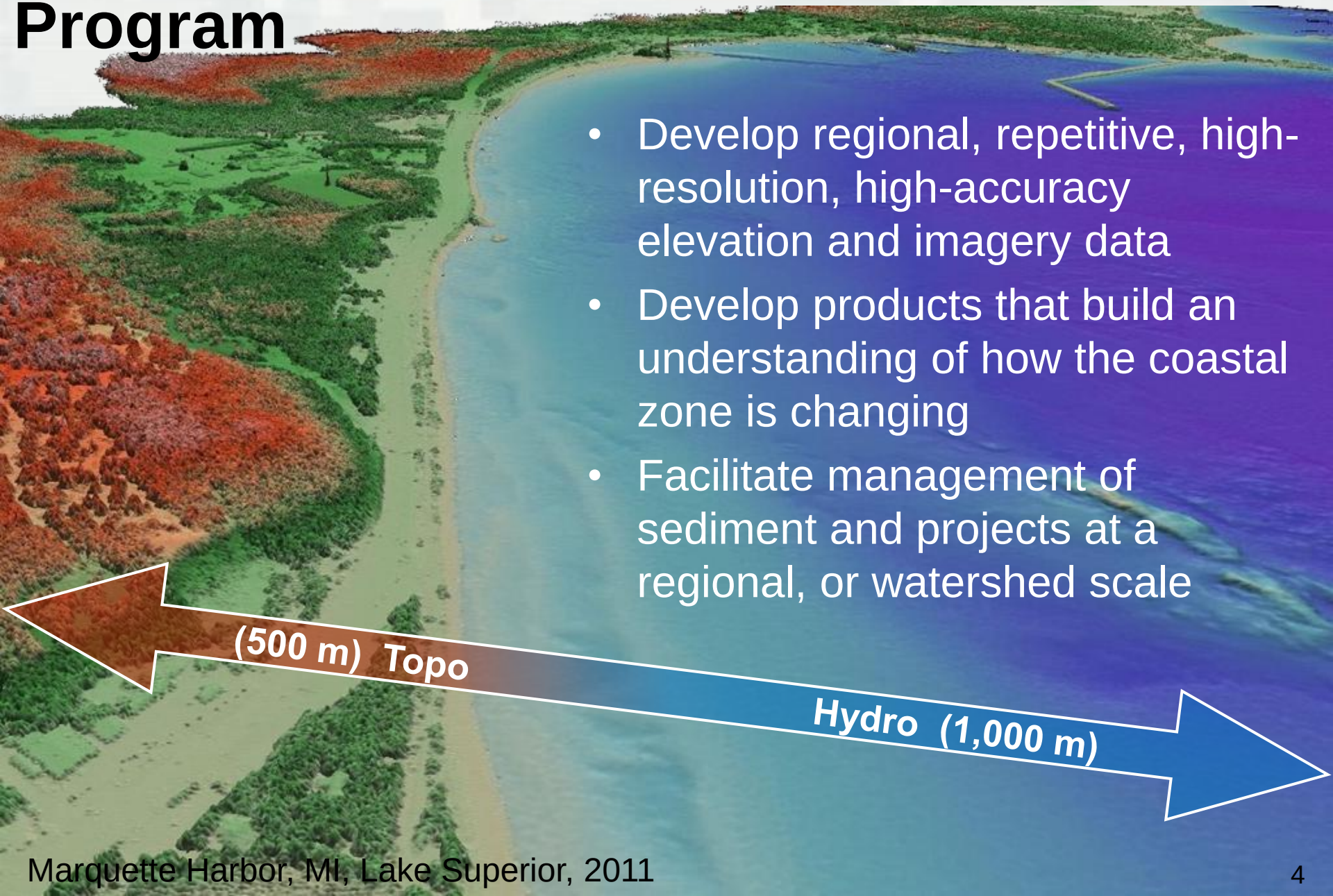
TEXAS A&M UNIVERSITY

UNIVERSITY of NEW HAMPSHIRE

Sensor development history



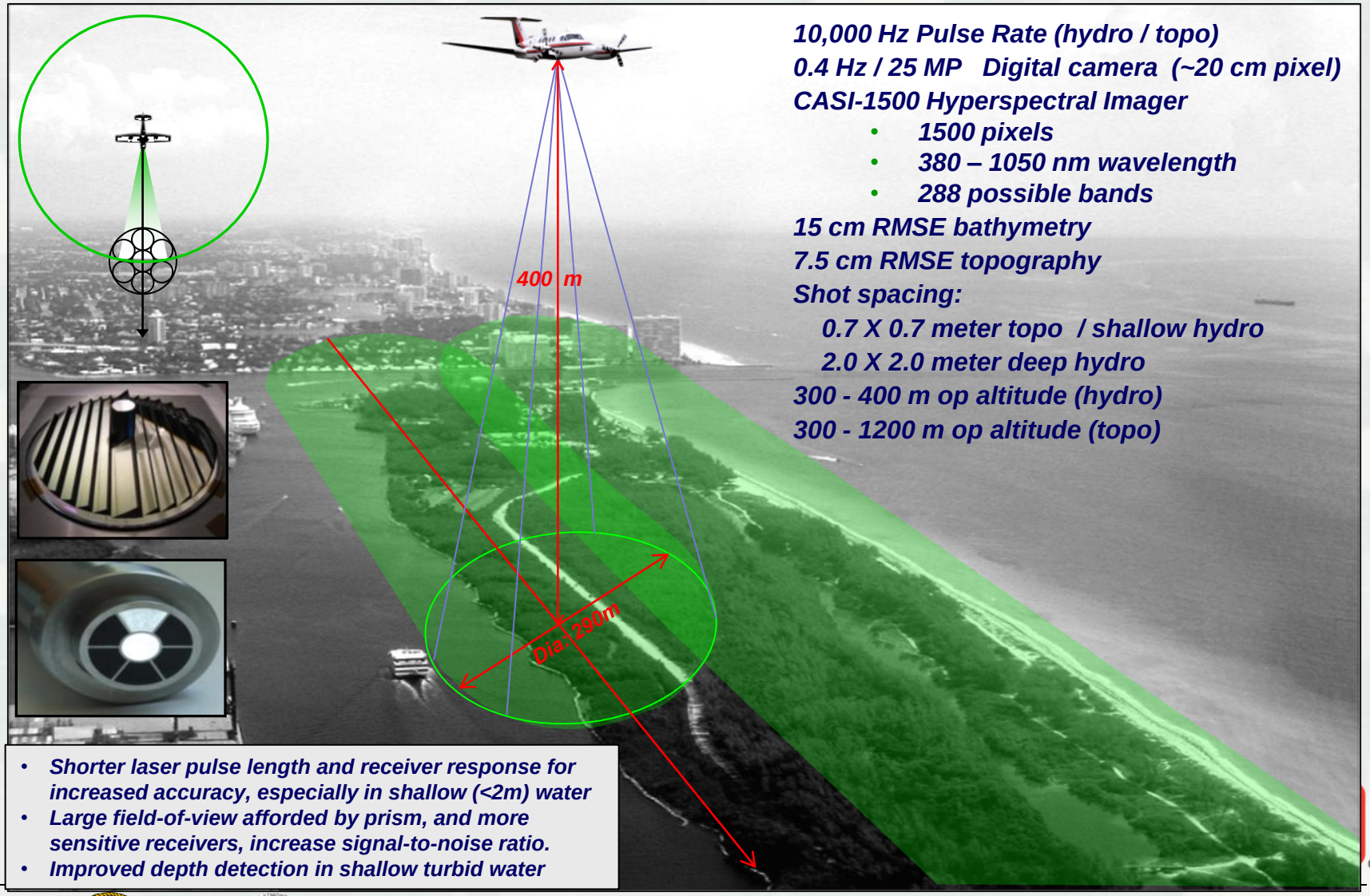
USACE National Coastal Mapping Program



- Develop regional, repetitive, high-resolution, high-accuracy elevation and imagery data
- Develop products that build an understanding of how the coastal zone is changing
- Facilitate management of sediment and projects at a regional, or watershed scale

Marquette Harbor, MI, Lake Superior, 2011

Coastal Zone Mapping and Imaging Lidar

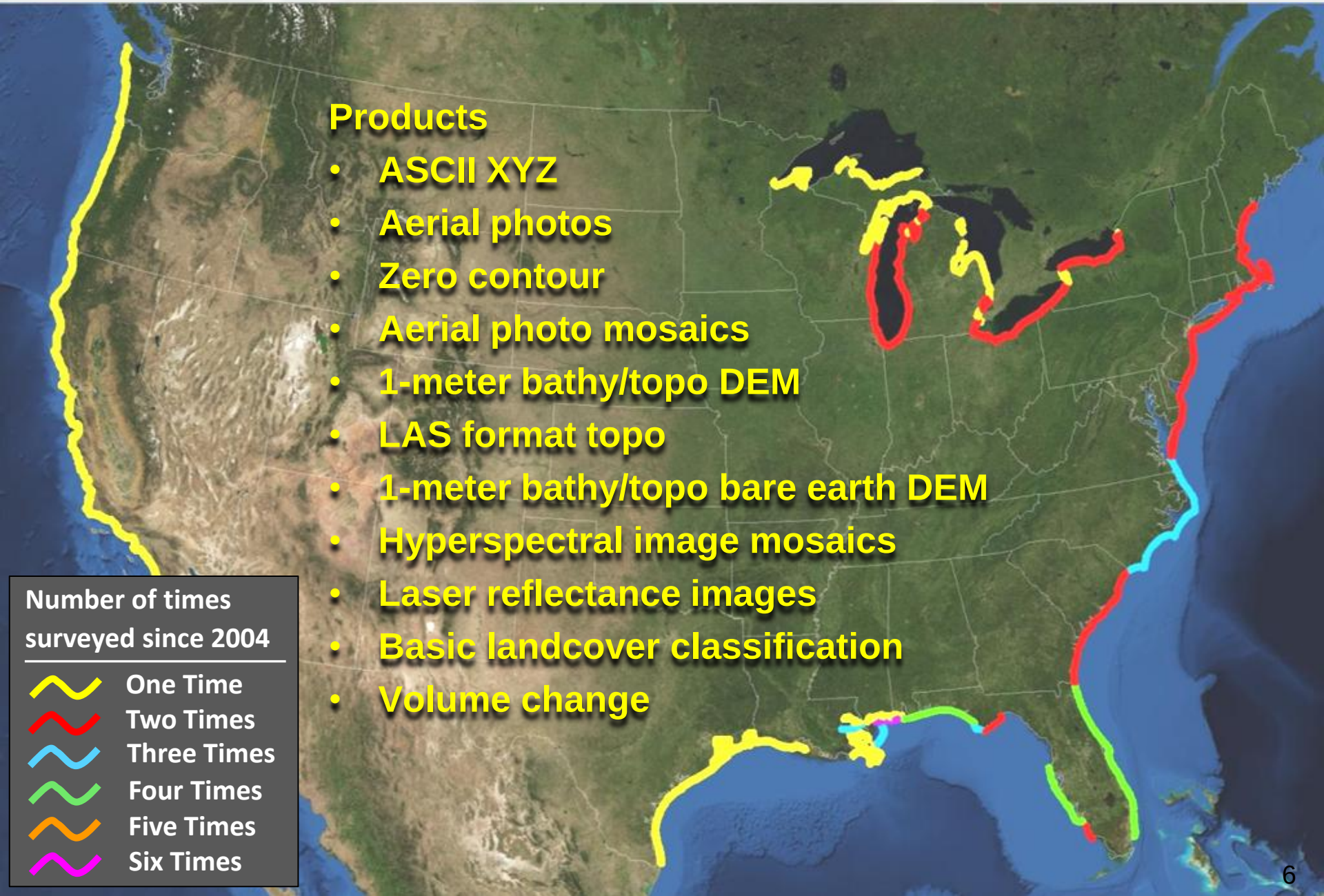


10,000 Hz Pulse Rate (hydro / topo)
0.4 Hz / 25 MP Digital camera (~20 cm pixel)
CASI-1500 Hyperspectral Imager
- *1500 pixels*
- *380 – 1050 nm wavelength*
- *288 possible bands*

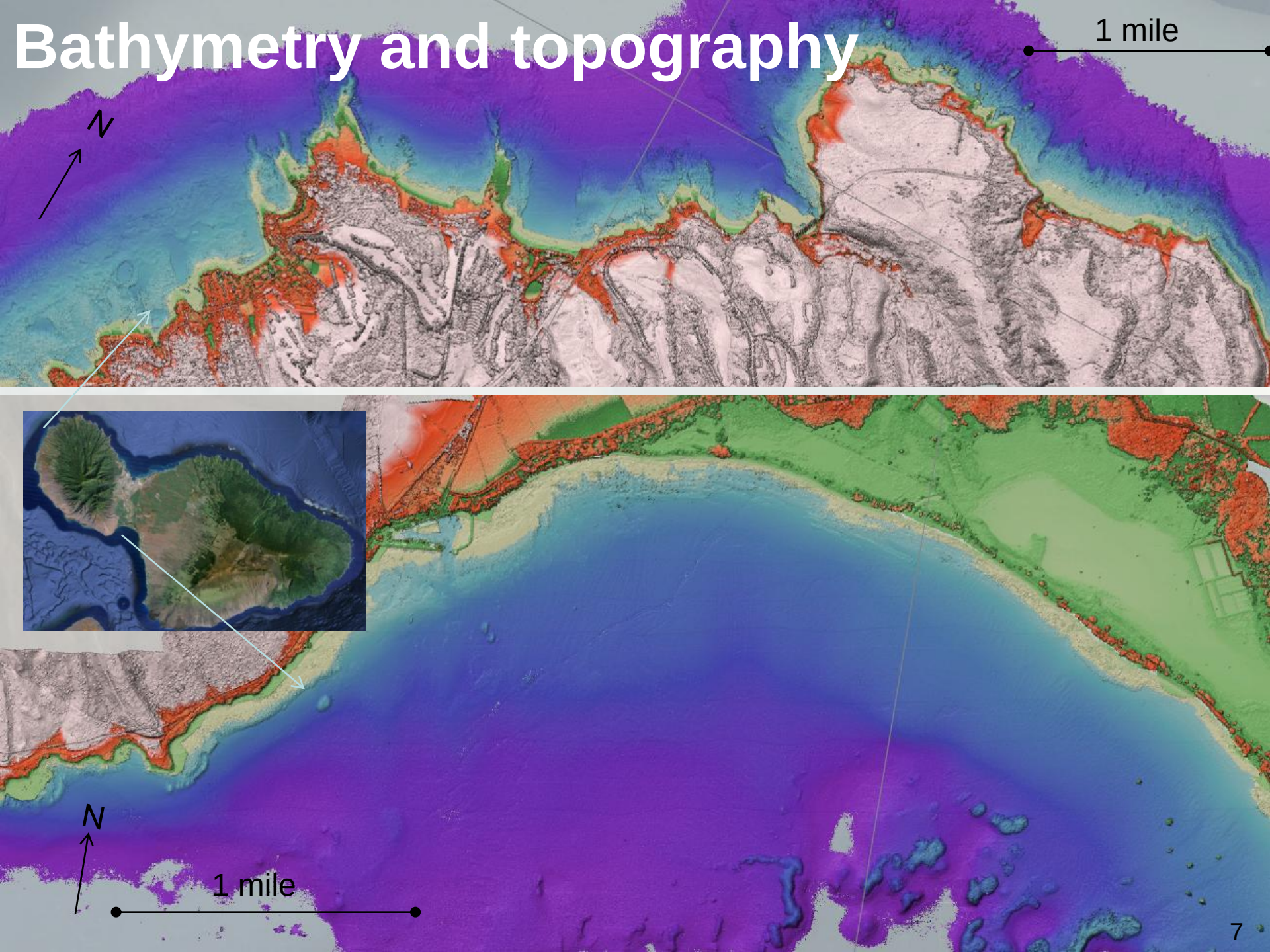
15 cm RMSE bathymetry
7.5 cm RMSE topography
Shot spacing:
0.7 X 0.7 meter topo / shallow hydro
2.0 X 2.0 meter deep hydro
300 - 400 m op altitude (hydro)
300 - 1200 m op altitude (topo)

- *Shorter laser pulse length and receiver response for increased accuracy, especially in shallow (<2m) water*
- *Large field-of-view afforded by prism, and more sensitive receivers, increase signal-to-noise ratio.*
- *Improved depth detection in shallow turbid water*

National Coastal Mapping Progress

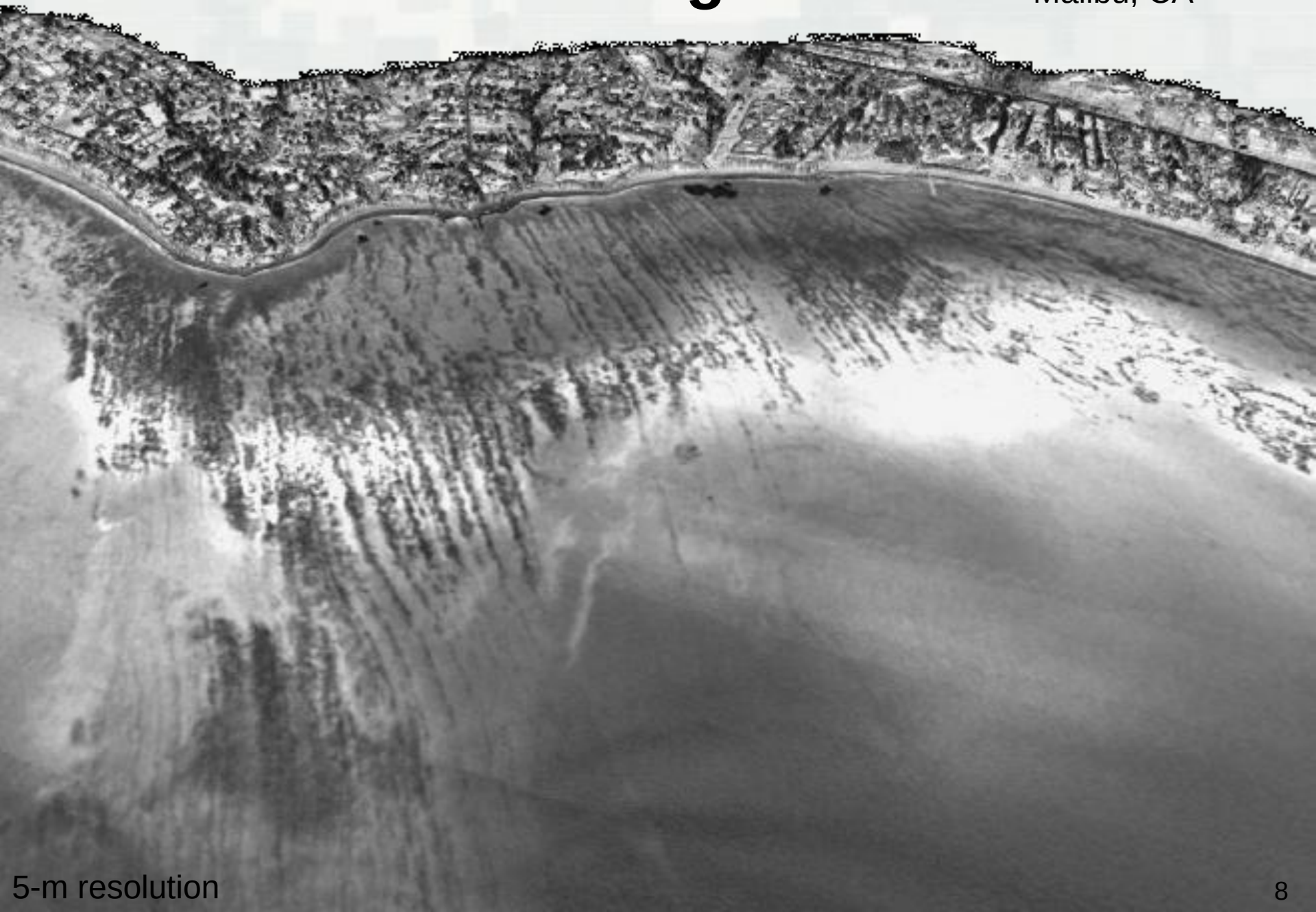


Bathymetry and topography



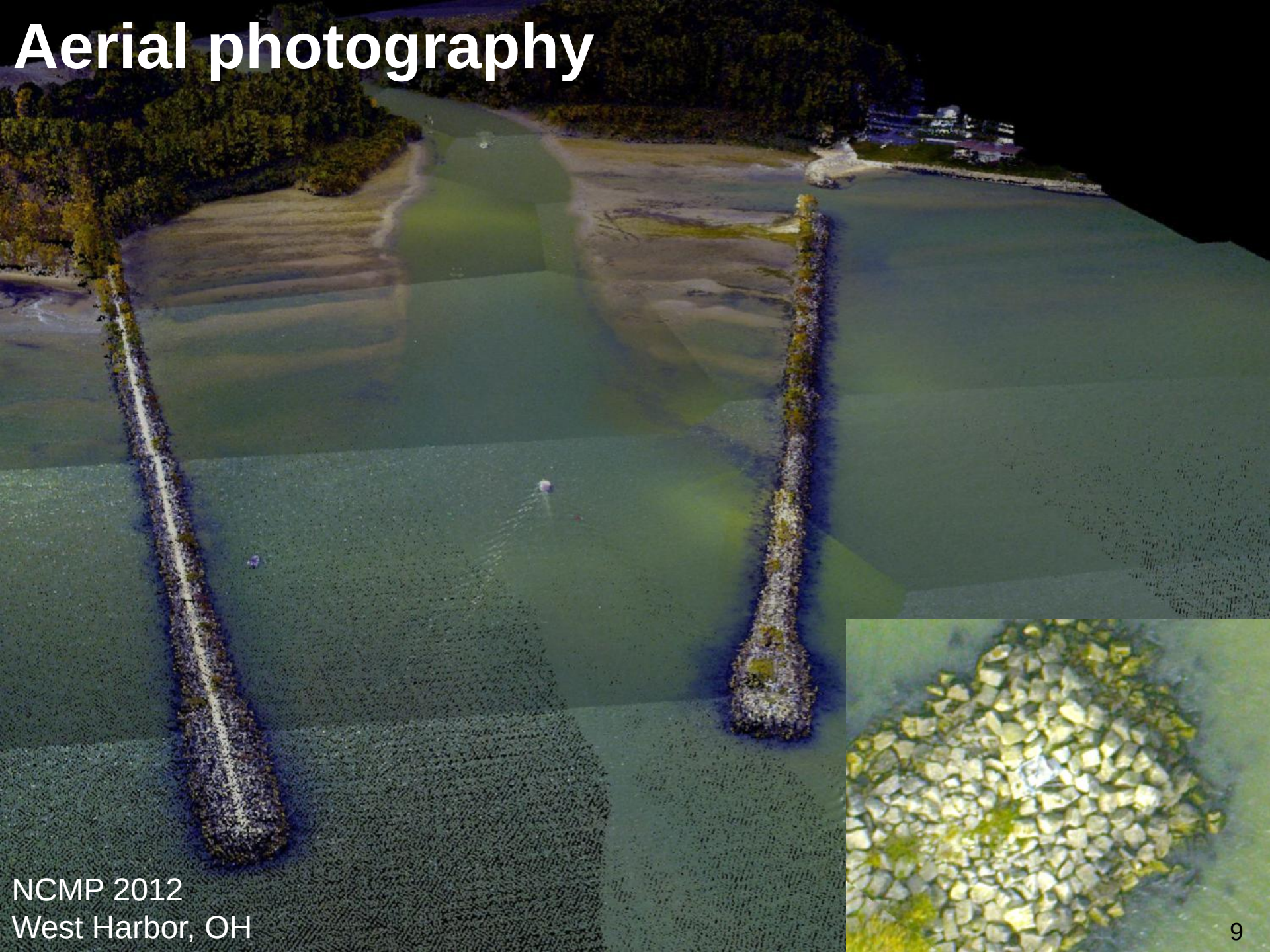
Laser reflectance image

NCMP 2009
Malibu, CA



5-m resolution

Aerial photography



NCMP 2012
West Harbor, OH

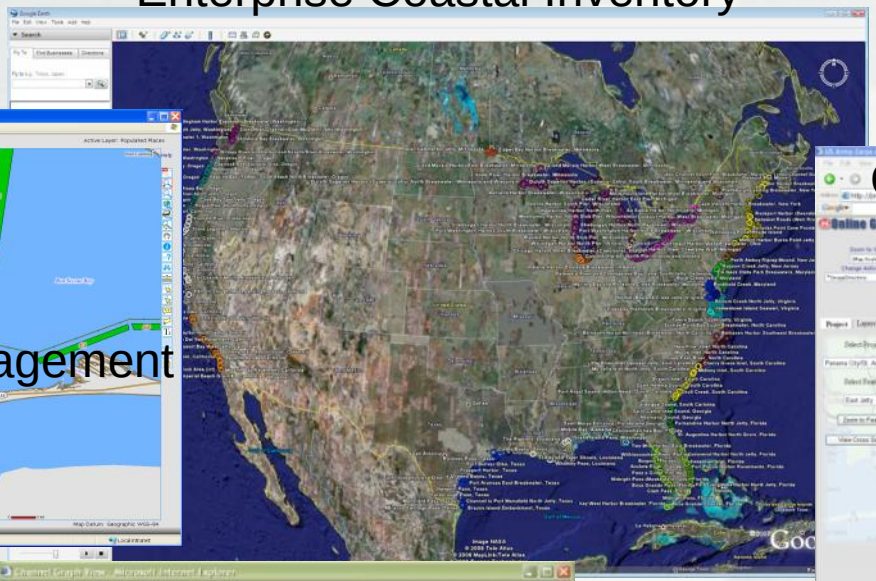
Hyperspectral imagery

1 m pixel resolution
36 spectral bands
375-1050 nm

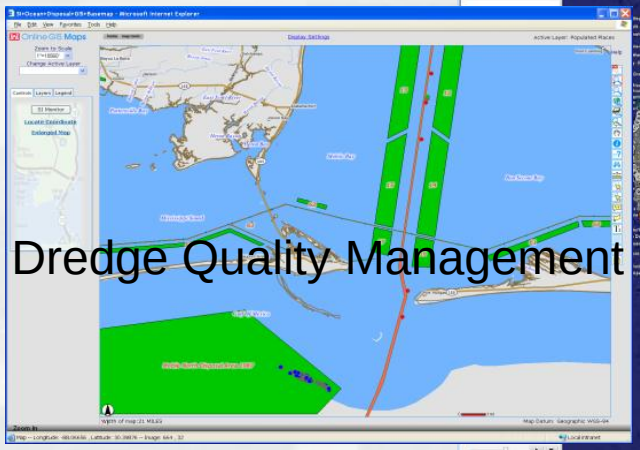
Near Laurence Harbor, NJ
Post-Sandy 2012

Navigation Data Integration Framework: Navigation and Coastal Data Bank

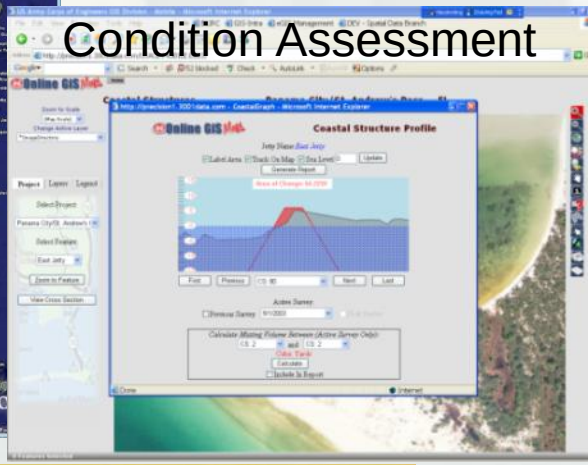
Enterprise Coastal Inventory



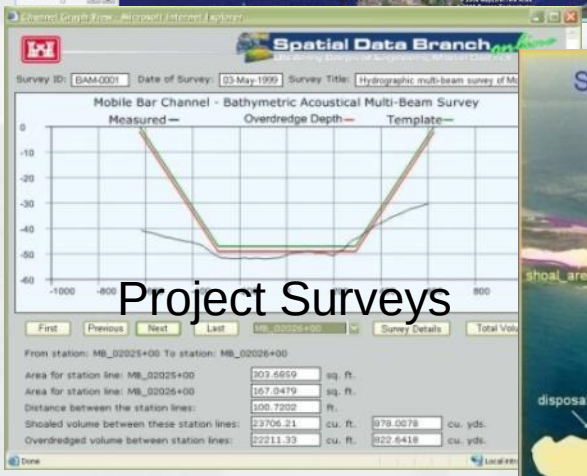
Dredge Quality Management



Coastal Structure Condition Assessment



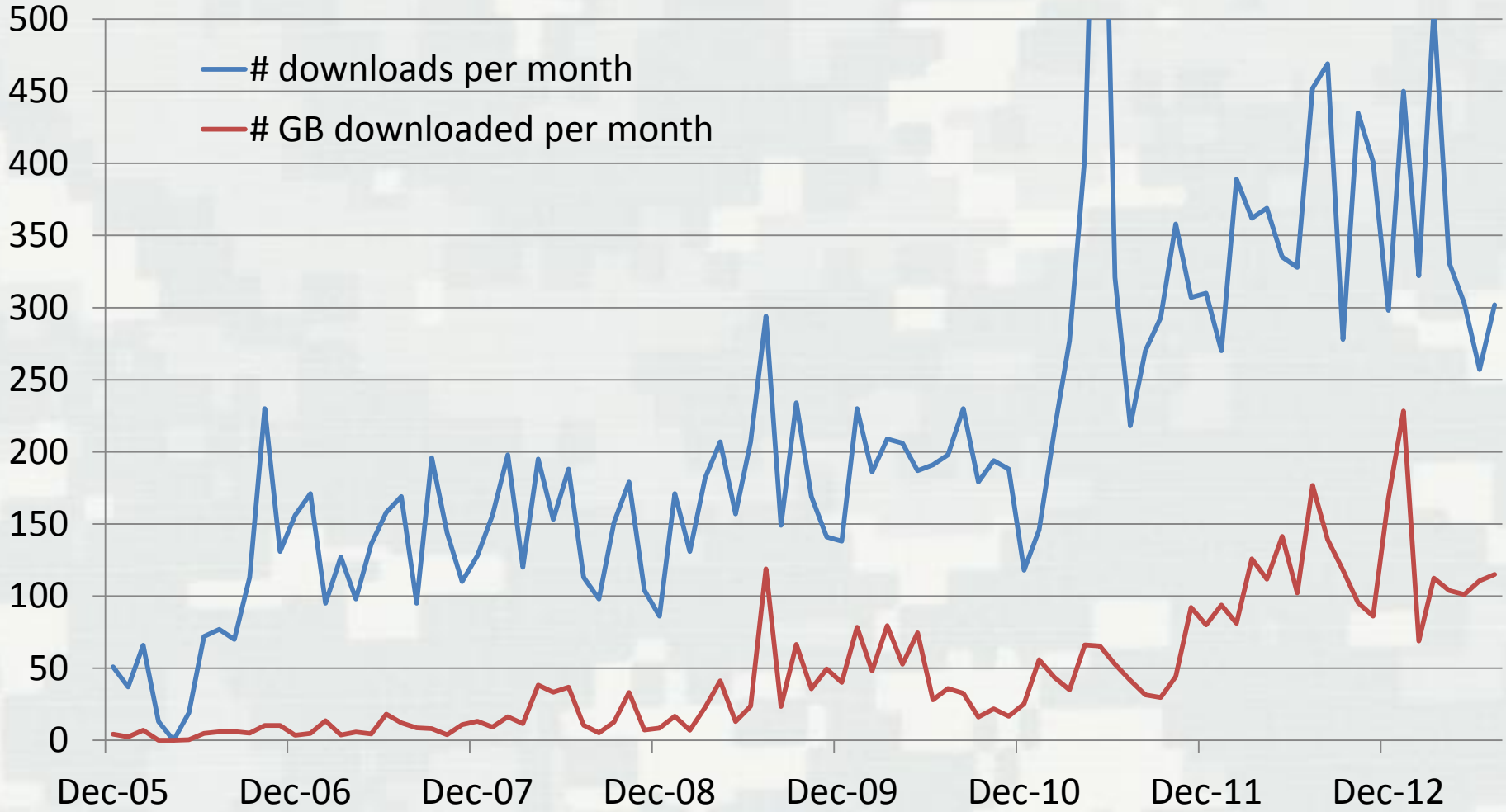
- USGS St. Petersburg
- USGS EROS Data Center
- NOAA CSC
- NOAA NGDC
- By Request



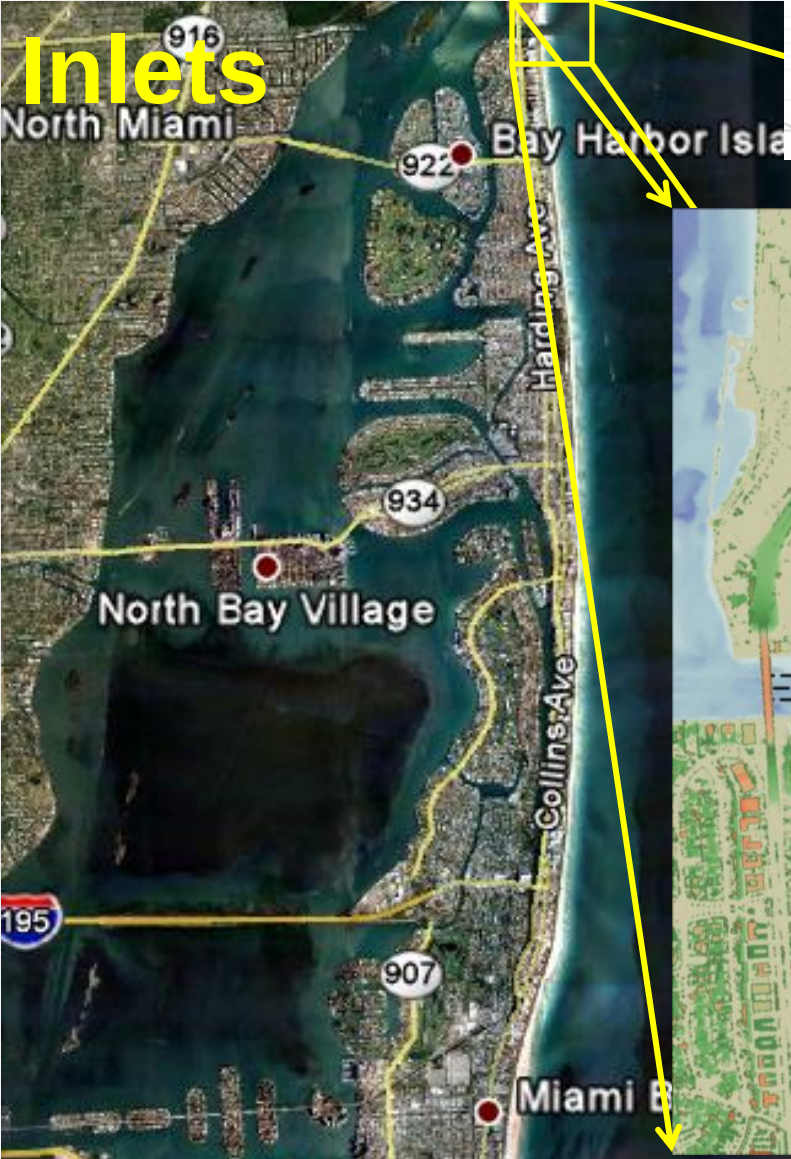
Project Surveys

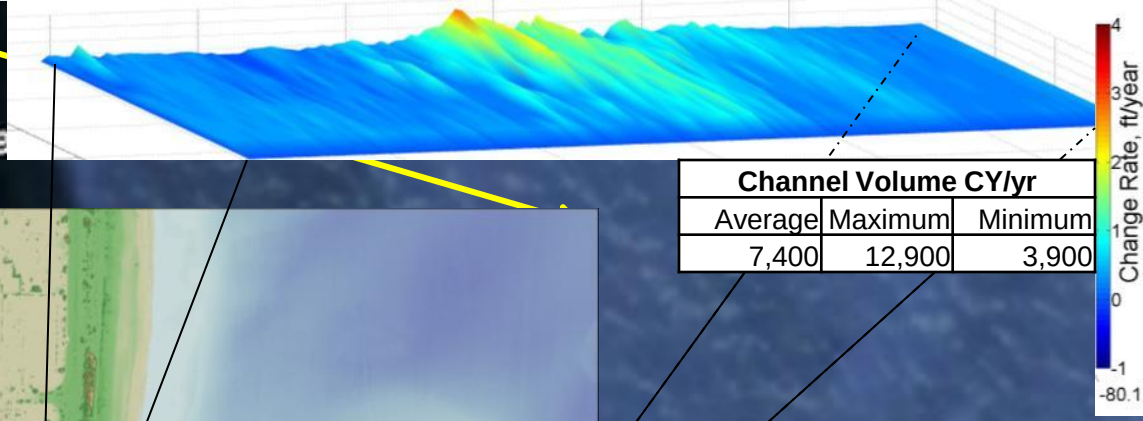
JALBTCX at the DIGITAL COAST

4.2 TB lidar data in more than 19,000 downloads

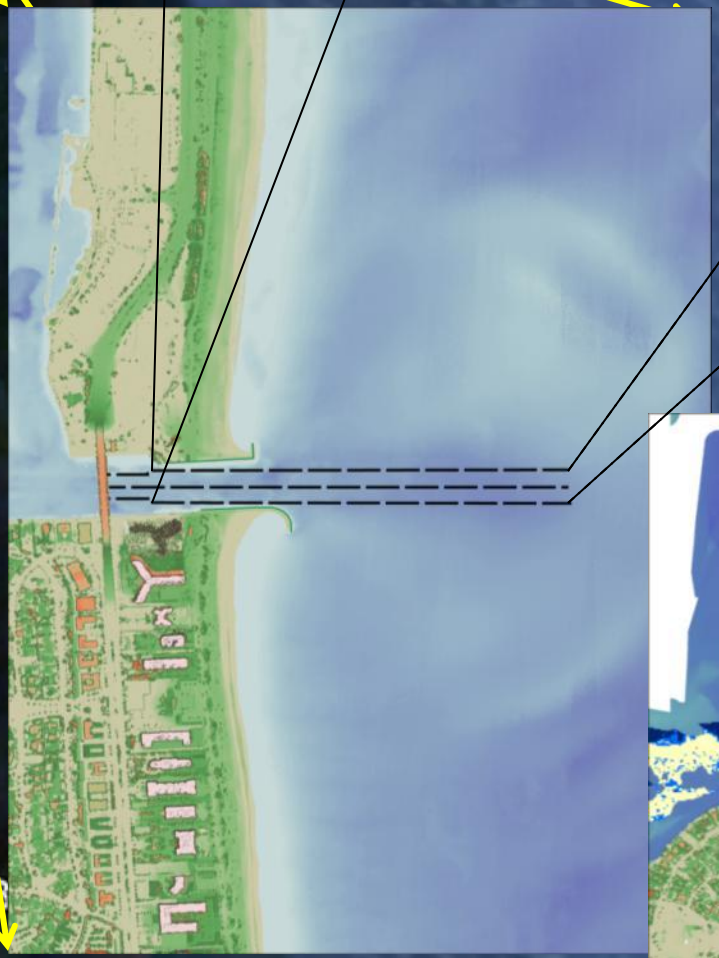


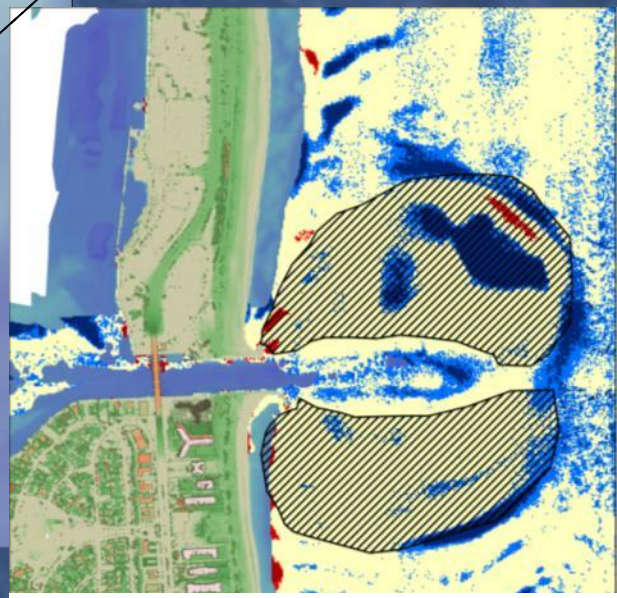
Inlets





Channel Volume CY/yr		
Average	Maximum	Minimum
7,400	12,900	3,900

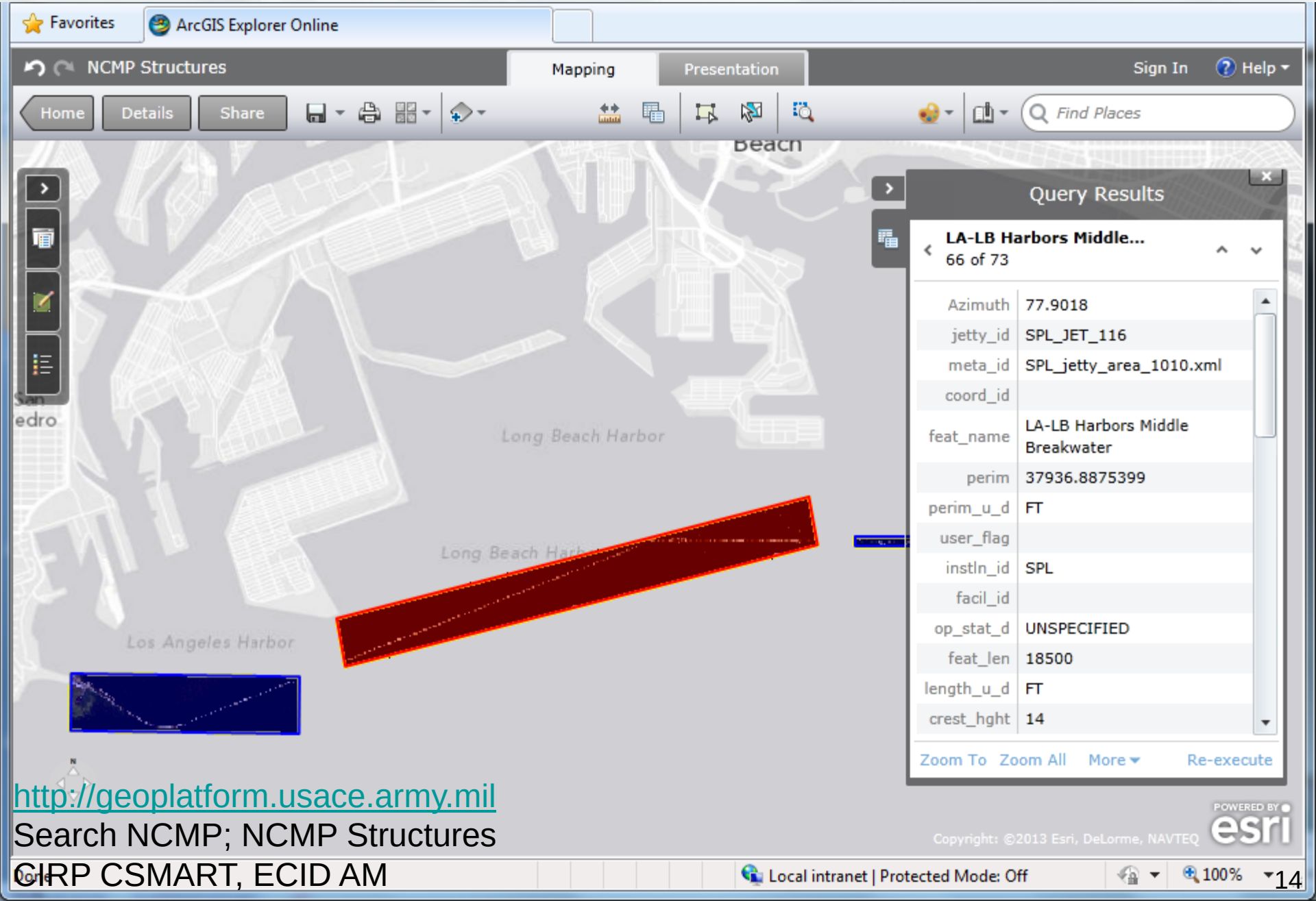




Volume Change (CY)

Survey	North Shoal	South Shoal	Total
10/2009--6/2004	266,158	174,736	440,894
10/2009--1/2006	232,284	150,703	382,987
1/2006--11/2004	106,561	21,548	128,109
11/2004--6/2004	-81,090	-64,643	-145,733

Asset management coastal structures

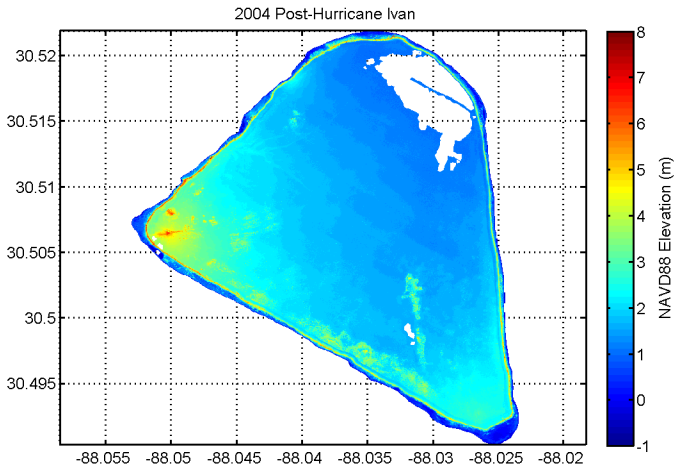


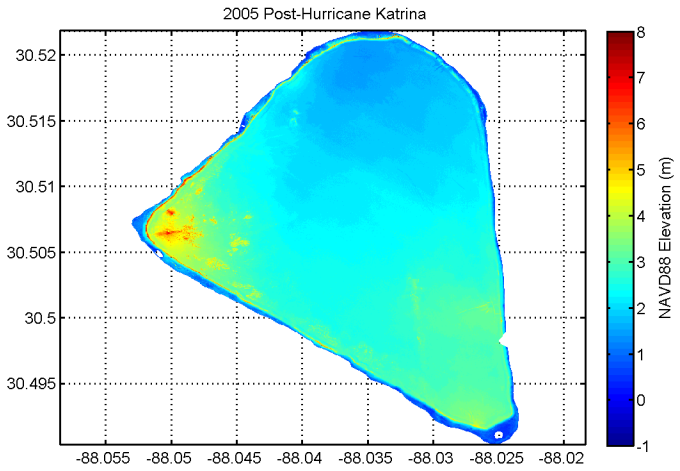
http://geoplatform.usace.army.mil

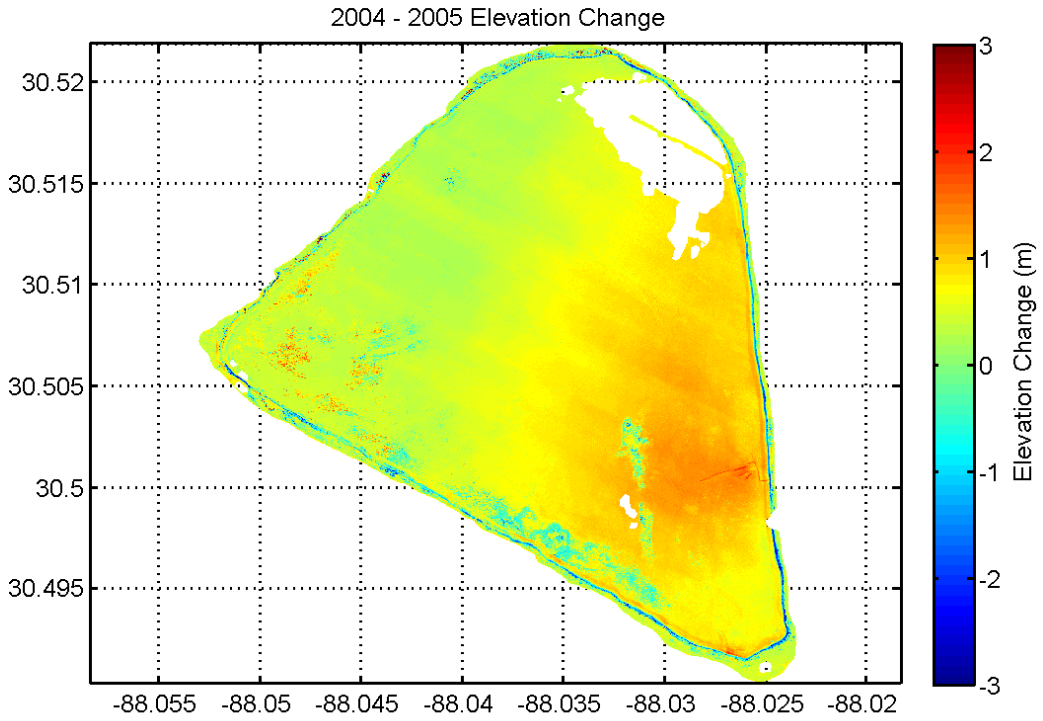
Search NCMP; NCMP Structures

CIRP CSMART, ECID AM

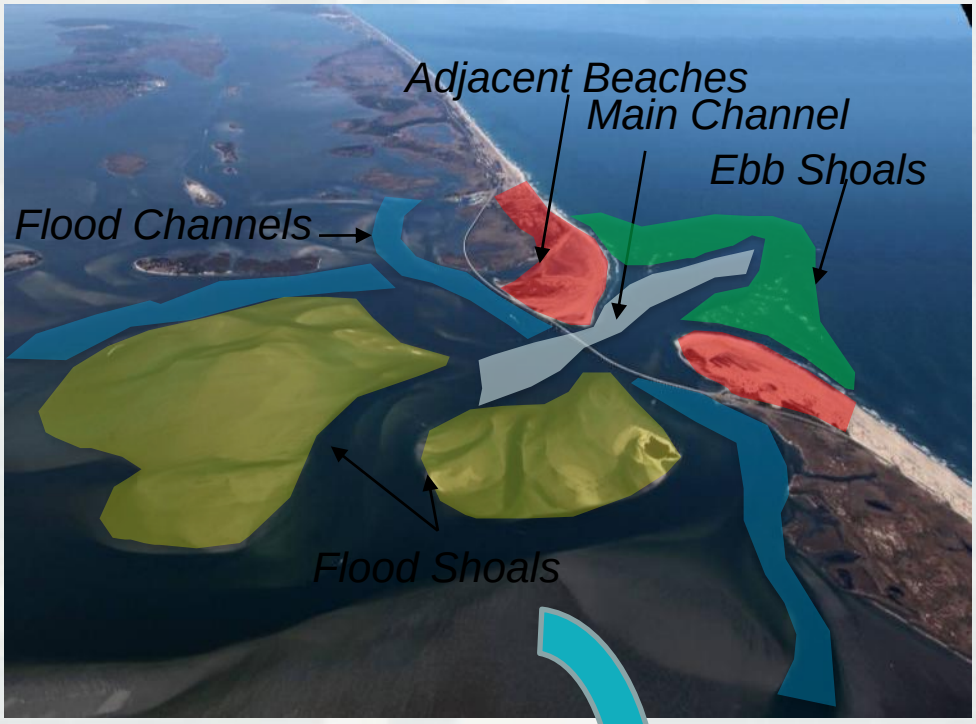
Disposal monitoring



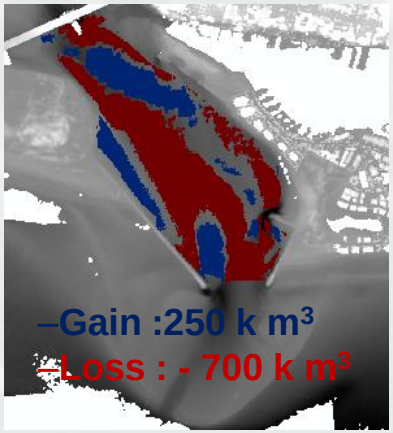


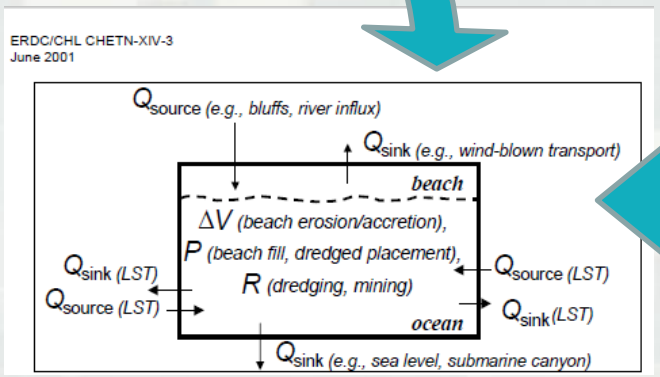


Sediment Pathways & Budget



Inlet and ebb shoal





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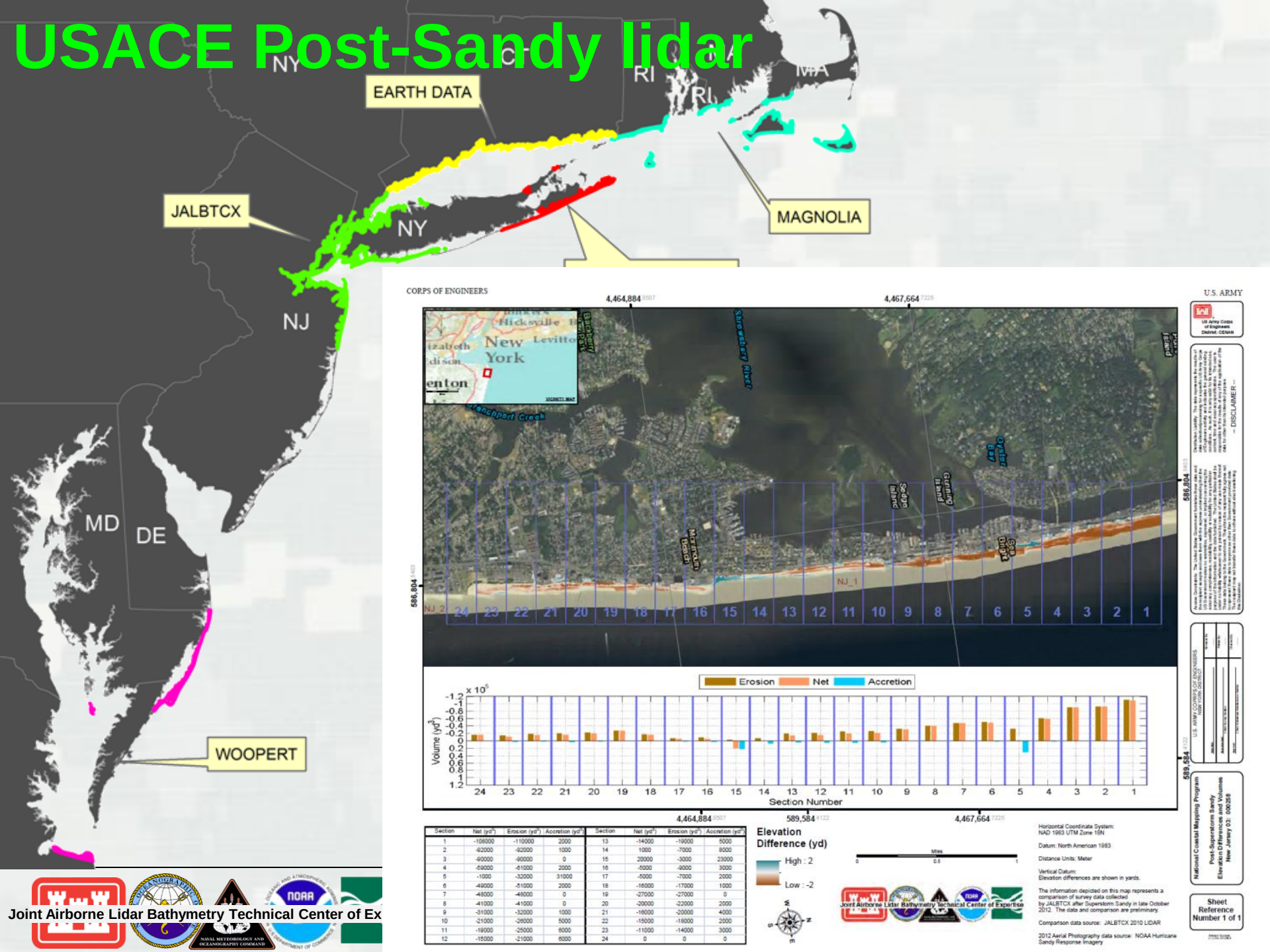
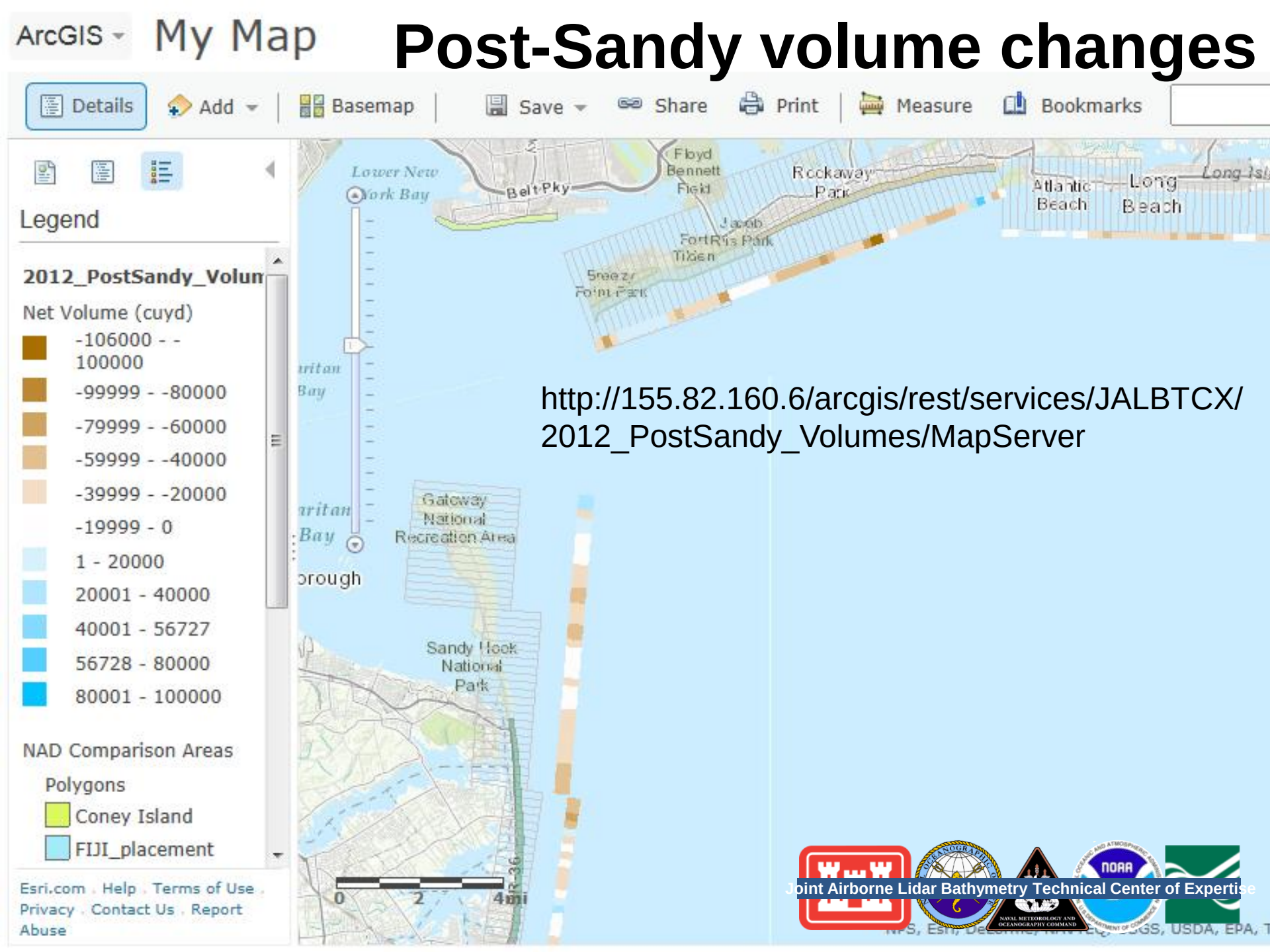
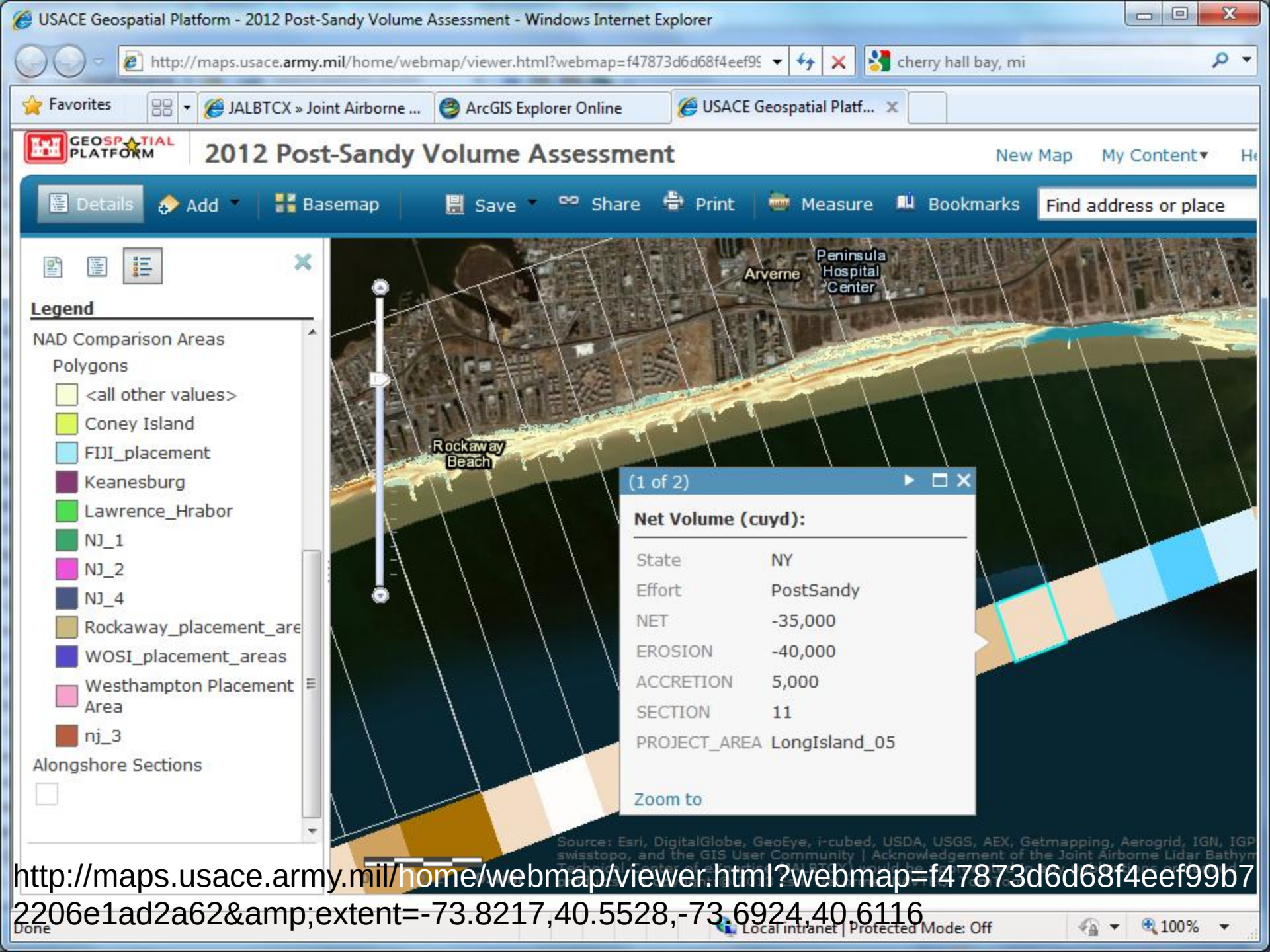
USACE Post-Sandy lidar



Section	Net (yd³)	Erosion (yd³)	Accretion (yd³)	Section	Net (yd³)	Erosion (yd³)	Accretion (yd³)
1	-108000	-110000	2000	13	-14000	-19000	5000
2	-92000	-92000	1000	14	1000	-7000	8000
3	-90000	-90000	0	15	20000	-3000	23000
4	-59000	-61000	2000	16	-5000	-9000	3000
5	-1000	-32000	31000	17	-5000	-7000	2000
6	-49000	-51000	2000	18	-16000	-17000	1000
7	-48000	-48000	0	19	-27000	-27000	0
8	-41000	-41000	0	20	-20000	-22000	2000
9	-31000	-32000	1000	21	-16000	-20000	4000
10	-21000	-26000	5000	22	-15000	-18000	2000
11	-19000	-25000	6000	23	-11000	-14000	3000
12	-15000	-21000	6000	24	0	0	0

Post-Sandy volume changes

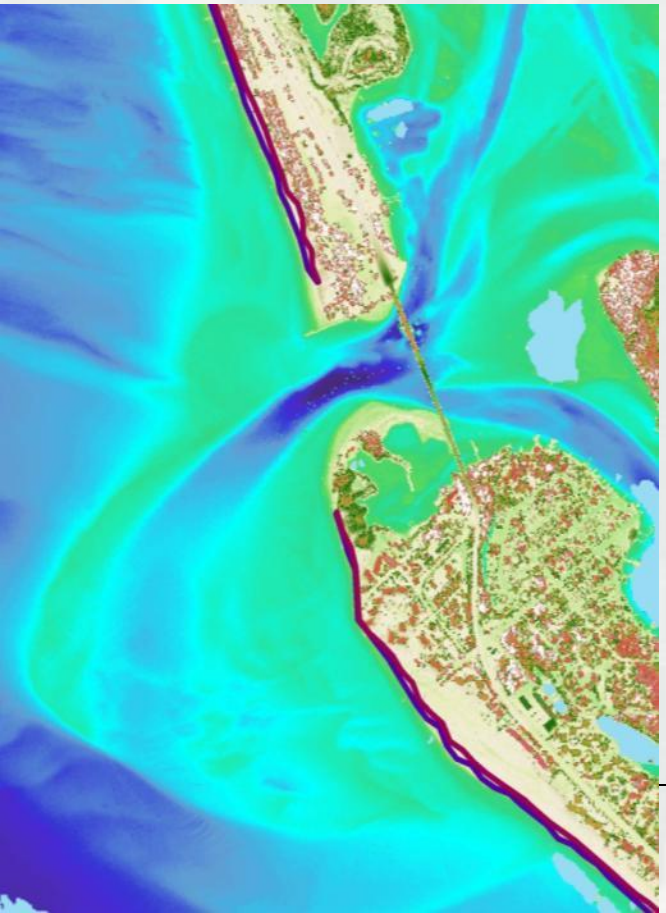


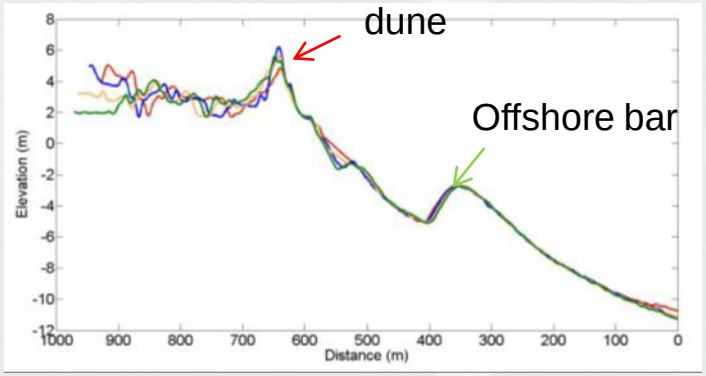


http://maps.usace.army.mil/home/webmap/viewer.html?webmap=f47873d6d68f4eef99b72206e1ad2a62&extent=-73.8217,40.5528,-73.6924,40.6116

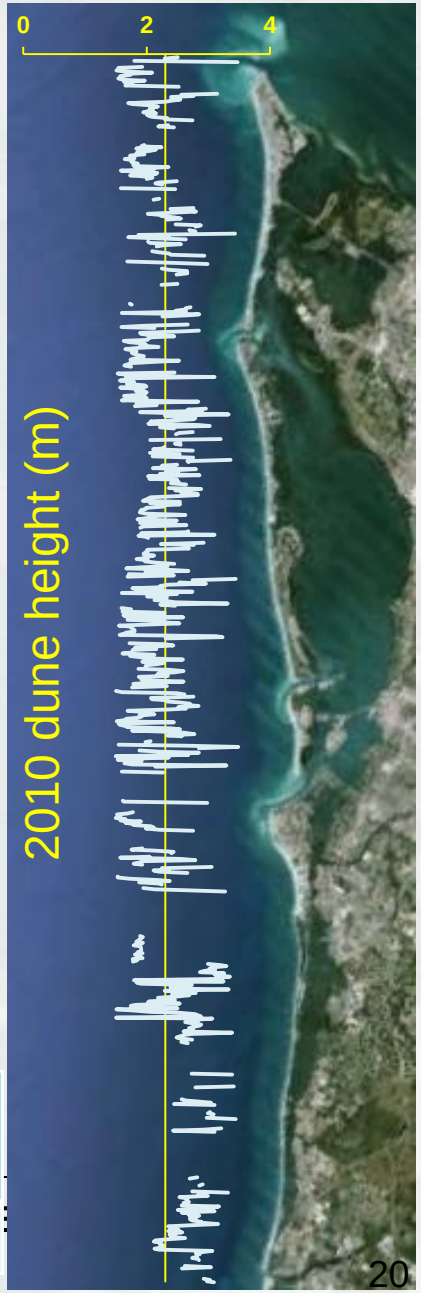
Dunes

- Provide natural buffer from waves/runup to upland areas
- Volume of sediment available for beach recovery
- Included as part of beach nourishment projects



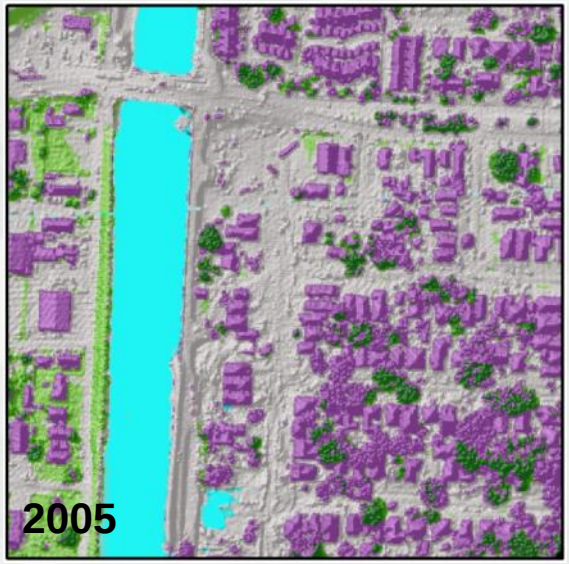


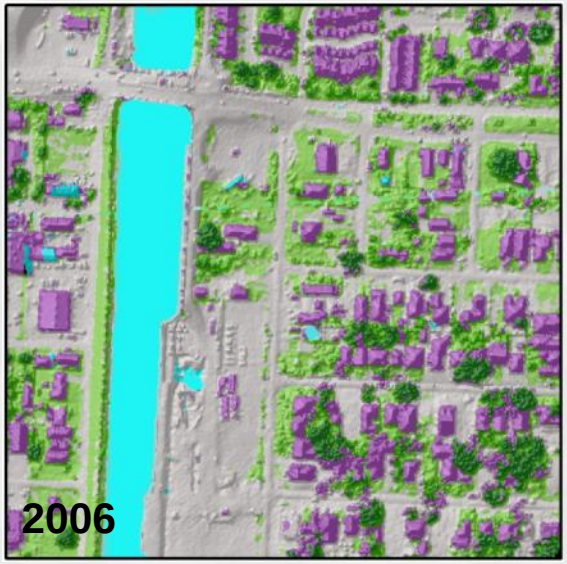
- Dune height – crest of the first dune
- Dune toe – slope change in dune

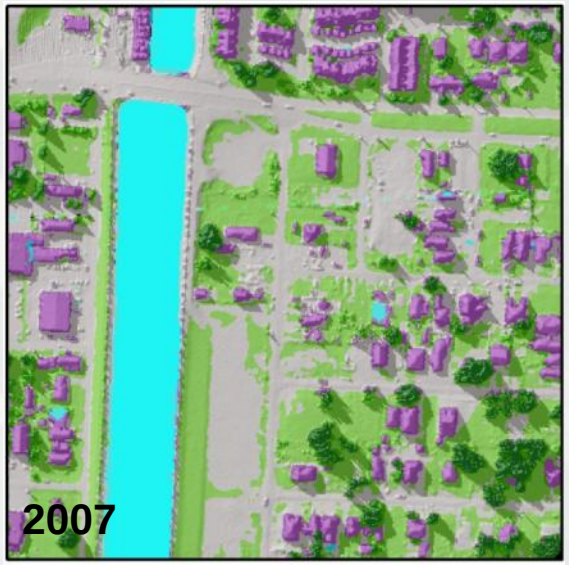


2010 Dune Height
2 m

Landscape changes







Roads/ Bare Ground

Structures

Low Vegetation

Medium Vegetation

Tall Vegetation

System-Wide Water Resources Program SWWRP

17th Street Canal
New Orleans, LA

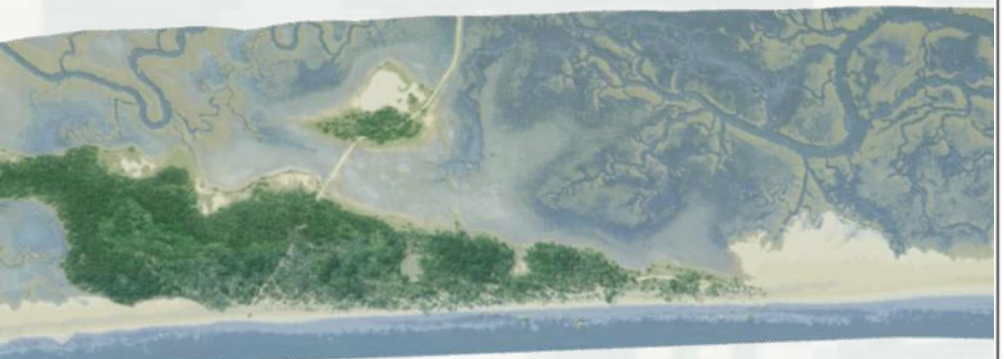
BUILDING STRONG®

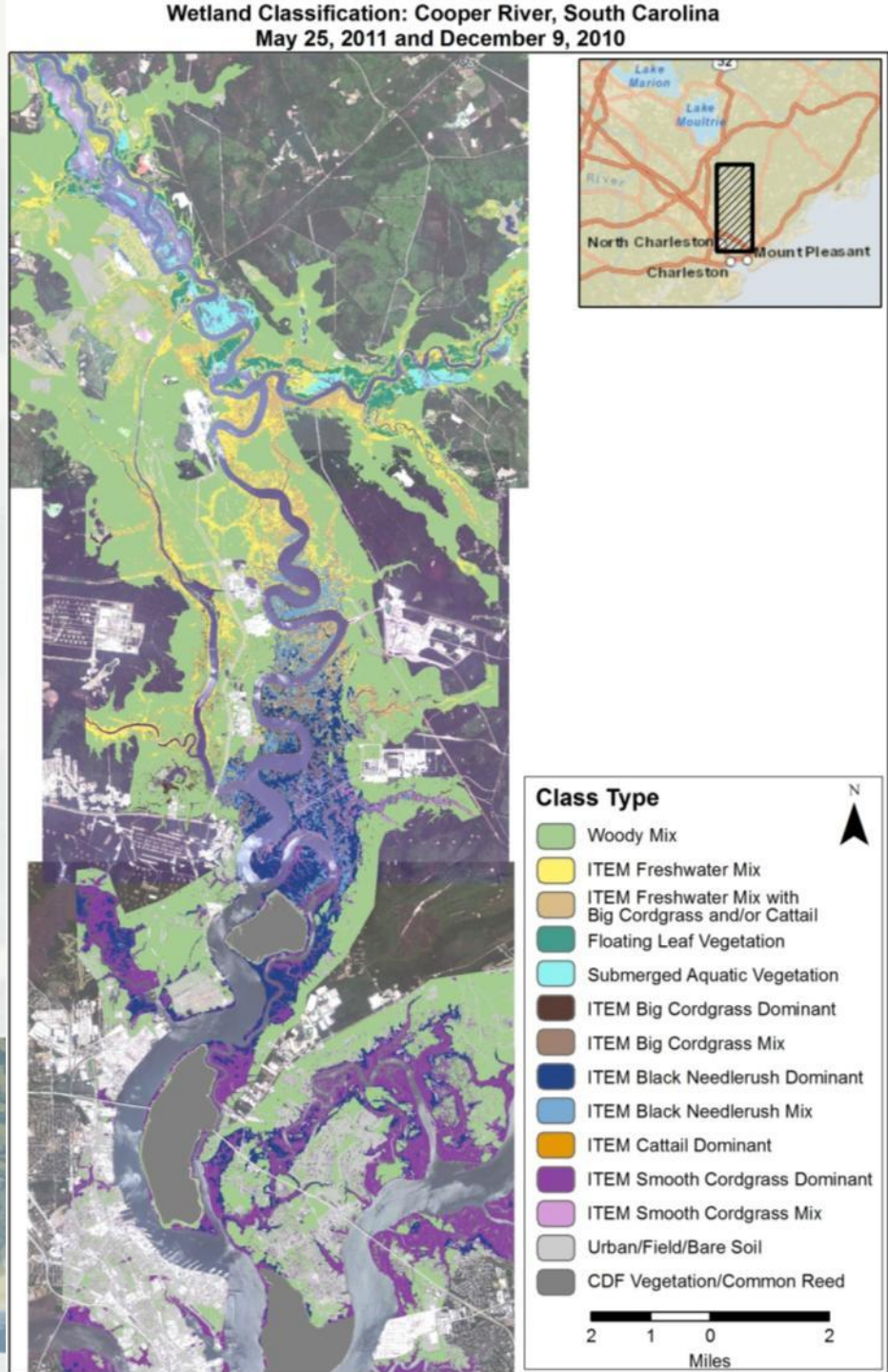
Invasive species detection

Times Beach, Buffalo NY, 2007
Emergent marsh dominated by *phragmites*

Wetland Density

- Detailed wetland habitat mapping may be required for specific projects
- Example: examine potential impacts from a harbor deepening project in SC
  - Identify potential changes in marsh ecosystems as result of salinity changes
  - Combine detailed wetland data with hydro model to examine wetland impacts



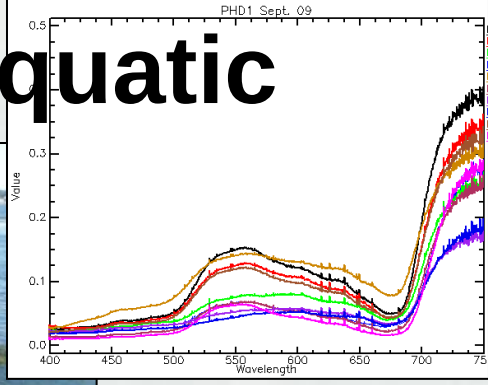


Discrimination of submerged aquatic vegetation species

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

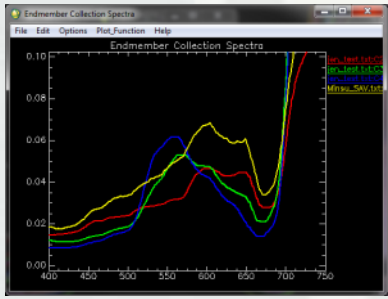
Mapping species is important for:

- Planning dredging operations
- Mitigating ecological damage
- Monitoring SAV



Submersed Eelgrass spectra, Plymouth Harbor, MA

http://www.coastalamericafoundation.org/savdoer.html



Water leaving reflectance

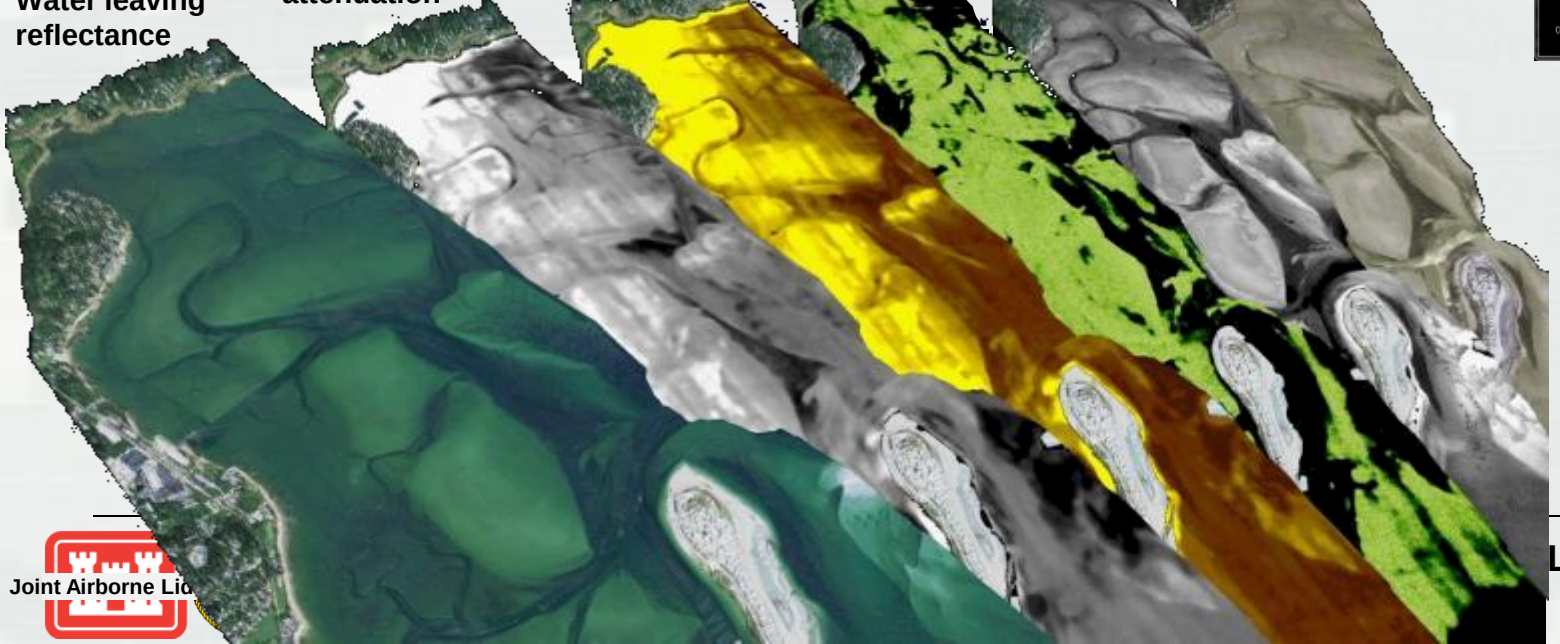
Water column attenuation

CDOM absorption

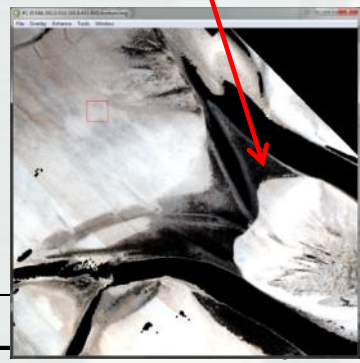
Chl concentration

Active seafloor reflectance

Spectral seafloor reflectance

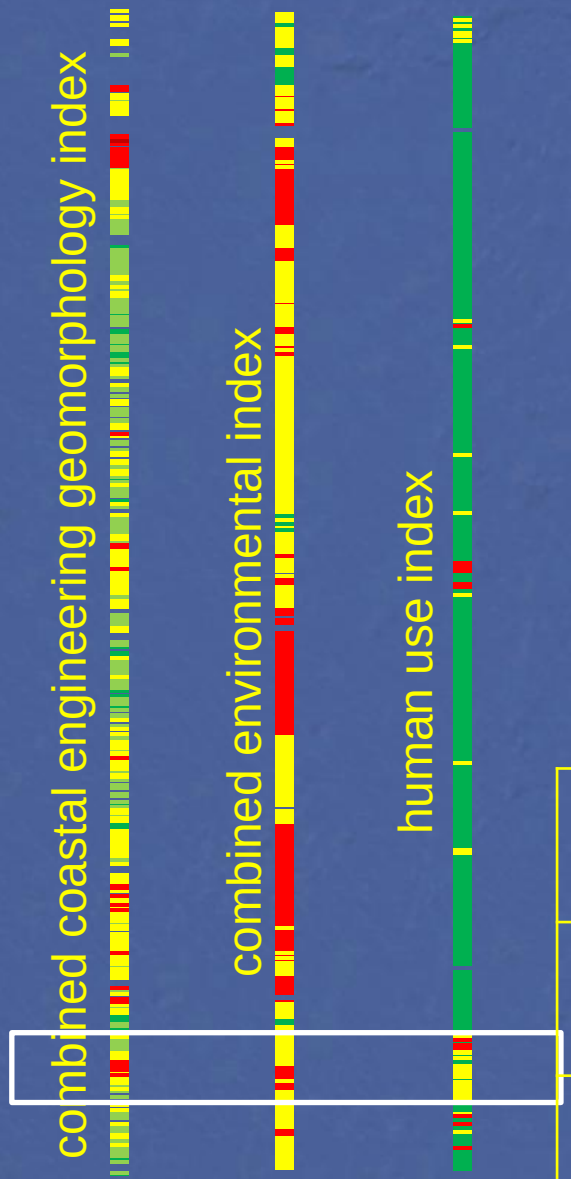


Seagrass

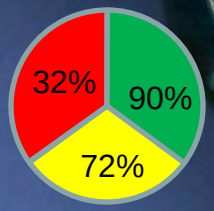


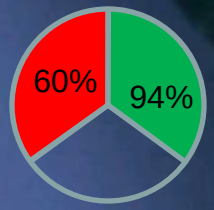
Joint Airborne Lid

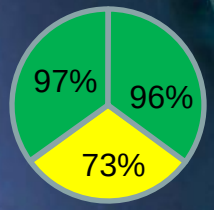
Coastal engineering indices

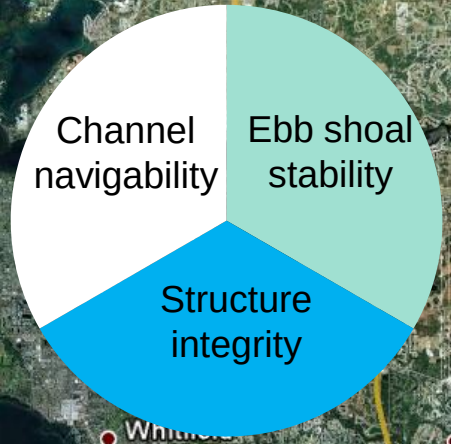


Green	Accreting shoreline, high dune, wide beach, critical habitat, more natural landscape
Yellow	Stable shoreline, medium dune and beach width, some critical habitat, more developed
Red	Eroding shoreline, low dune, narrow beach, no critical habitat, developed landscape









Questions?

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228-806-6044