Joint Airborne Lidar Bathymetry Technical Center of Expertise
National Coastal Mapping Program

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Joint Airborne Lidar Bathymetry Technical Center of Expertise
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August 21, 2013
Vicksburg, MS

US Army Corps of Engineers
BUILDING STRONG®

Joint Airborne Lidar Bathymetry Technical Center of Expertise

Joint Airborne Lidar Bathymetry Technical Center of Expertise

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

NAVAL METEOROLOGY AND OCEANOGRAPHY COMMAND

NORTHROP GRUMMAN

ONR Office of Naval Research

FUGRO

COASTAL PLANNING & ENGINEERING CPE

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

NOAA

USGS science for a changing world

itres

UNIVERSITY OF NOTRE DAME

Bowhead

AHAB Airborne Hydrography AB

WOOLPERT DESIGN | GEOSPATIAL | INFRASTRUCTURE

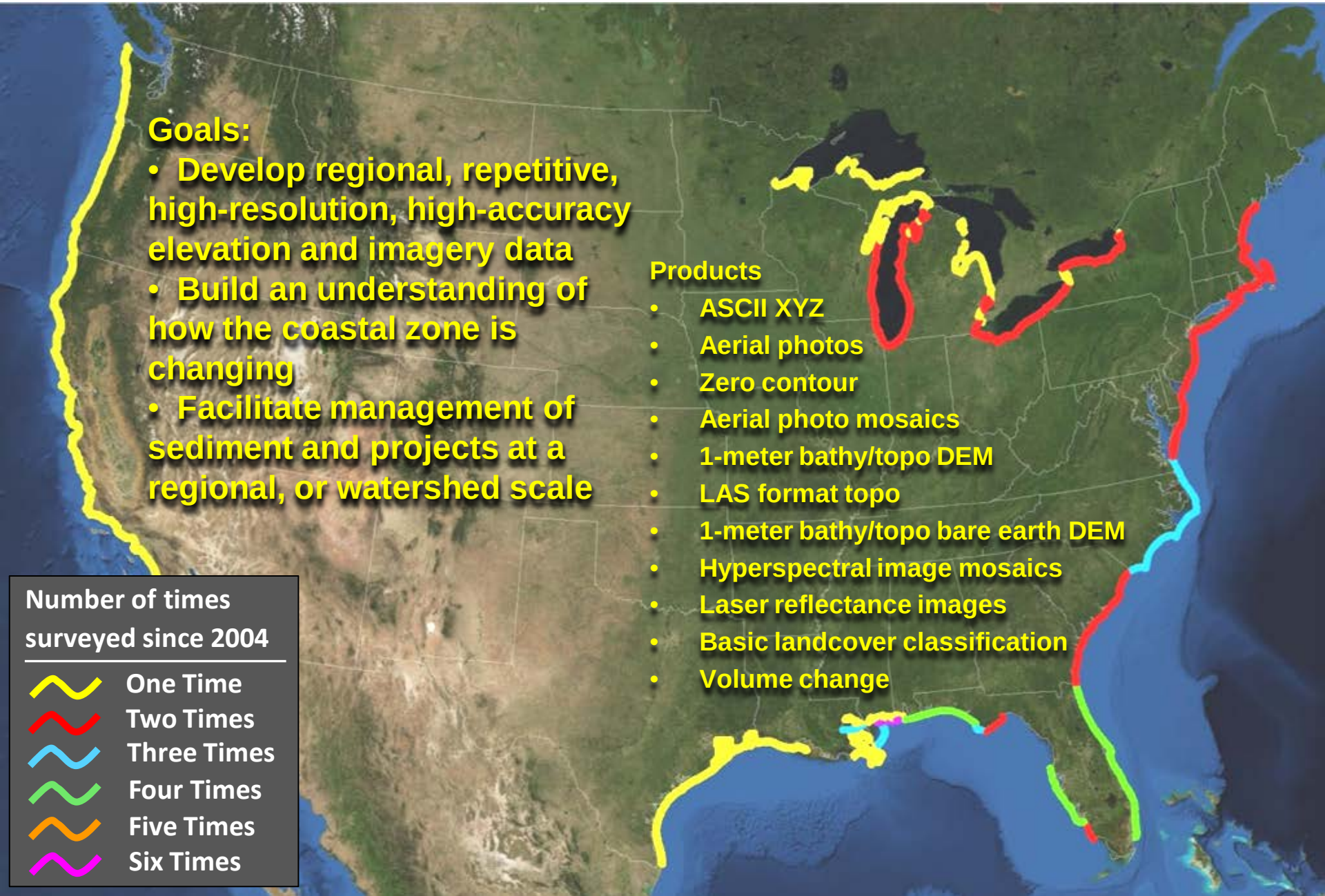
U. S. Naval Research Laboratory Stennis Space Center, MS

Pelydryn

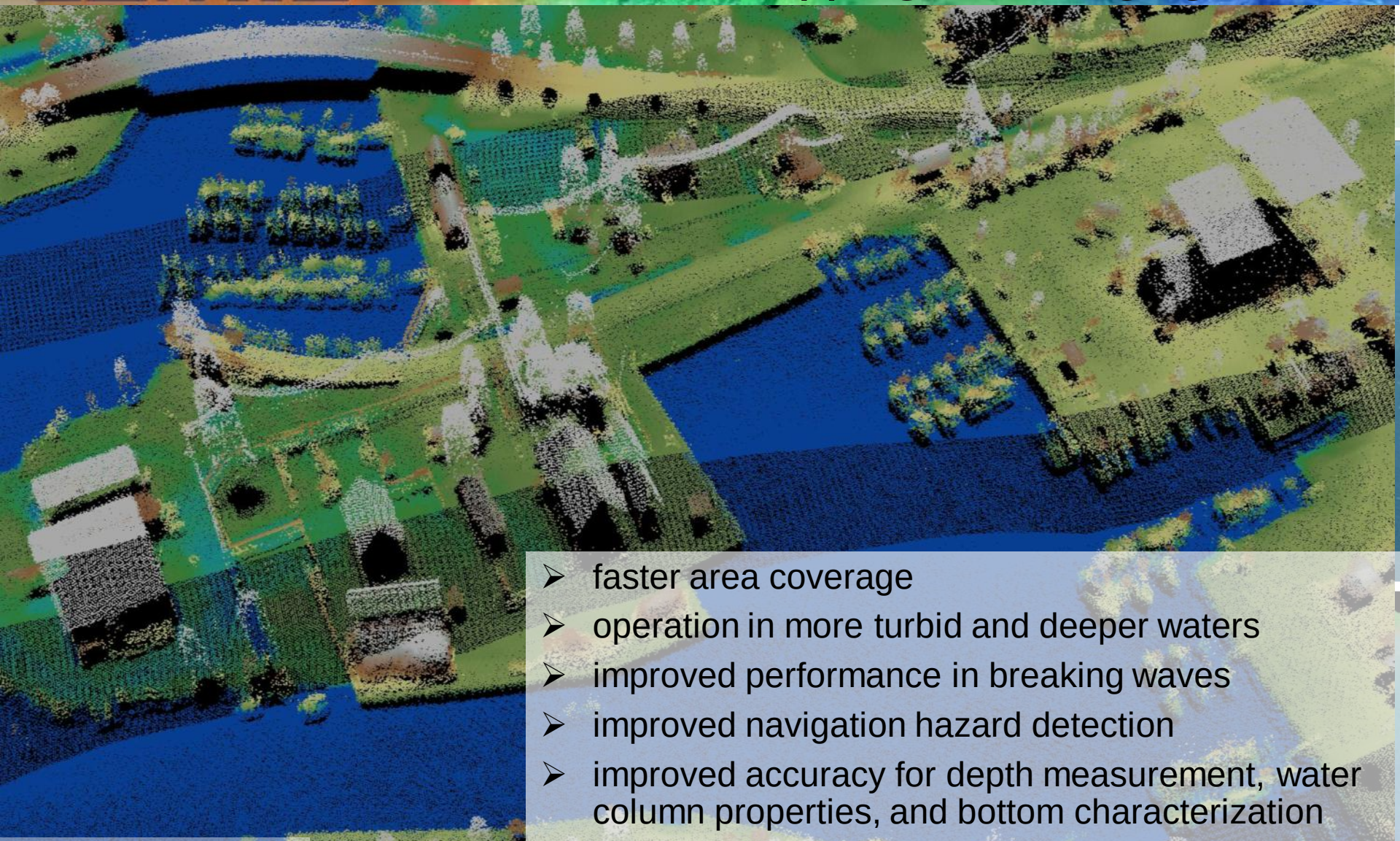
TEXAS A&M UNIVERSITY

UNIVERSITY of NEW HAMPSHIRE

National Coastal Mapping Program



Coastal Zone Mapping and Imaging Lidar



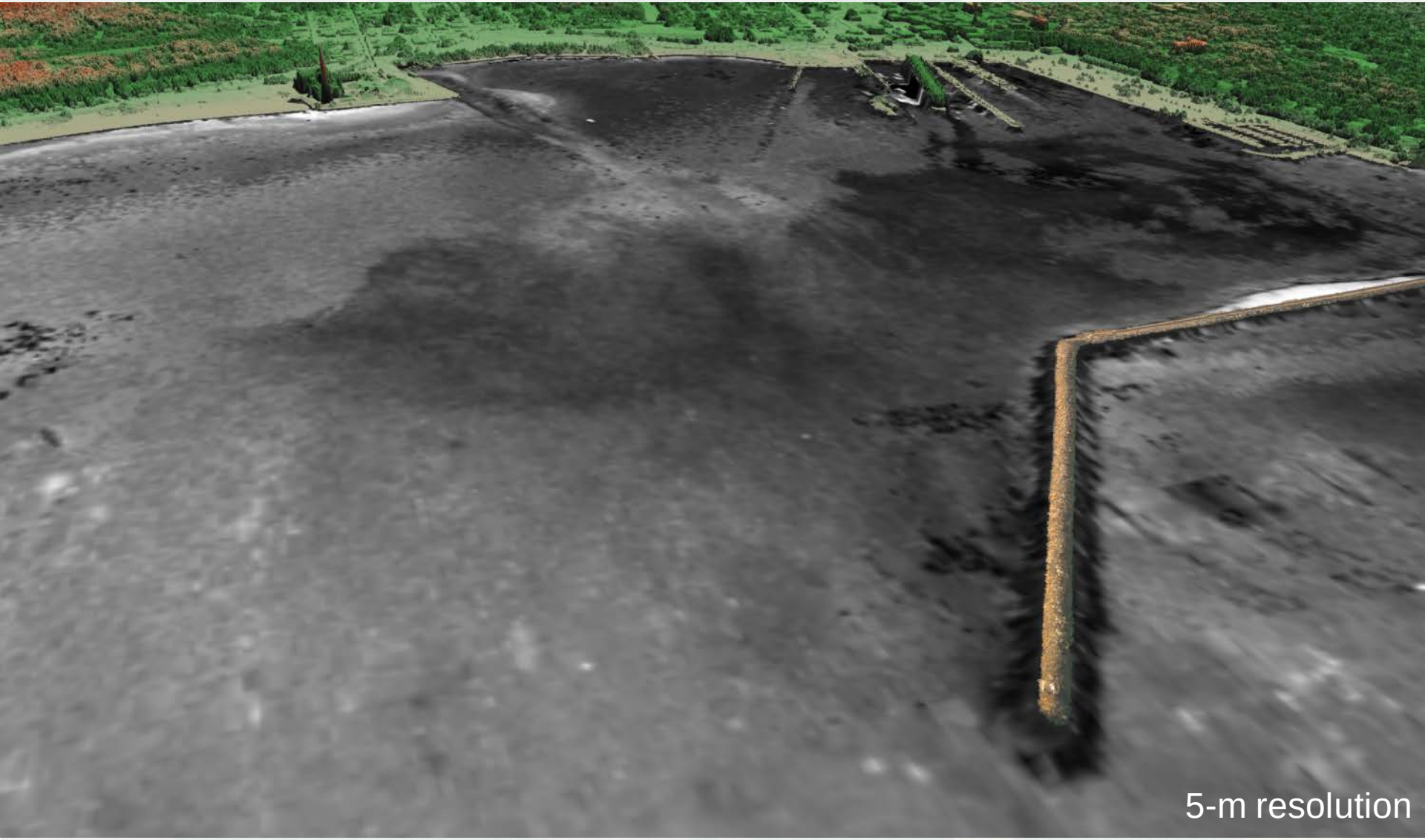
Sturgeon Bay, WI
Point Cloud

- faster area coverage
- operation in more turbid and deeper waters
- improved performance in breaking waves
- improved navigation hazard detection
- improved accuracy for depth measurement, water column properties, and bottom characterization
- higher-density topographic and shallow bathymetric measurements

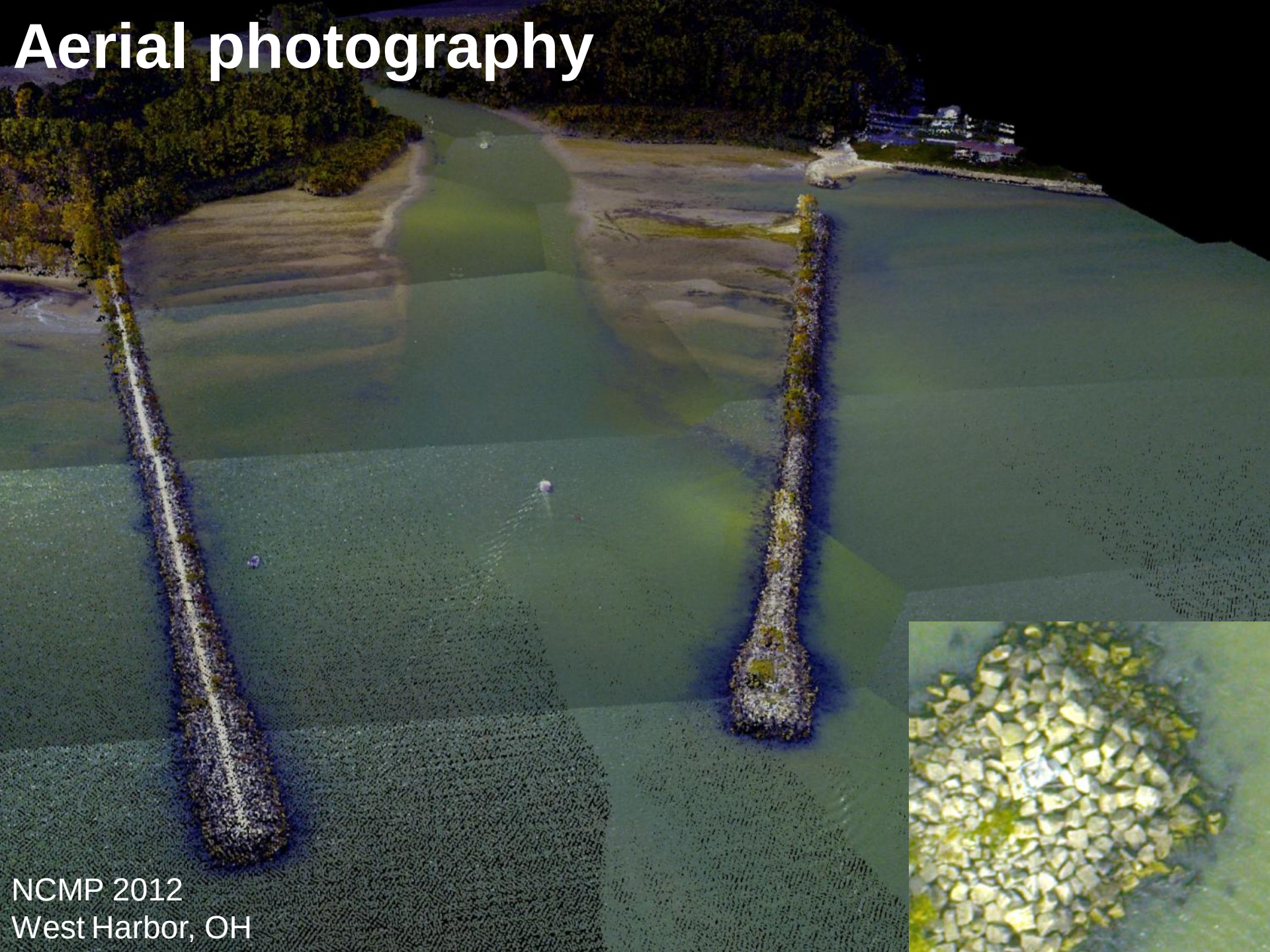
- 2011

Bathymetry and topography

Laser reflectance imagery



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

What's new at the NCMP

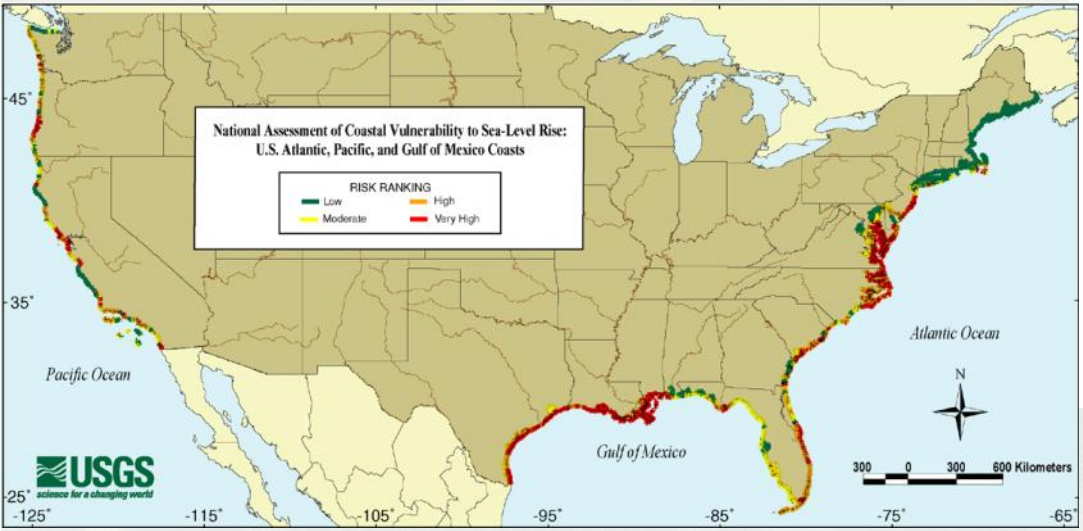
- Coastal Engineering Indices
  - coastal index that combines environmental and engineering/geomorphology parameters extracted from spatial data
- Post-Sandy Surveys
  - Volume change analysis to support NAD
- Online map products
  - Emergency response
  - Track survey progress
  - Upcoming planned survey locations

Coastal Engineering Indices

- The Civil Works program includes flood risk management, navigation, recreation, infrastructure and environmental stewardship, and emergency response
- JALBTCX data supports CW through:
  - Regional, high-resolution spatial data
  - Recurring surveys of the coast
- Need: synthesize data to identify coastal conditions and opportunities for operations and management improvement through projects, regional sediment management, engineering with nature, or emergency response.
- Solution: develop a coastal index that combines environmental and engineering/geomorphology parameters extracted from spatial data

Indices

Coastal vulnerability index (USGS)



Product mean: $CVI_1 = \frac{(x_1 * x_2 * x_3 * x_4 * \ldots x_n)}{n}$,

Modified product mean: $CVI_2 = \frac{[x_1 * x_2 * \square(x_3 + x_4) * x_5 * \square(x_6 + x_7)]}{n - 2}$,

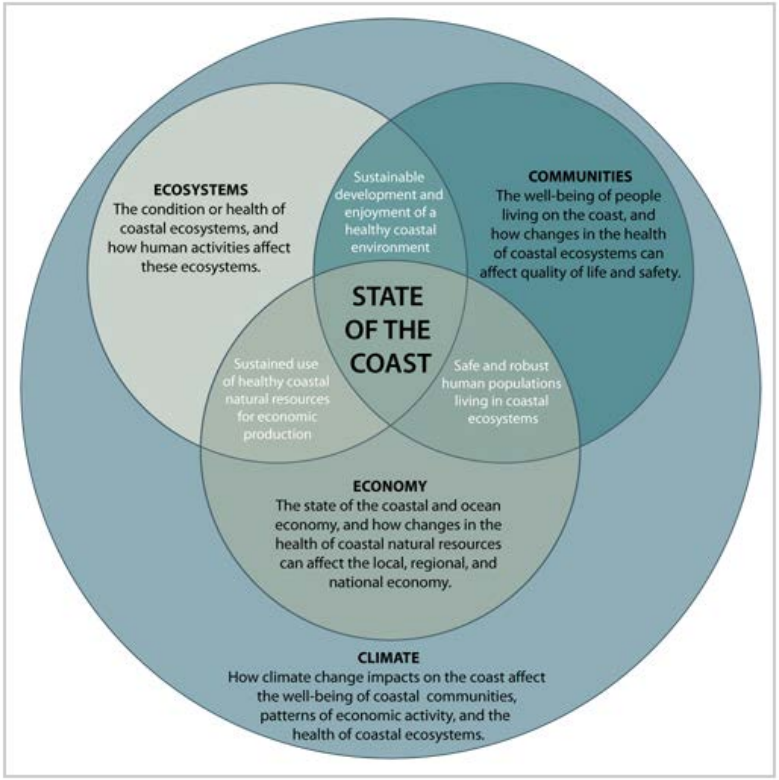
Average sum of squares: $CVI_3 = \frac{(x_1^2 x_2^2 x_3^2 x_4^2 \ldots x_n^2)}{n}$,

Modified product mean (2): $CVI_4 = \frac{(x_1 * x_2 * x_3 * x_4 * \ldots x_n)}{5^{(n-4)}}$,

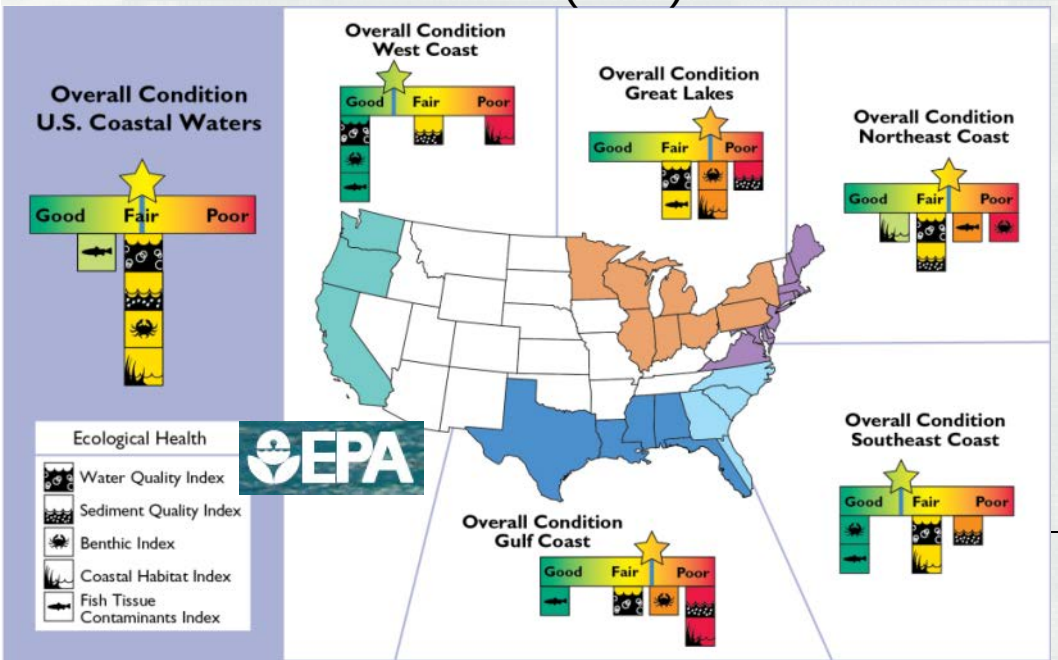
Square root of product mean: $CVI_5 = [CVI_1]^{\square}$, and

Sum of products: $CVI_6 = 4x_1 + 4x_2 + 2(x_3 + x_4) + 4x_5 + 2(x_6 + x_7)$.

State of the Coast (NOAA)

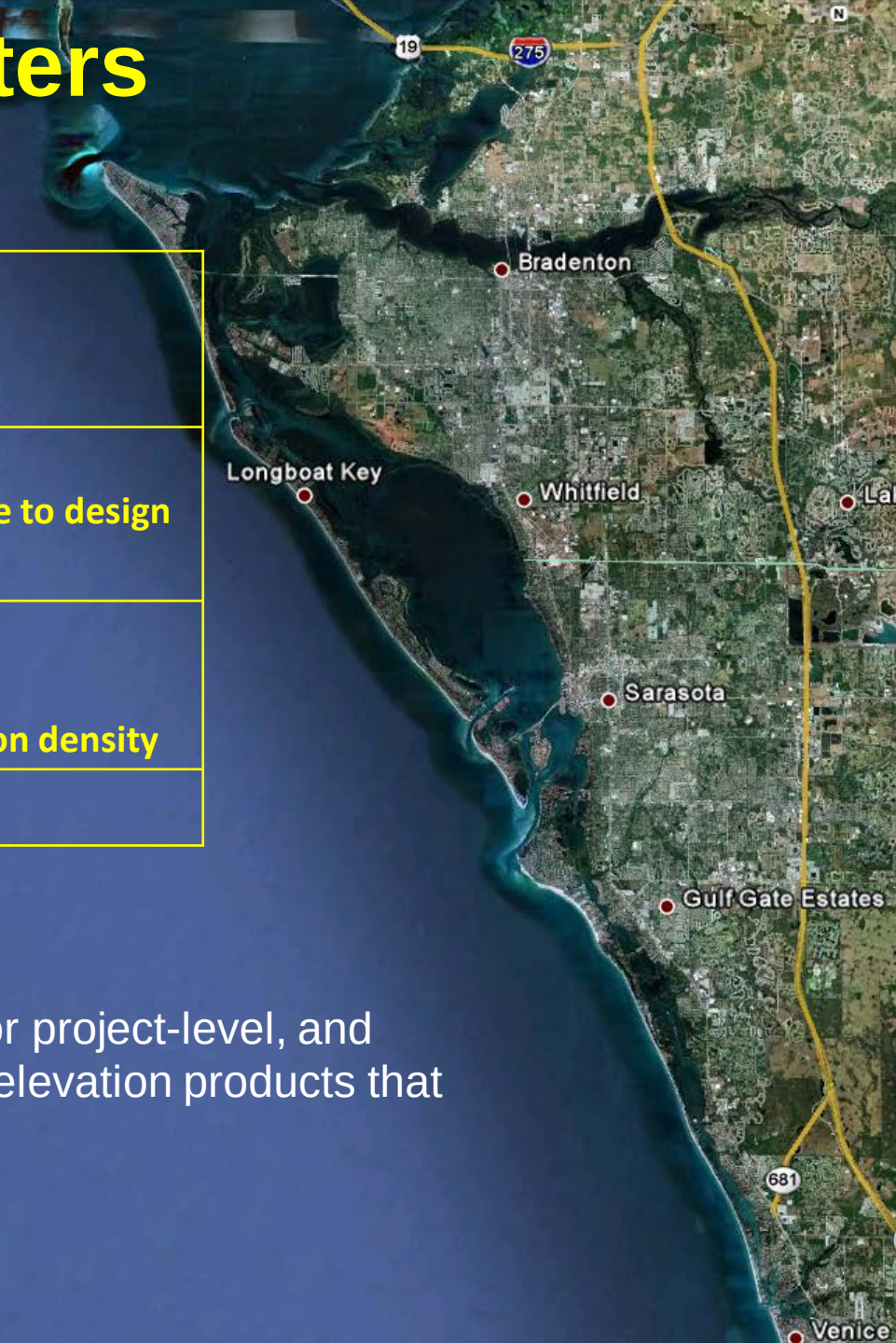


Coastal condition index (EPA)



Key Coastal Parameters

Geomorphology	**Dune height** **Beach width** **Shoreline change**
Inlets	**Ebb shoal volume change** **Structure dimensions relative to design** **Navigability**
Environment	**Dune vegetation density** **Wetland density** **Submerged aquatic vegetation density**
Human use	**Impervious surface density**

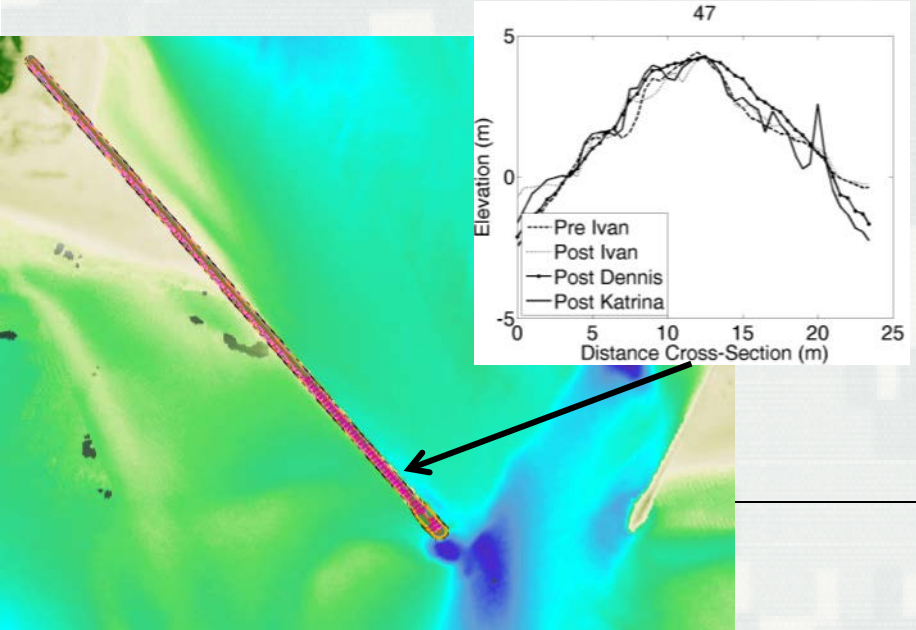


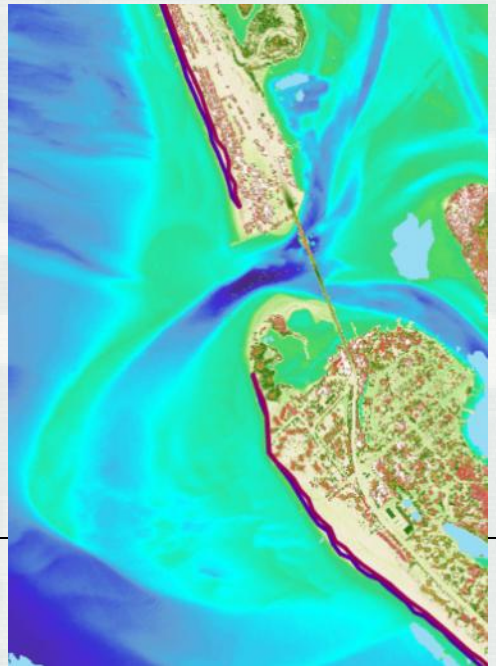
Parameters provide:

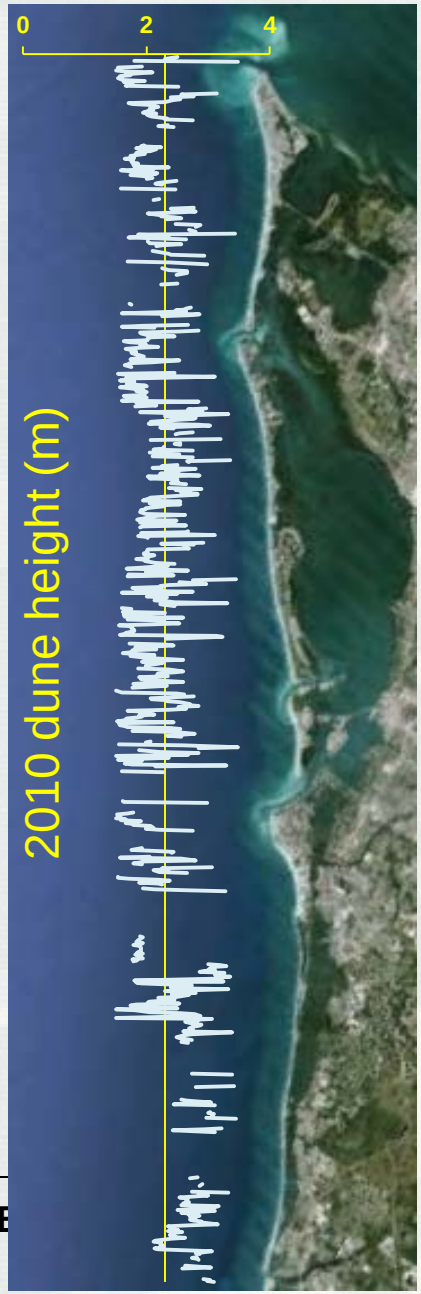
1) variability in scaling to either a region or project-level, and
2) data using remote sensing image and elevation products that do not require ground based sampling

Geomorphic and Inlet Parameters

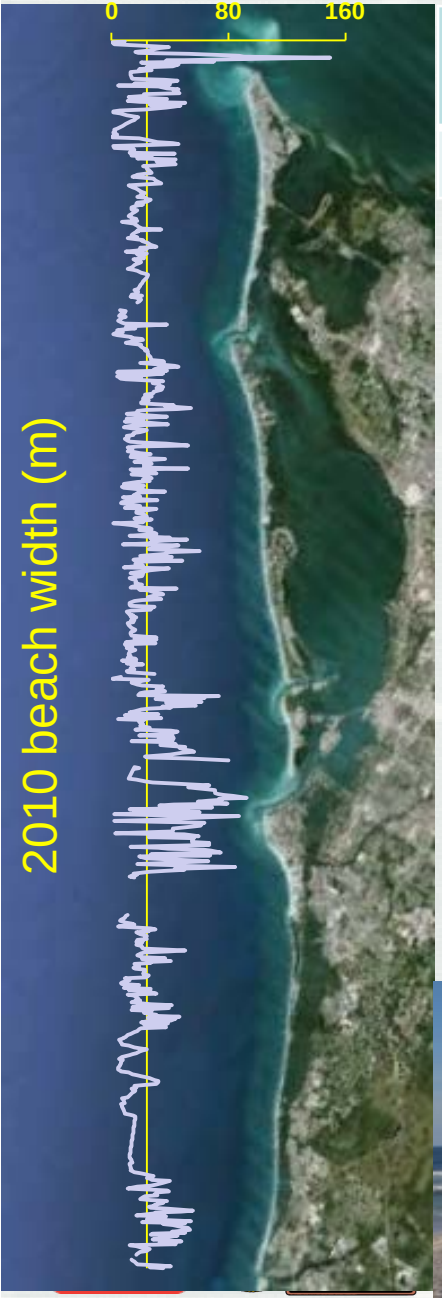
- The components needed for the geomorphic/inlet parameters are topographic/bathymetric dataset, multi-year data availability, navigation specific criteria (channel/structure dimensions)
- High, resolution topo/bathy data provides level of detail needed for local data extraction that can then be regionalized







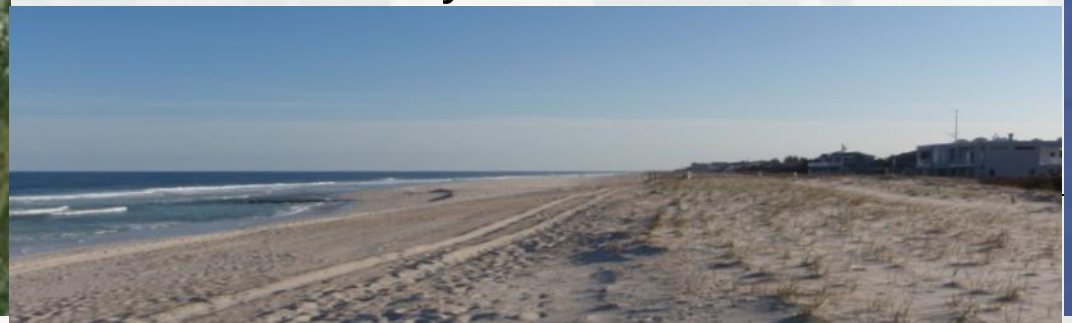
Contours

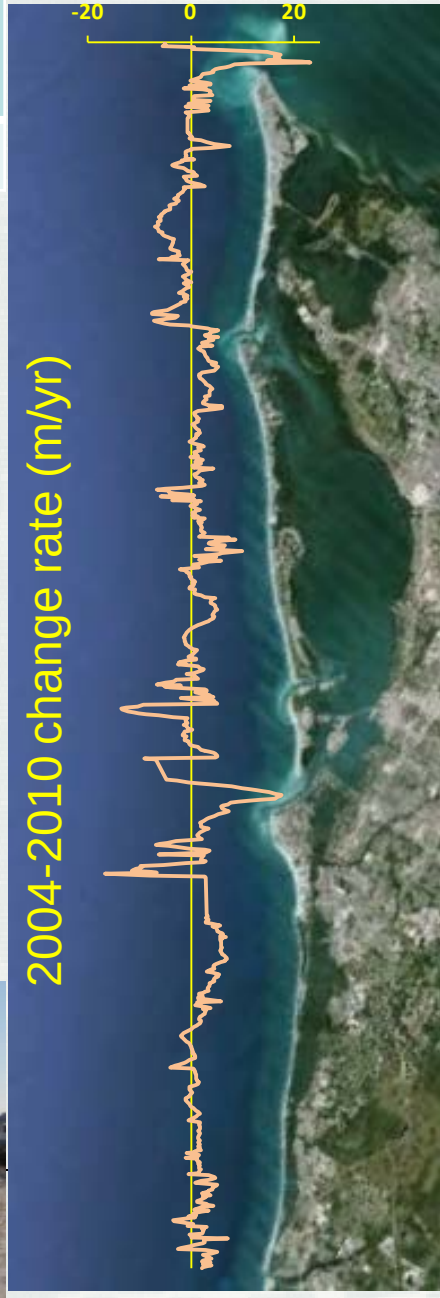


2010 Beach Width
24 m

Zero Contour Change Rate
1.3 m

- Beach width provides buffer before the dune as well as recreational benefits
  - Defined as the distance between the zero contour and the dune toe
  - Active portion of the beach
- Contour change rate
  - Used to determine hot spots of erosion and cumulative change can identify extent of inlet influence

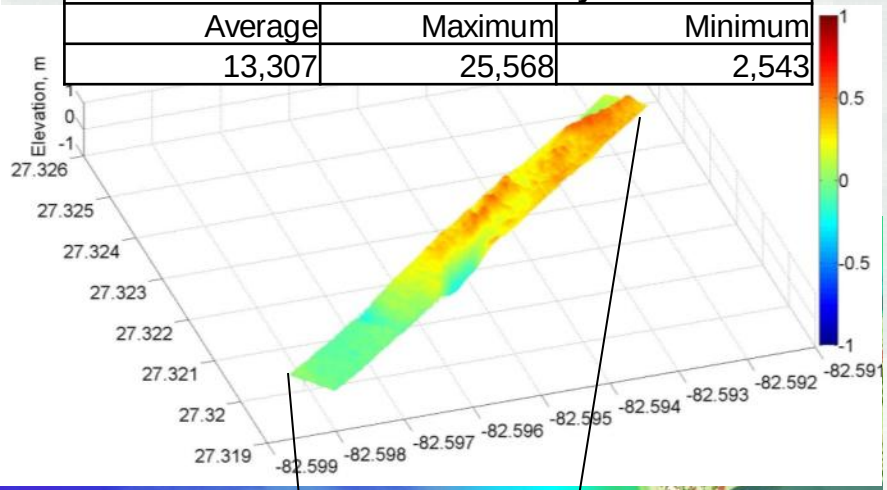


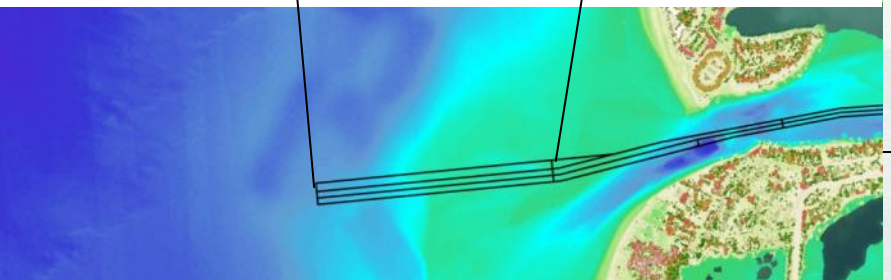


Channel Navigability

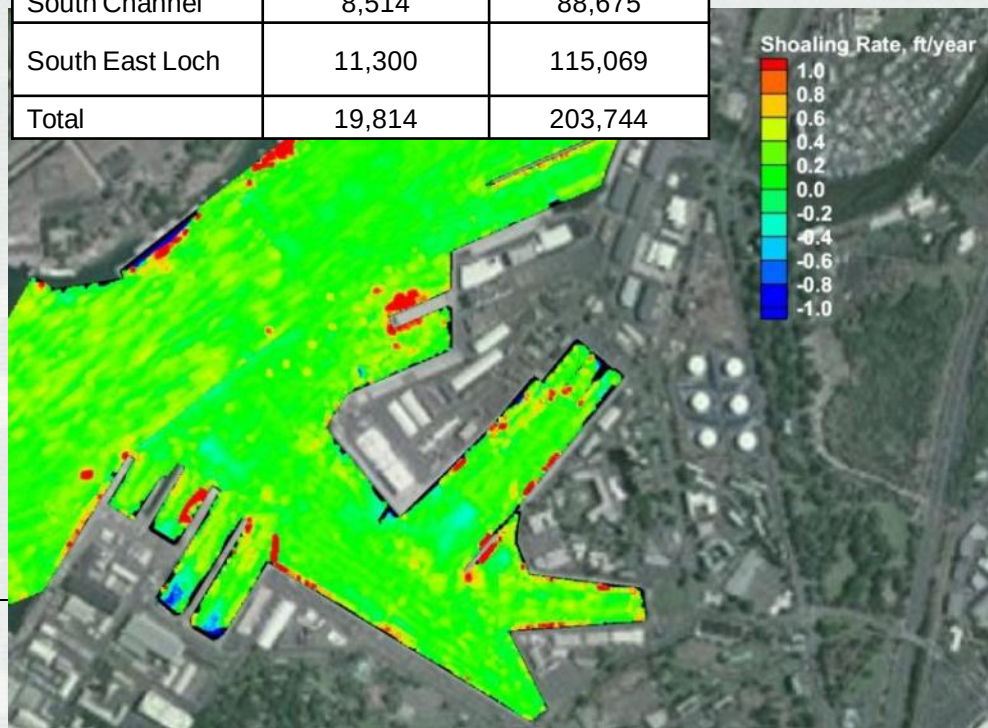
- Channel shoaling can reduce navigability and may require dredging.
- Spatial data used to determine dredging requirements and identify shoaling hotspots and other morphological trends.
- Prioritize dredging needs for shallow draft channels.

Channel Volume CY/yr		
Average	Maximum	Minimum
13,307	25,568	2,543



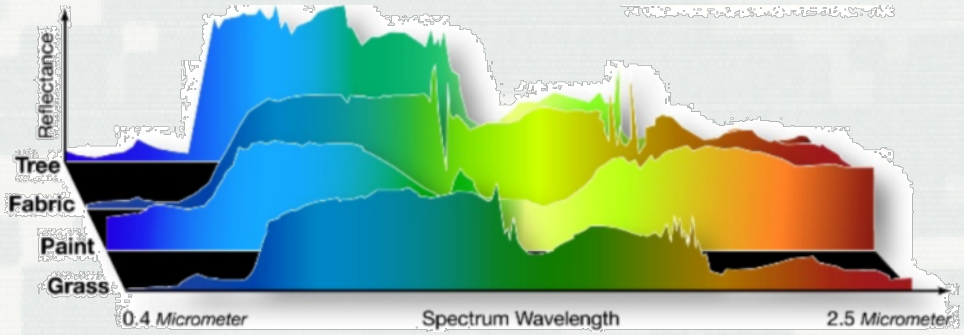


Area	Avg. (cu yds/yr)	Max (cu yds/yr)
South Channel	8,514	88,675
South East Loch	11,300	115,069
Total	19,814	203,744



Environmental and Human Use Parameters

- The basis for most environmental/human use parameters is a terrestrial/aquatic habitat classification
- Hyperspectral/lidar fusion provides advantages to accurately discriminate habitat types



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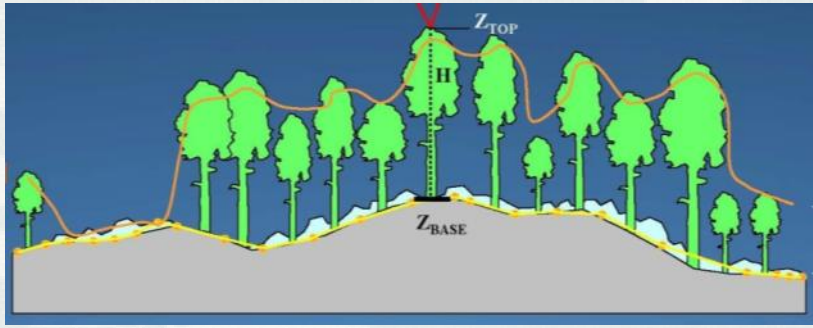
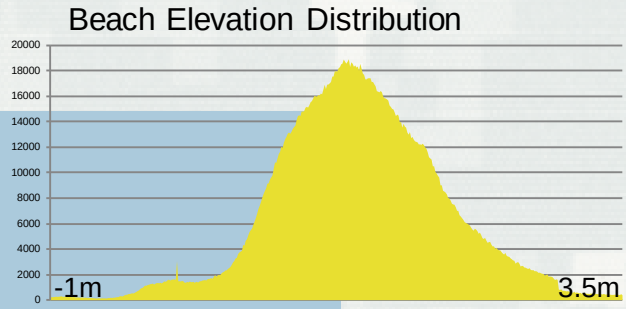
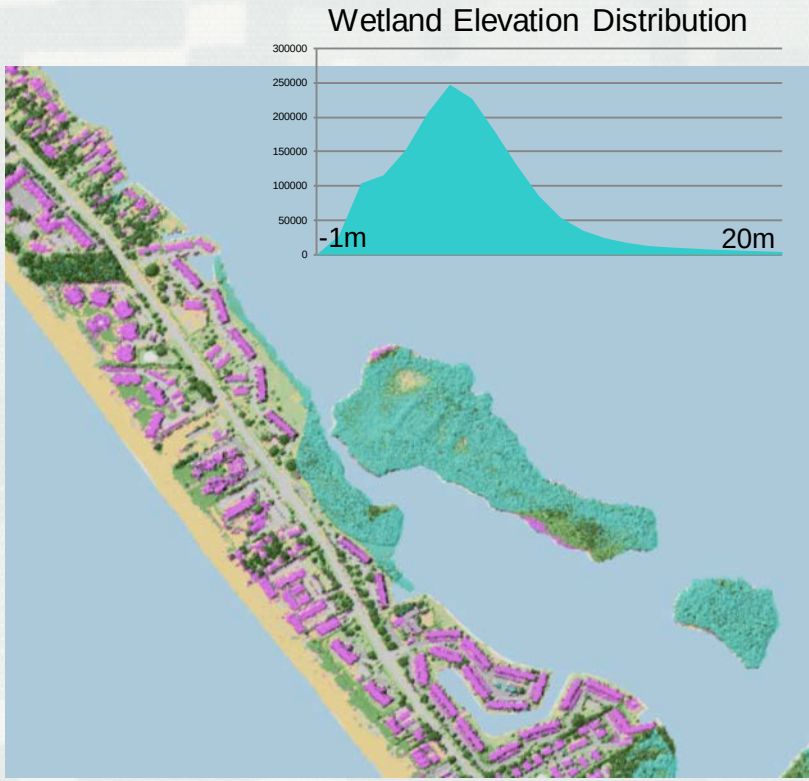
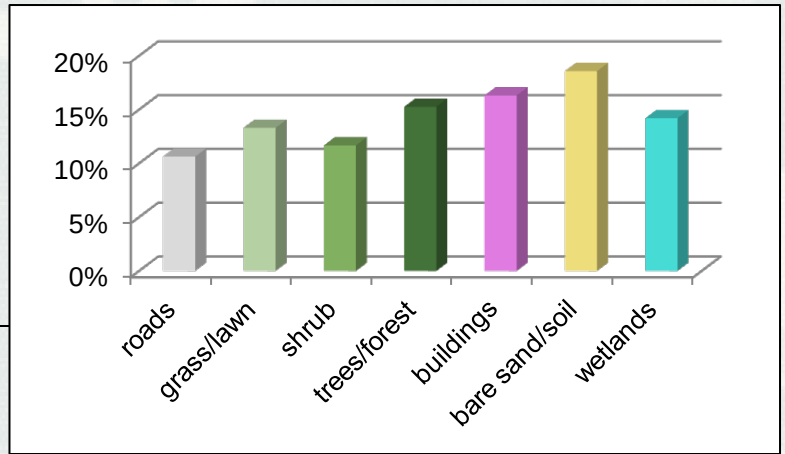


Coastal Land Cover Classification



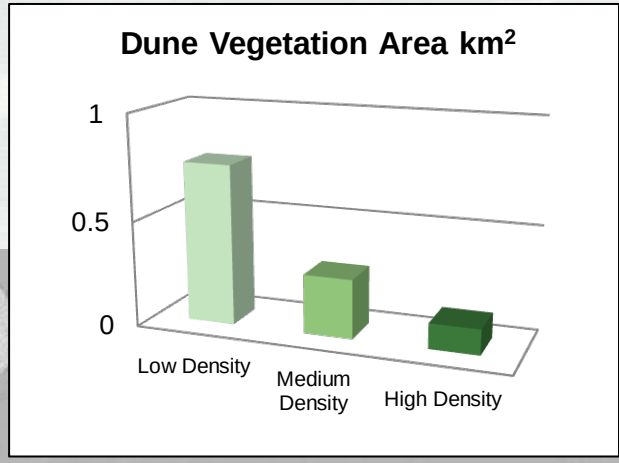
Landcover type	Manning n Value
bare sand/soil	0.04
buildings	0.07
grass/lawn	0.034
roads	0.012
shrub	0.05
trees/forest	0.12
wetlands	0.04





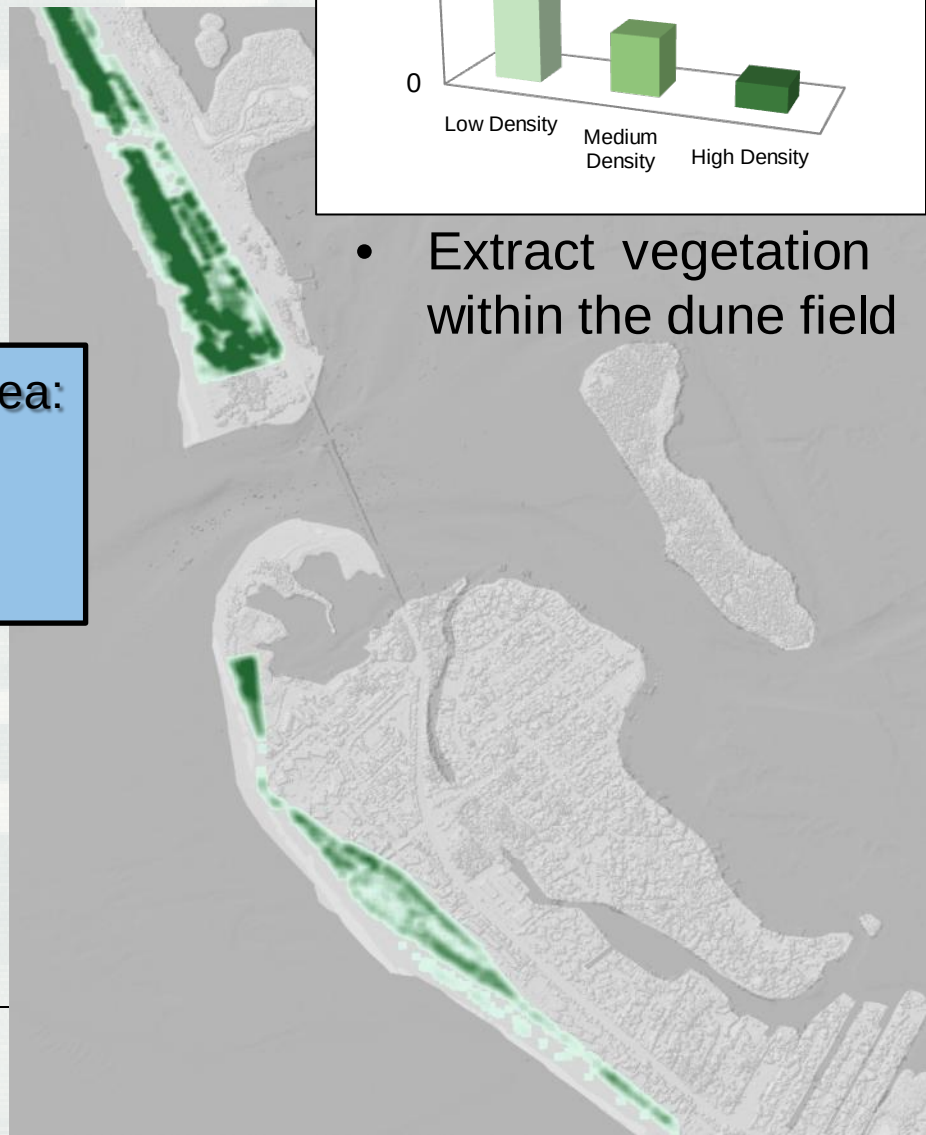
Dune Vegetation Density

- Helps stabilize dunes and reduces erosion by trapping sand
- Provide habitat for critical species, including TE species



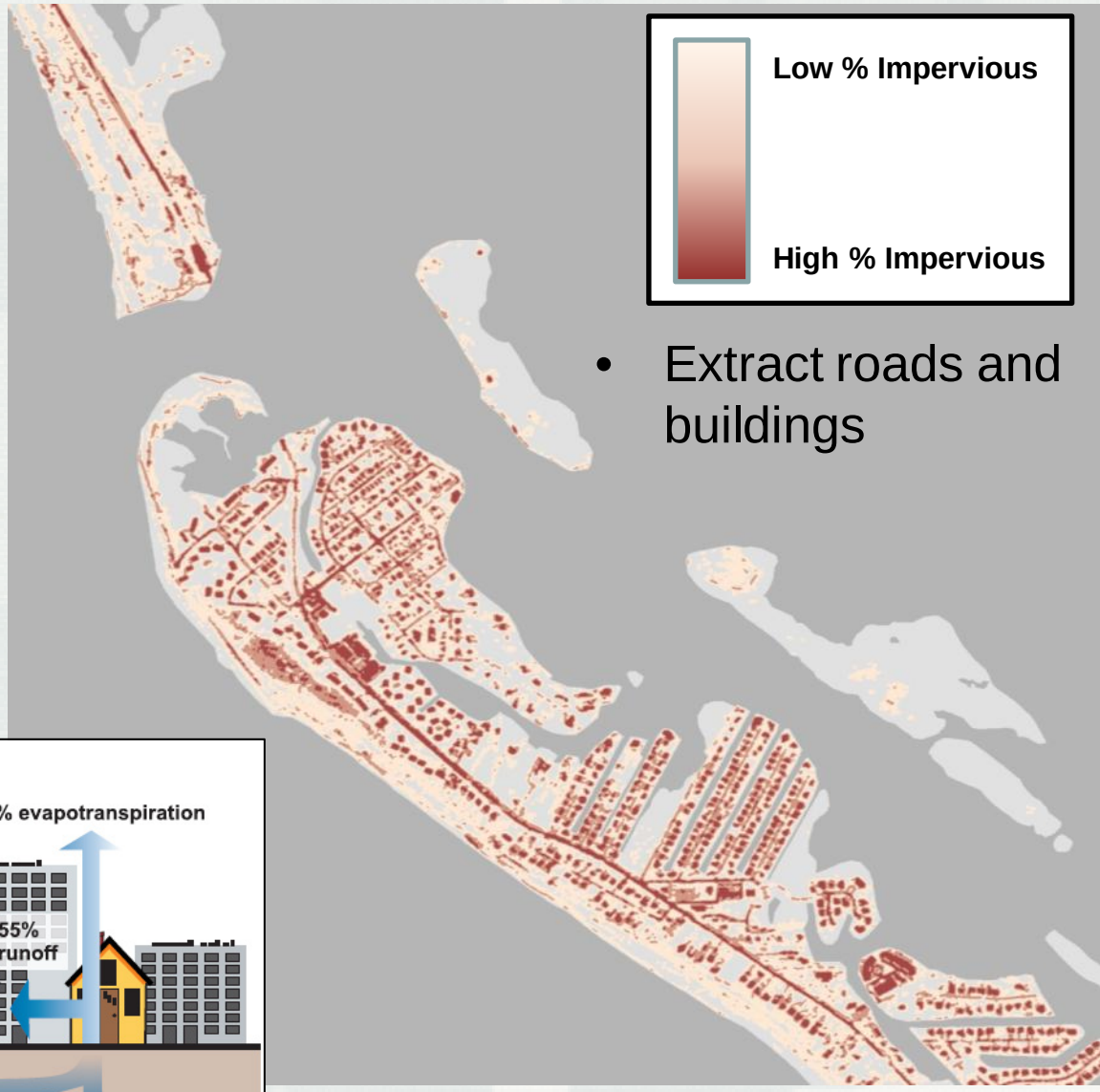
- Extract vegetation within the dune field

Dune Vegetation Density Area:
Low: *0.75km²*
Medium: *0.28km²*
High: *0.12km²*

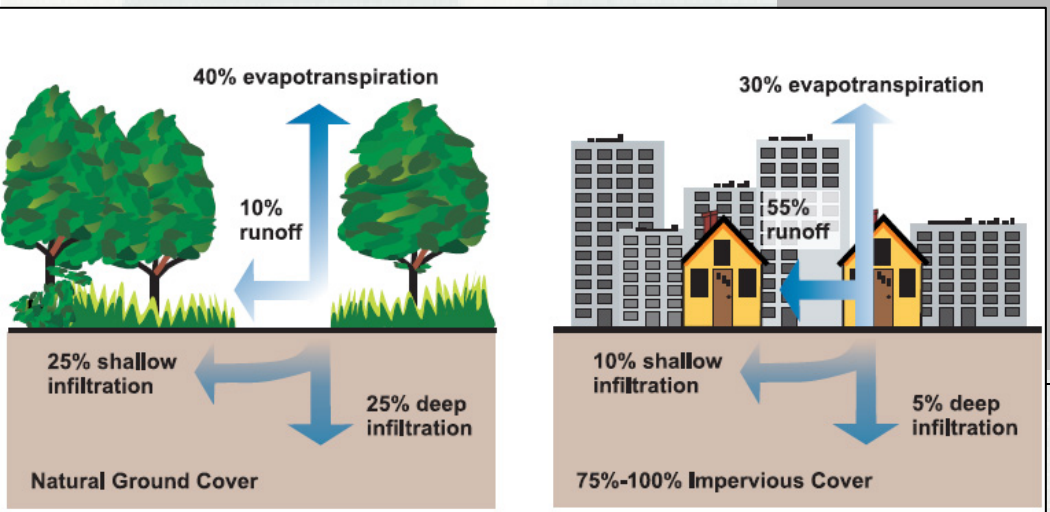


Impervious Surface Density

- Increase potential for runoff and erosion
- Decrease water filtration and groundwater recharge
- Reduce ecological productivity through decreased water quality and replacement of natural habitat

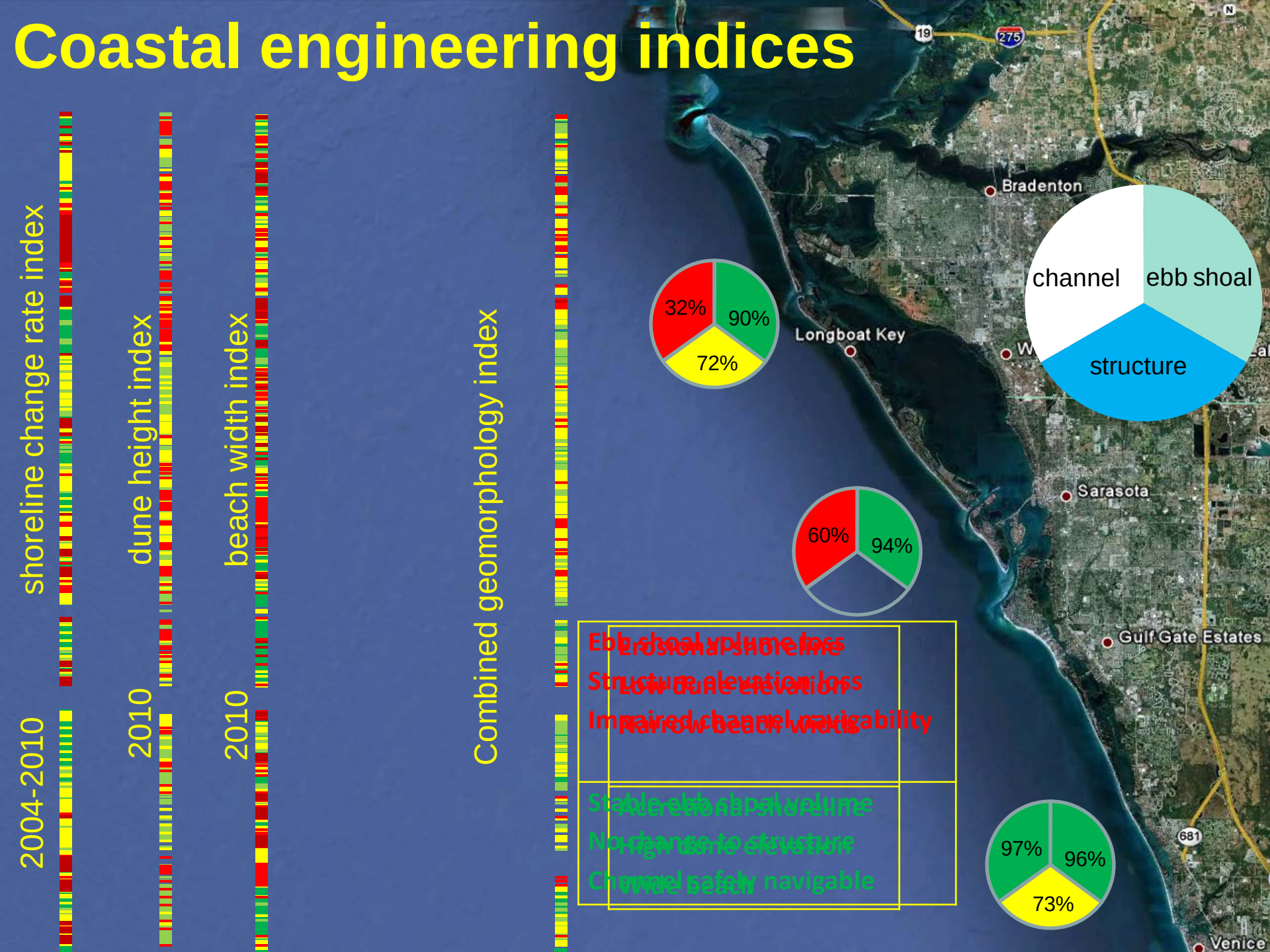


- Extract roads and buildings

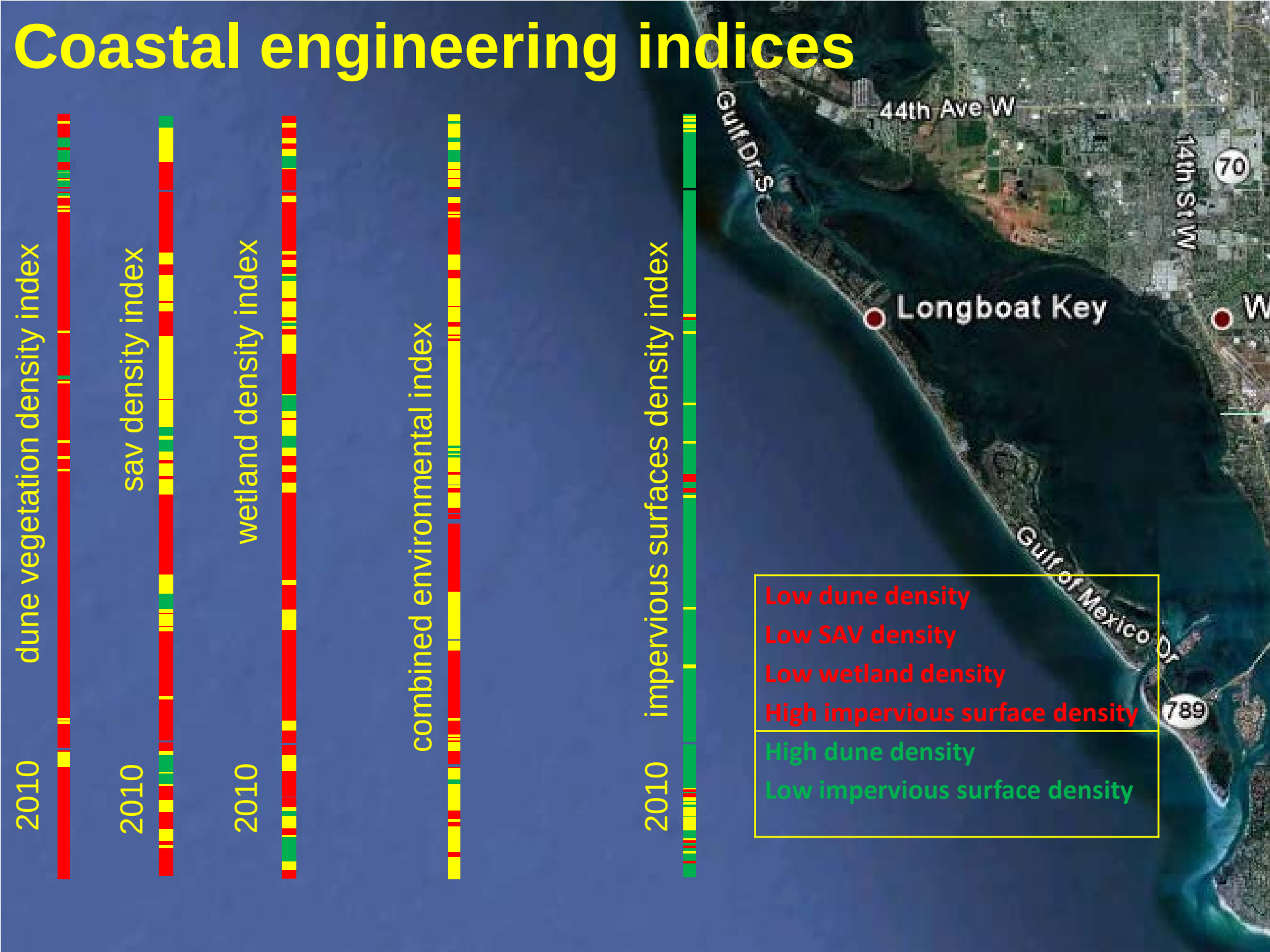


BUILDING STRONG®

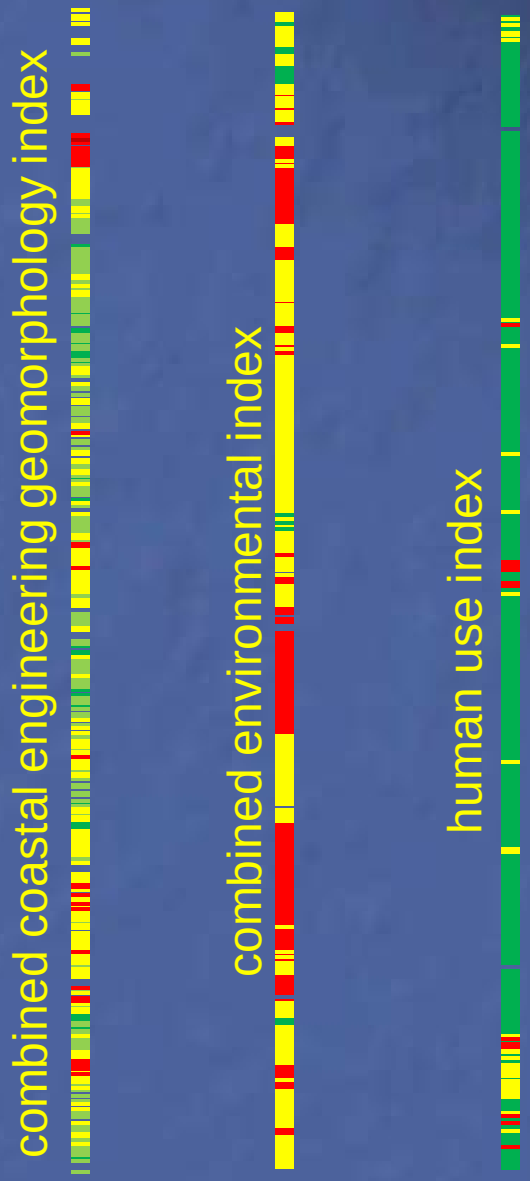
Coastal engineering indices

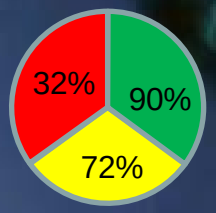


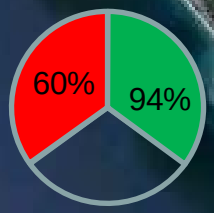
Coastal engineering indices



Coastal engineering indices





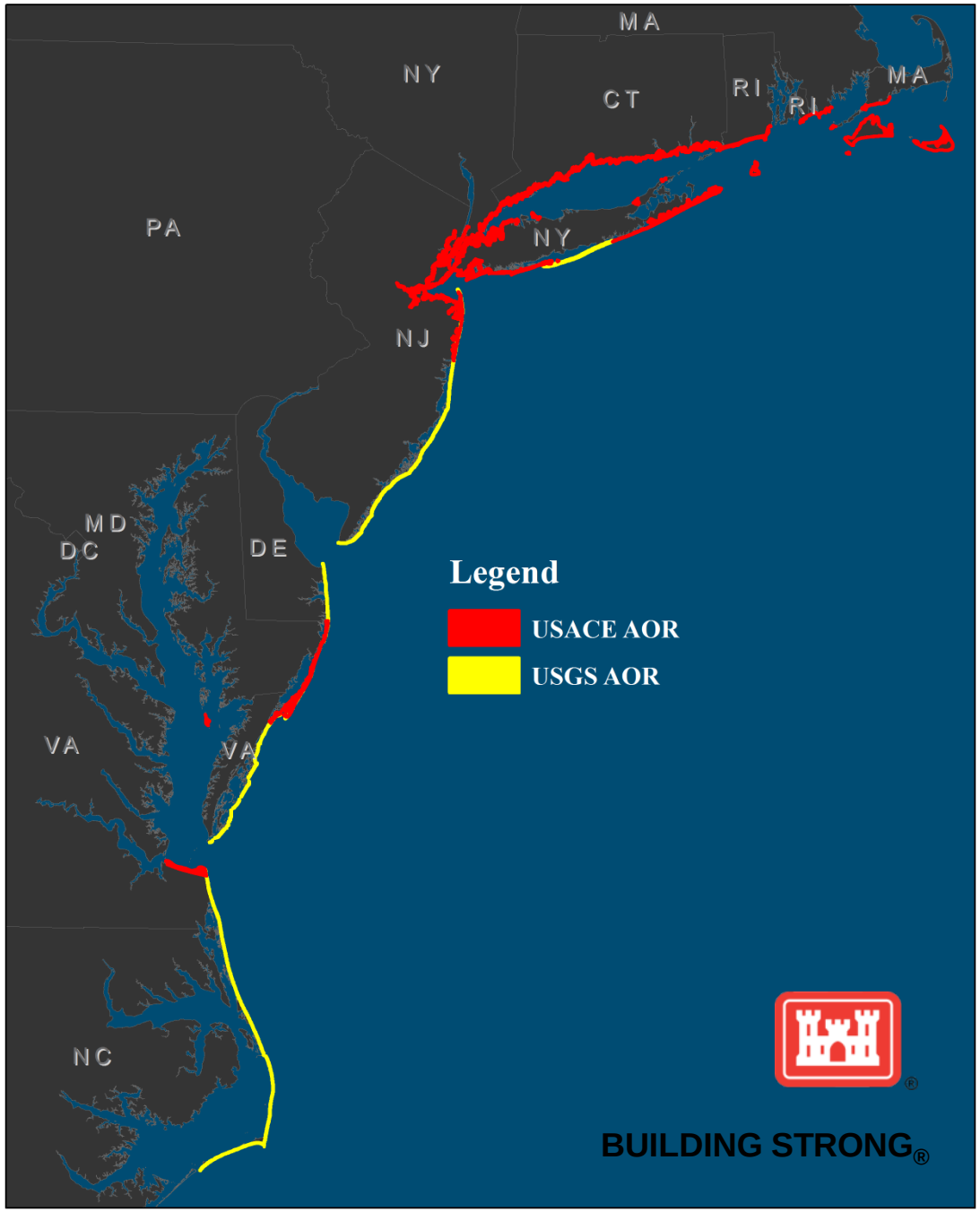


CEI provides comparable combined indices for engineering, environmental, human use, and the inlets that provide a snap shot of coastal conditions

Post-Sandy activities

- Identify requirements
  - Where
  - High-resolution
  - High-accuracy
  - Rapid acquisition
  - Quick product turn-around
- Coordinate with other agencies
  - Data collection areas
  - Specifications
- Acquisition and delivery
- Change analysis
  - Support funding requests for restoration of coastal projects

Post-Sandy Lidar Acquisition Areas of Responsibility



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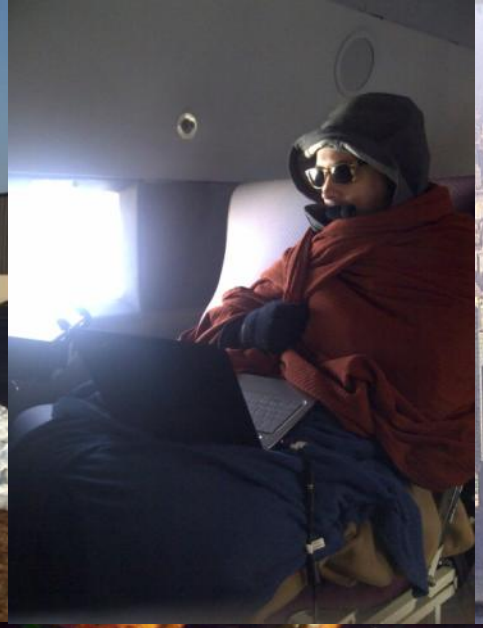
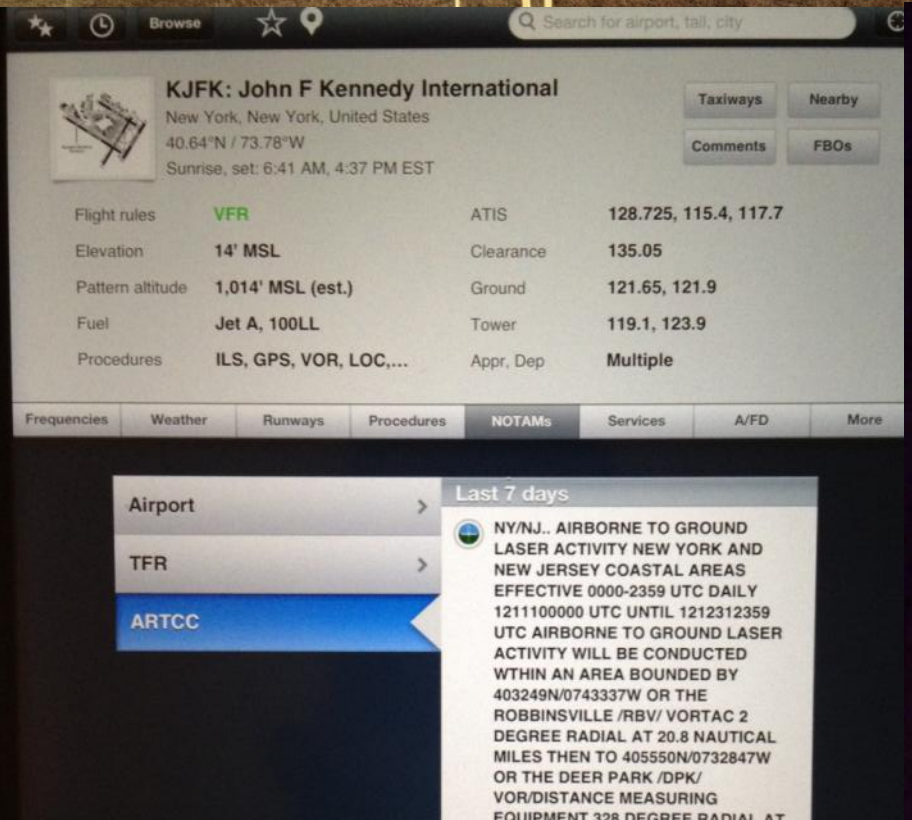
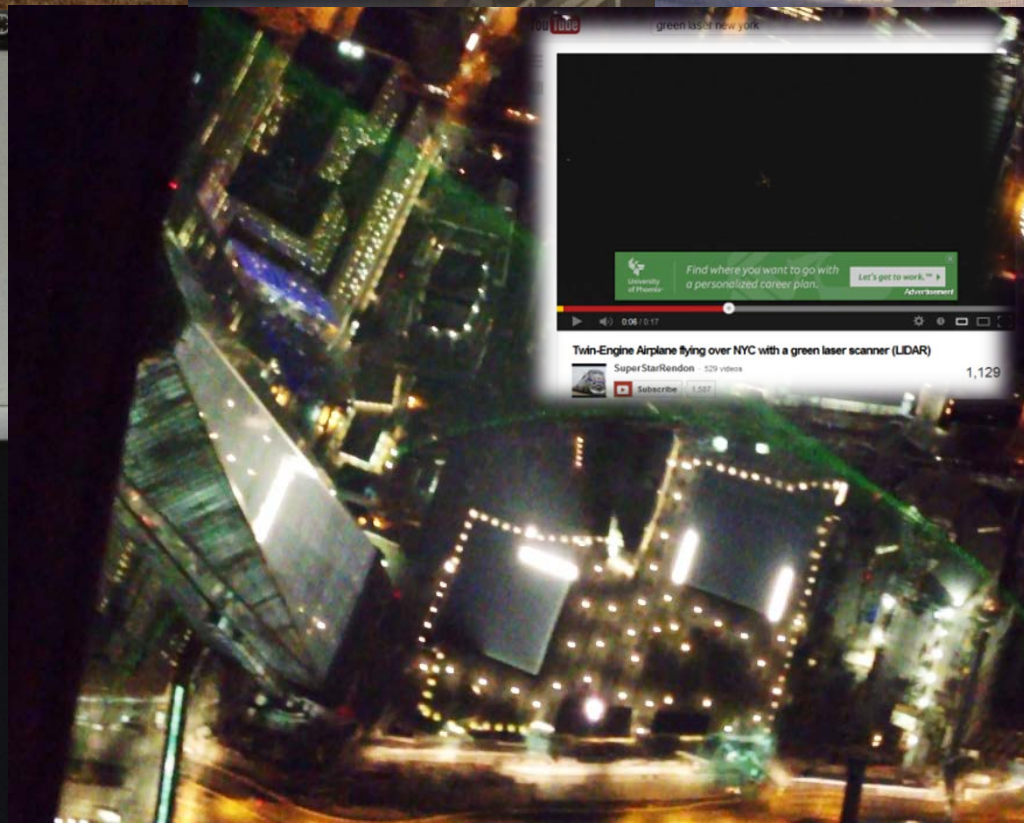
JALBTCX Post-Sandy Acquisition

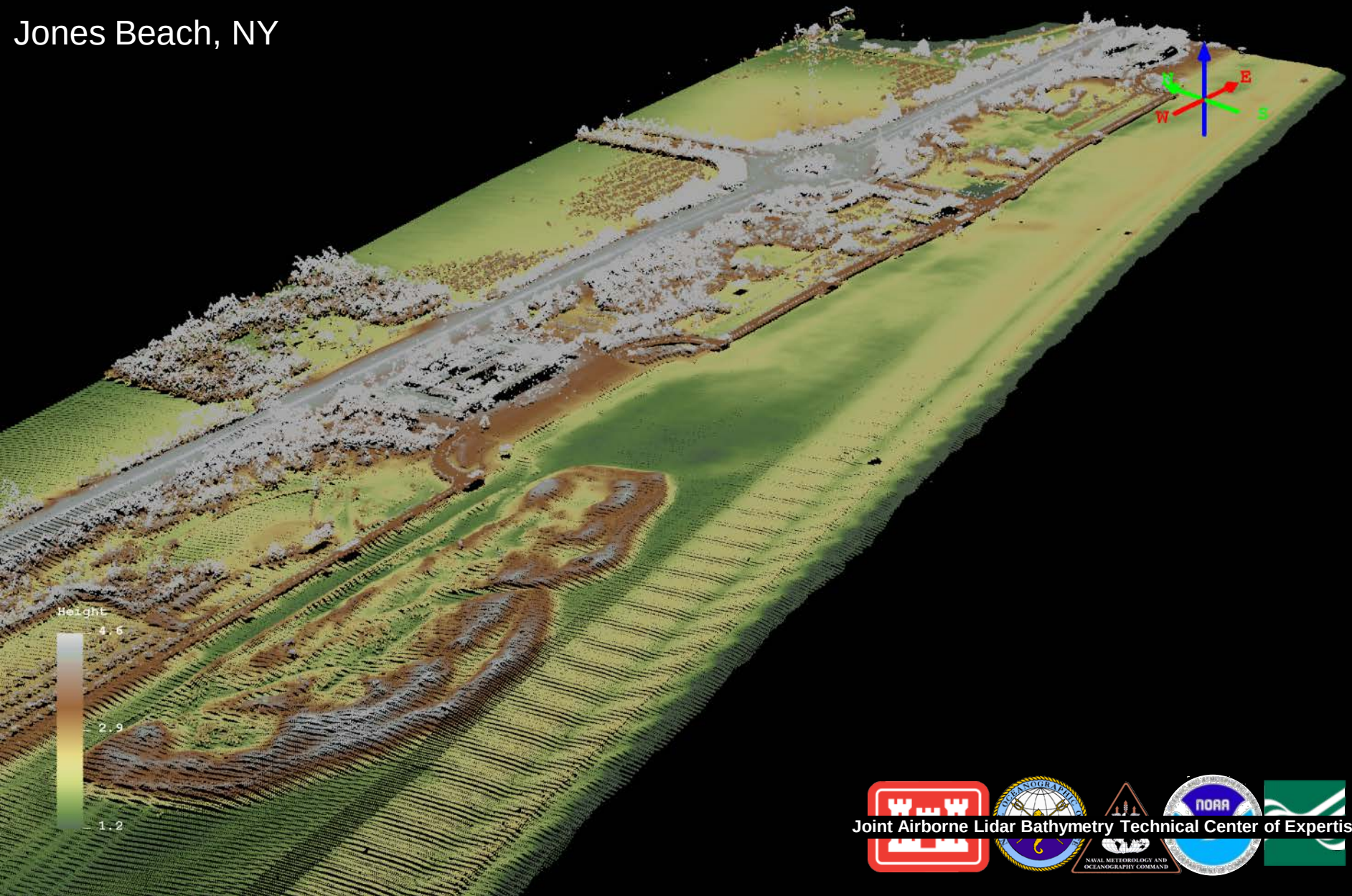






JALBTCX Post-Sandy lidar

Jones Beach, NY



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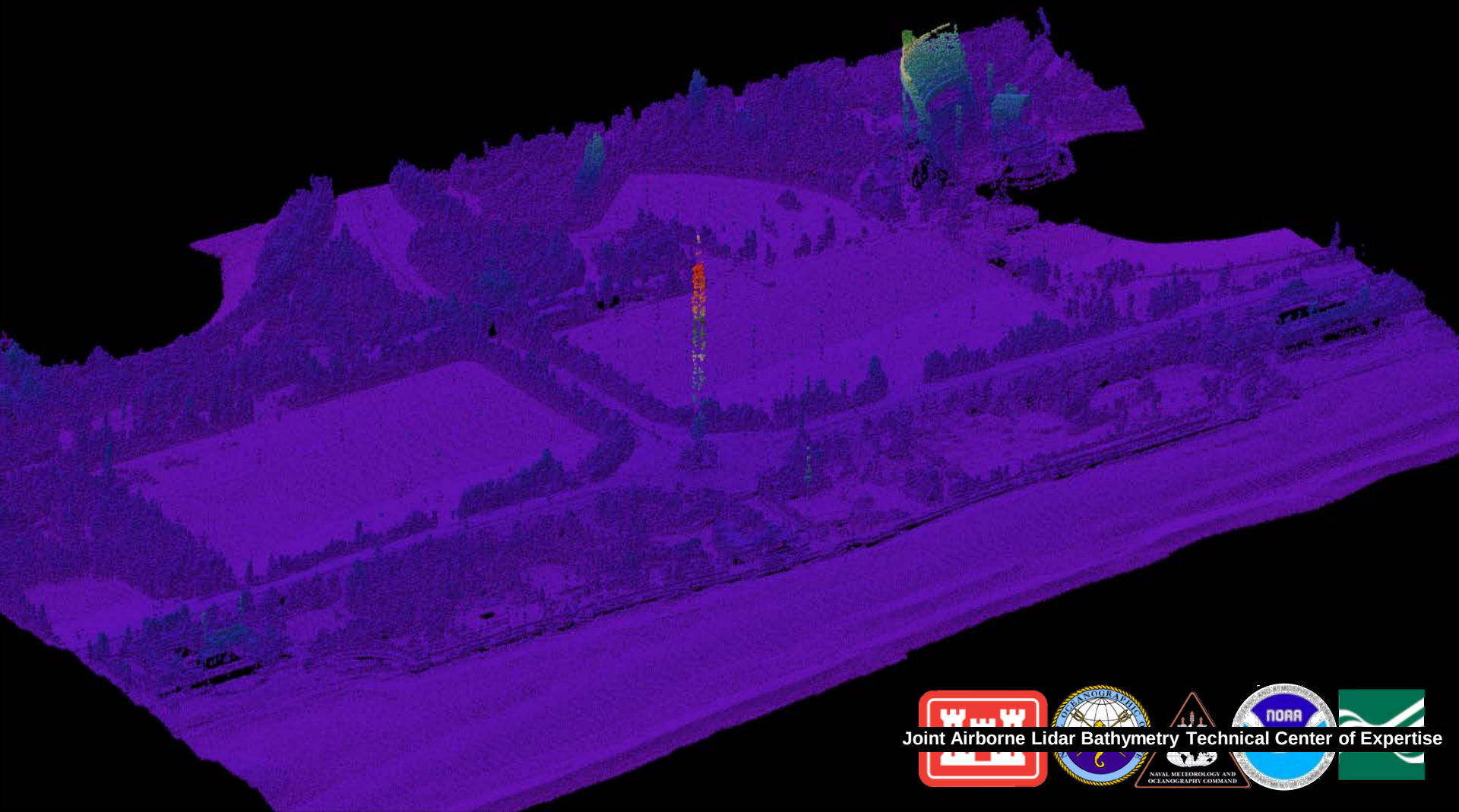
JALBTCX Post-Sandy lidar

Jones Beach, NY

Joint Airborne Lidar Bathymetry Technical Center of Expertise

JALBTCX Post-Sandy 24hr Data Products
Point Clouds

Jones Beach, NY



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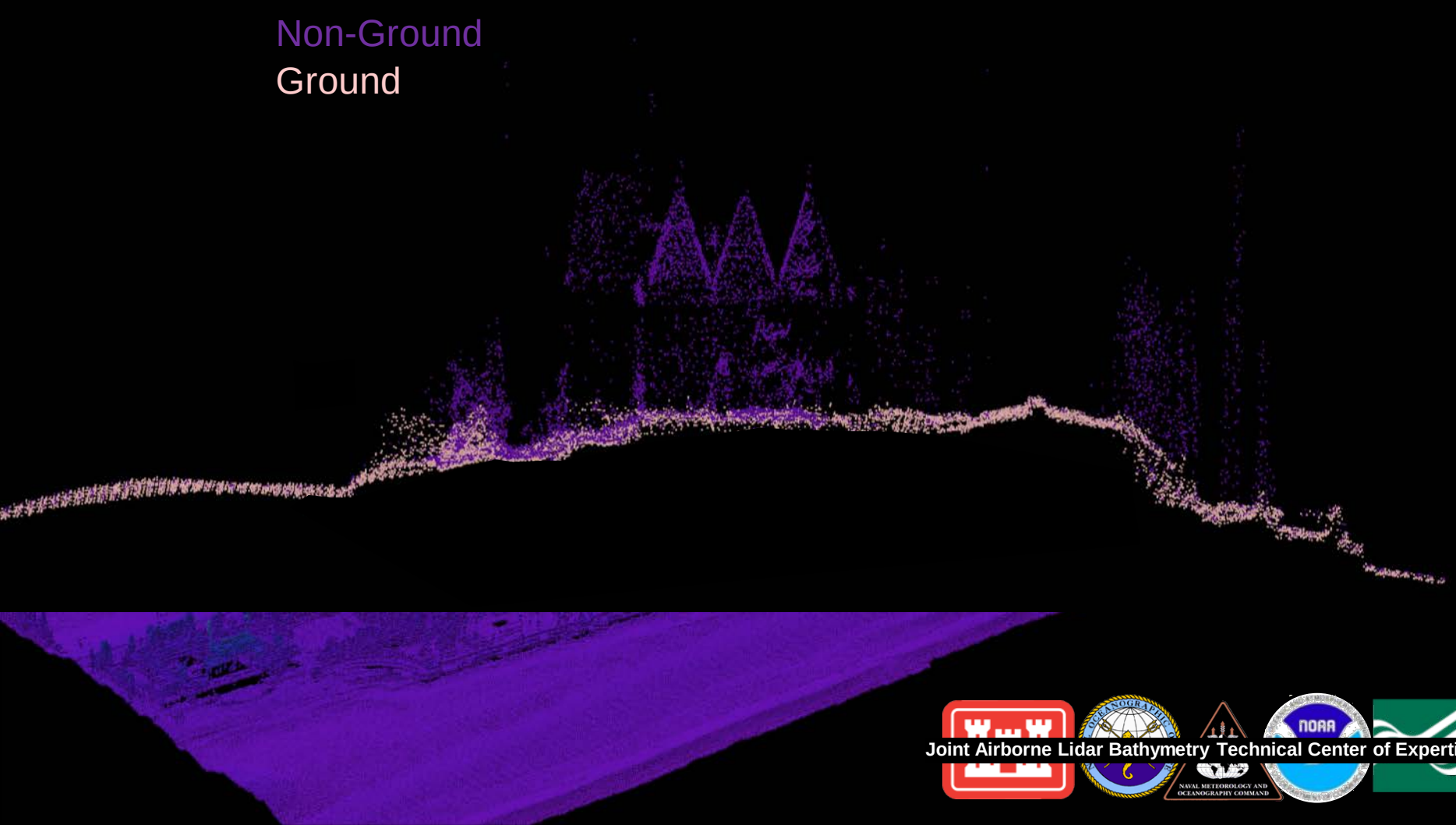
JALBTCX Post-Sandy 24hr Data Products Ground/Non-Ground Classifications

Jones Beach, NY



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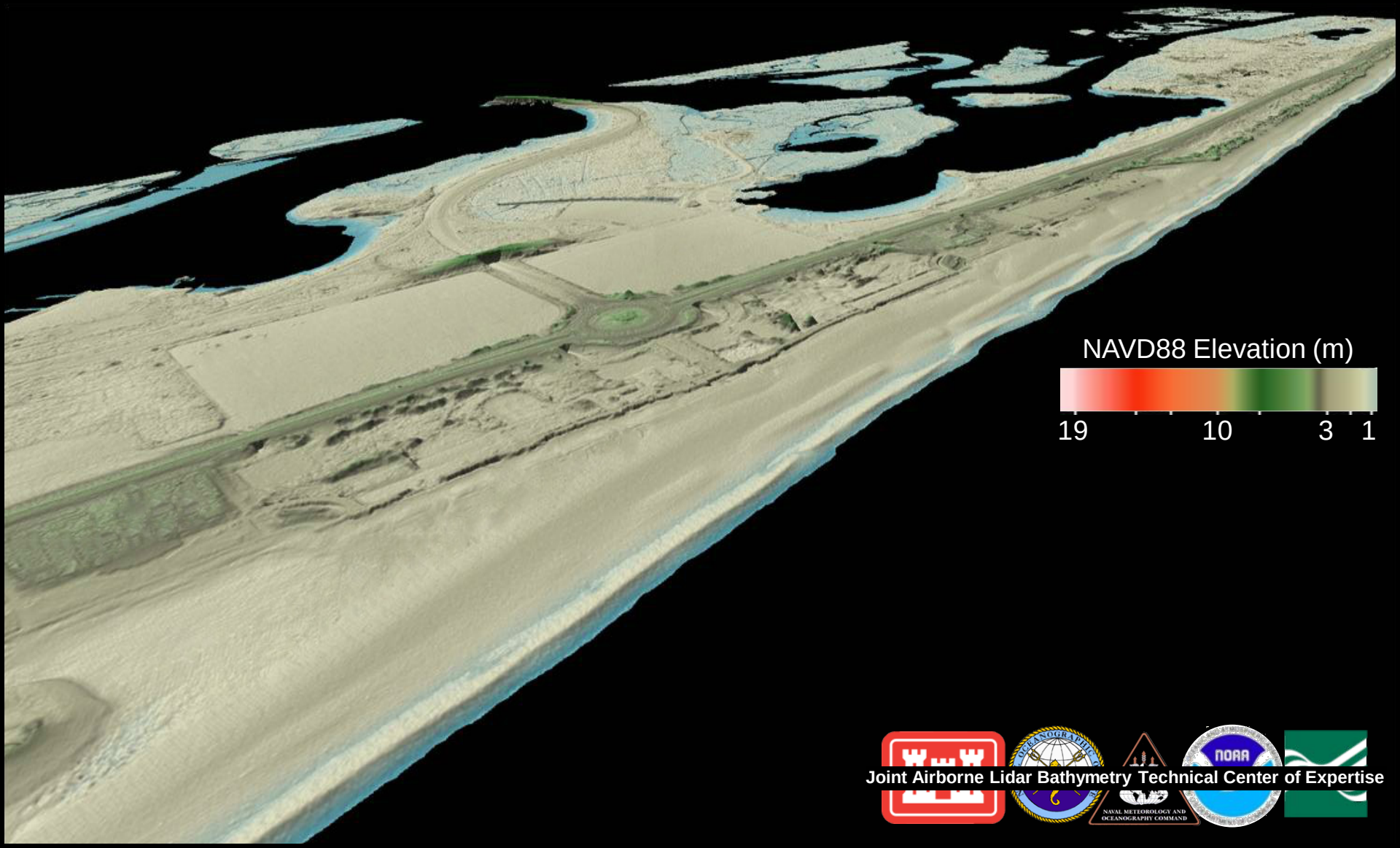
JALBTCX Post-Sandy 24hr Data Products
Digital Surface Models

Jones Beach, NY

Joint Airborne Lidar Bathymetry Technical Center of Expertise

JALBTCX Post-Sandy 24hr Data Products
Digital Elevation Models

Jones Beach, NY



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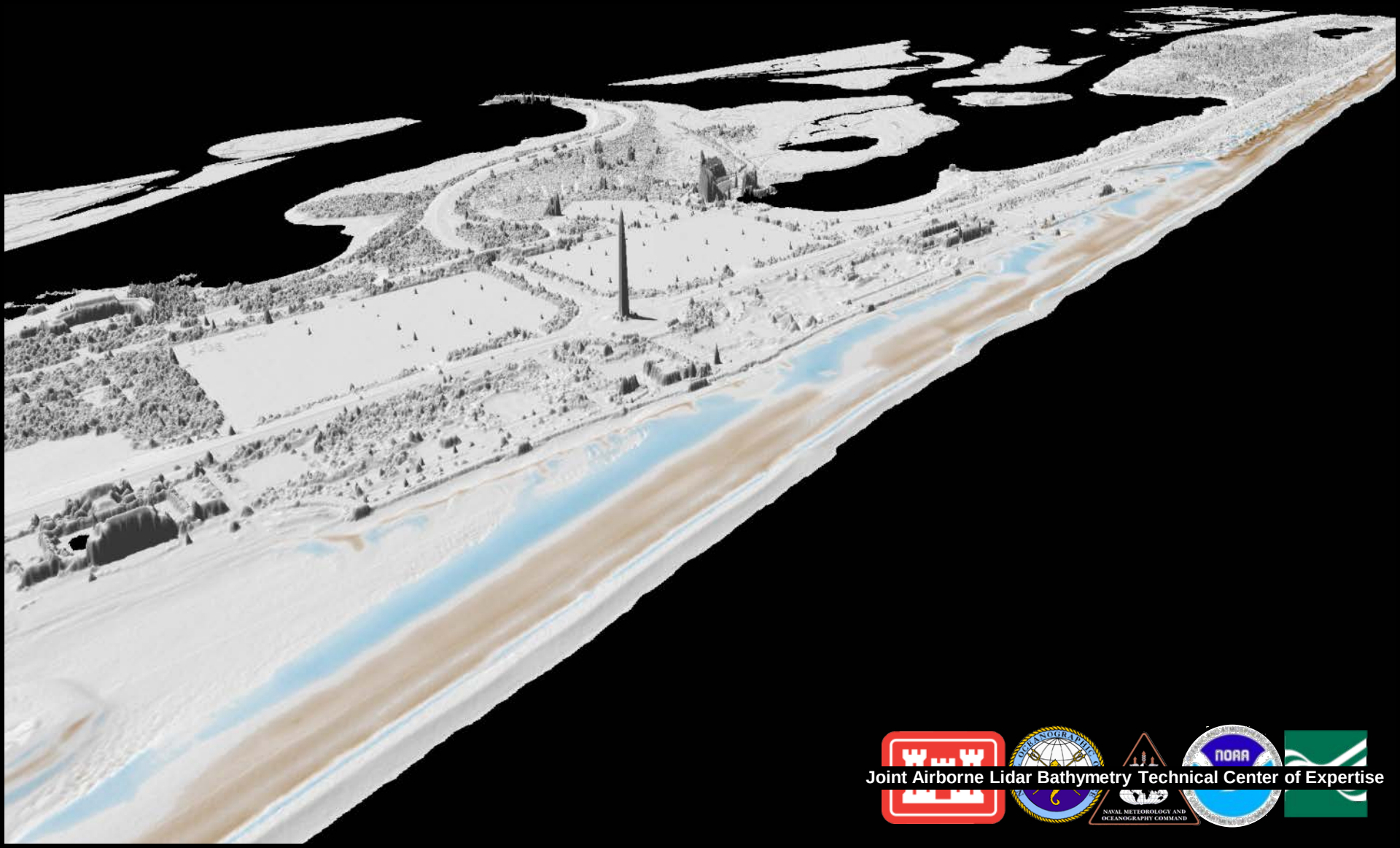
JALBTCX Post-Sandy Change Analysis
Elevation Change Rasters

Jones Beach, NY 2012



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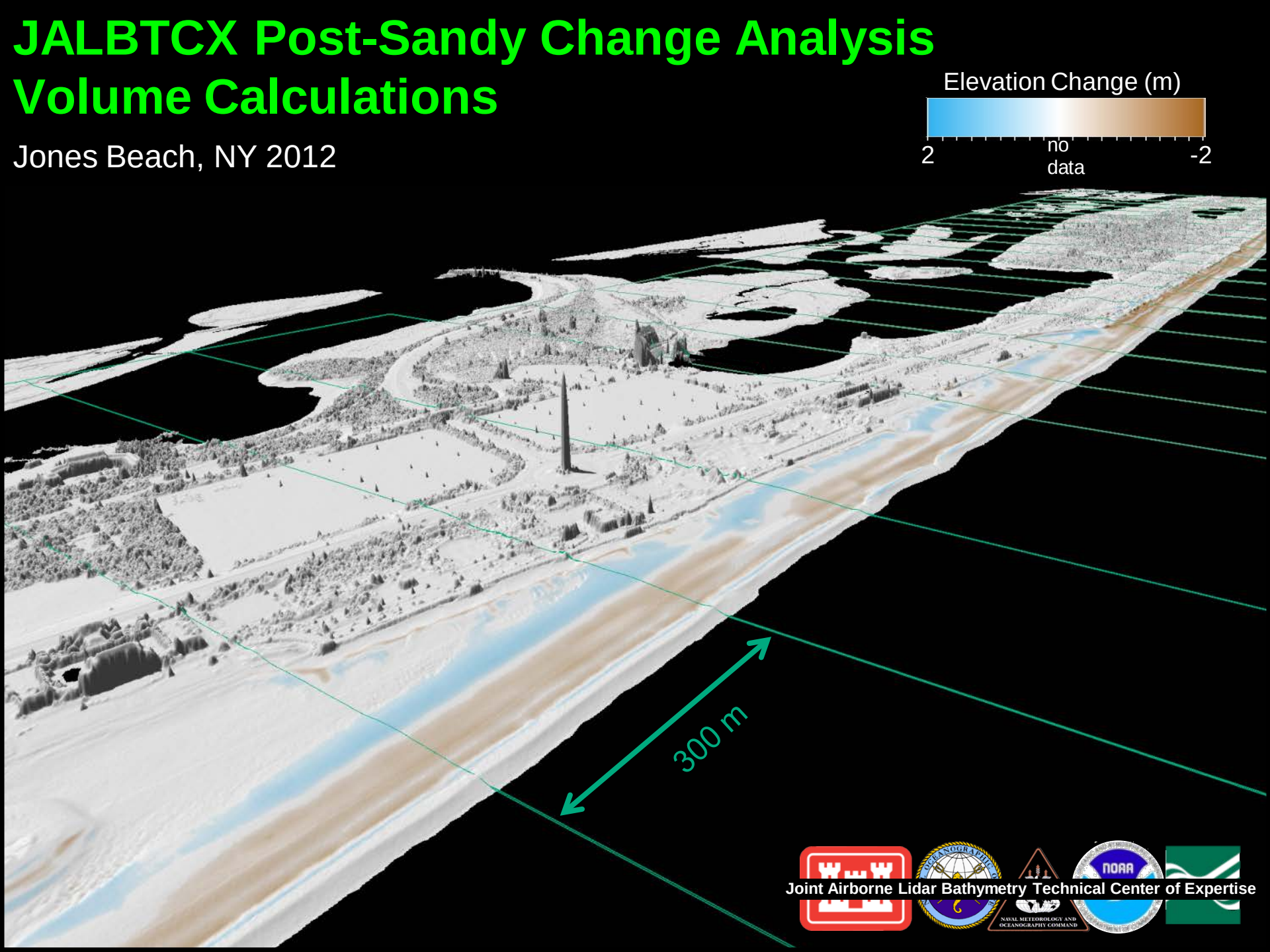
JALBTCX Post-Sandy Change Analysis Volume Calculations

Jones Beach, NY 2012



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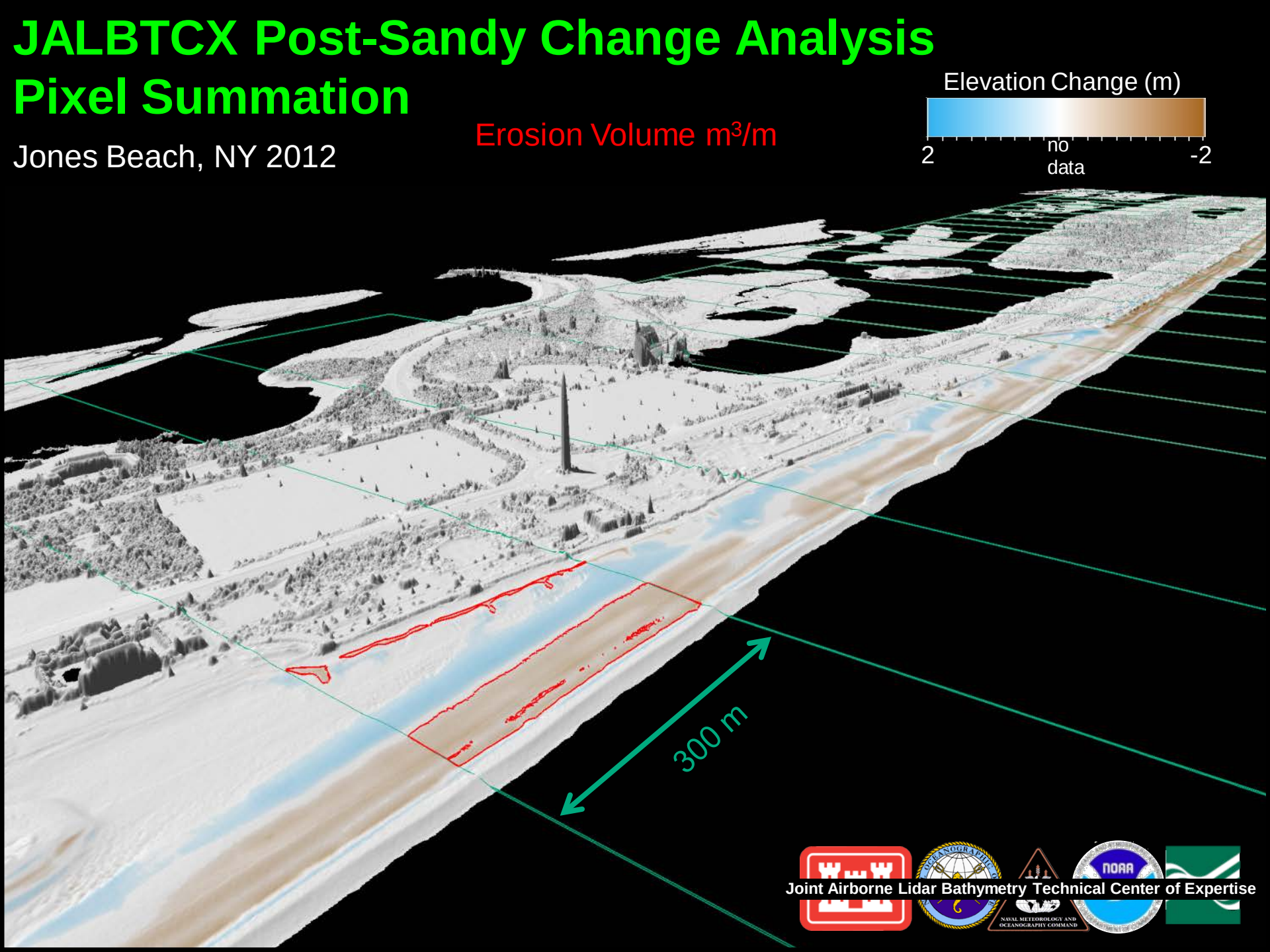
JALBTCX Post-Sandy Change Analysis
Pixel Summation

Jones Beach, NY 2012

Erosion Volume m^3/m



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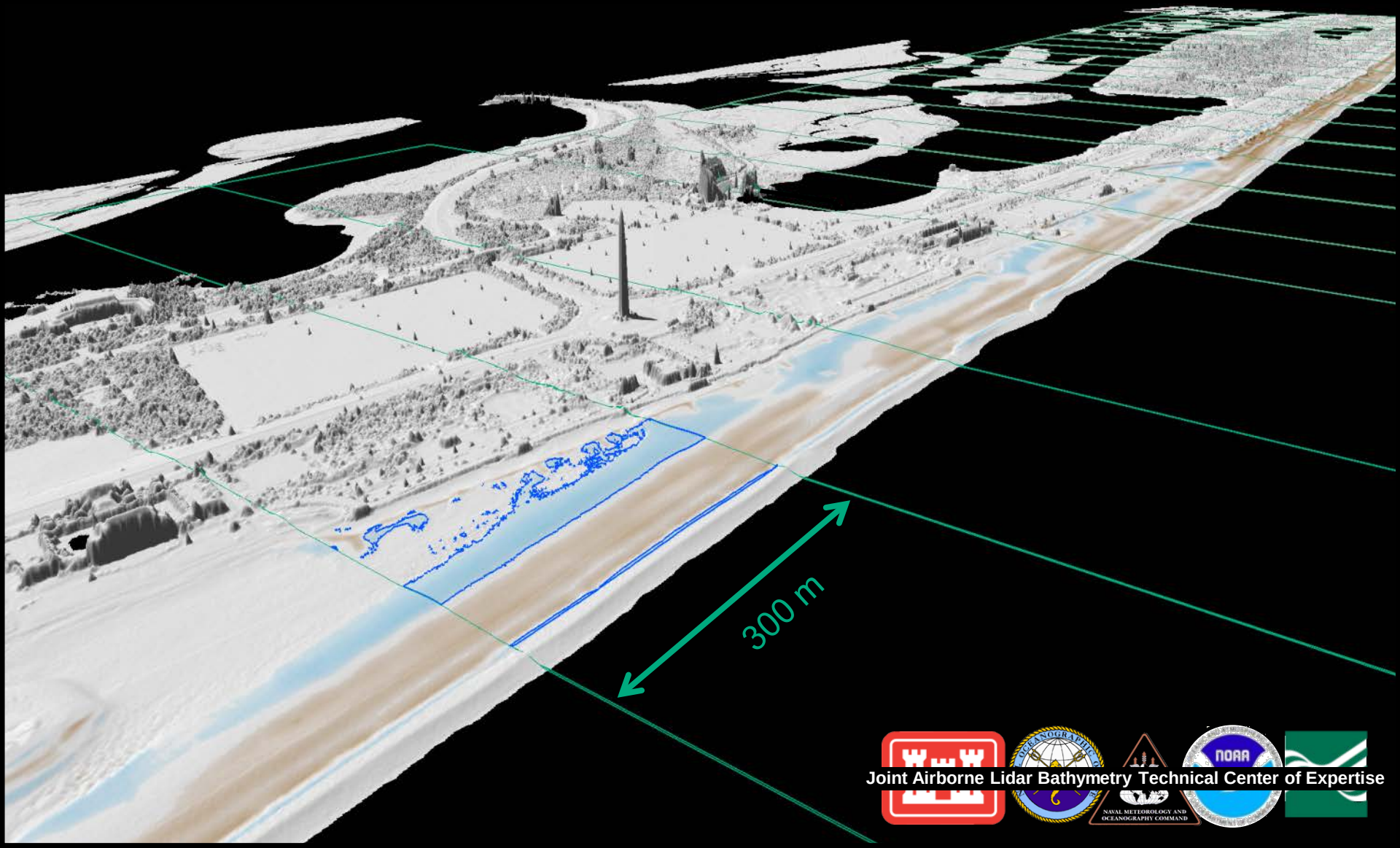
JALBTCX Post-Sandy Change Analysis
Pixel Summation

Jones Beach, NY 2012

Accretion Volume m^3/m

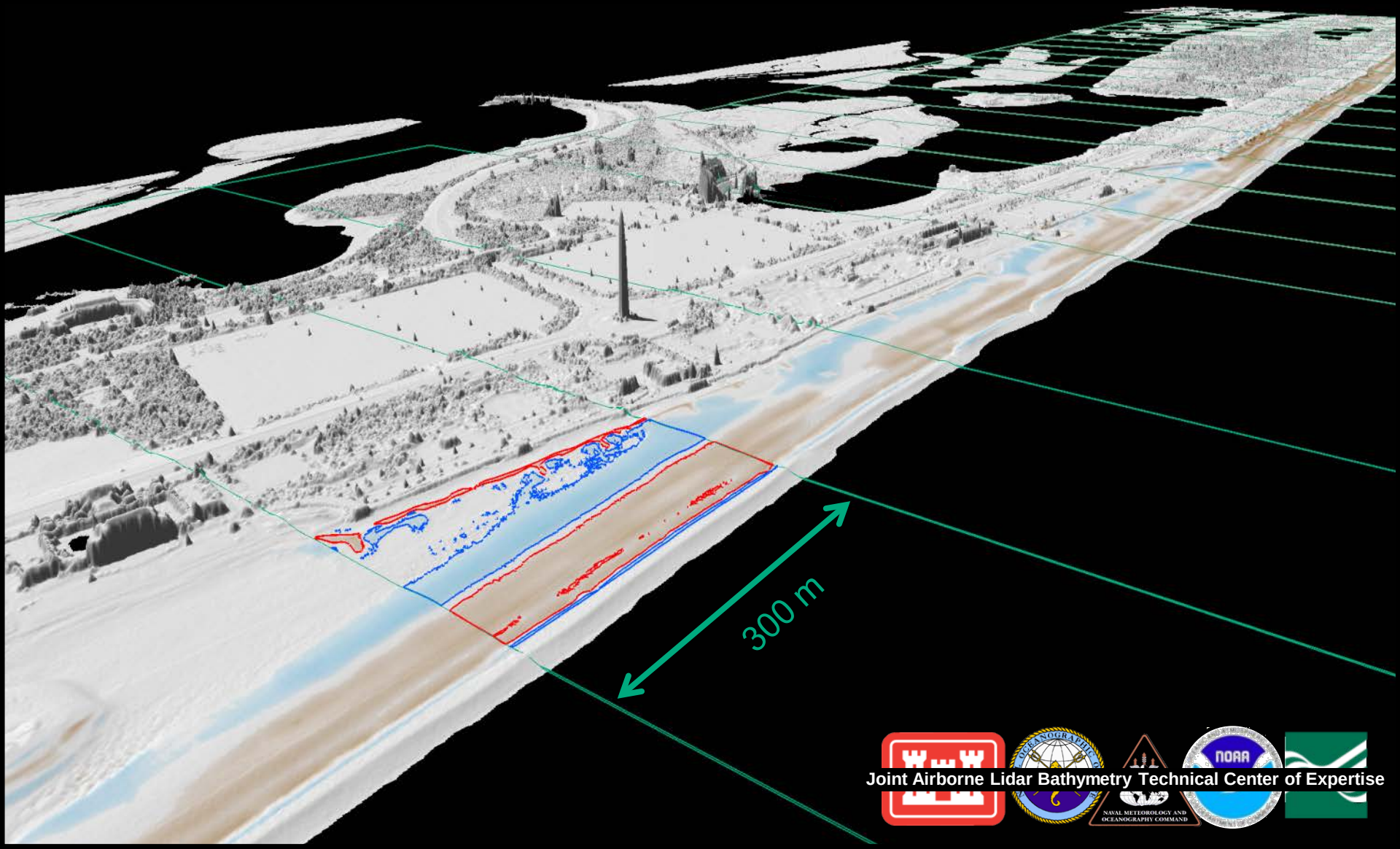


Joint Airborne Lidar Bathymetry Technical Center of Expertise

JALBTCX Post-Sandy Change Analysis
Pixel Summation

Jones Beach, NY 2012

Net Volume m^3/m



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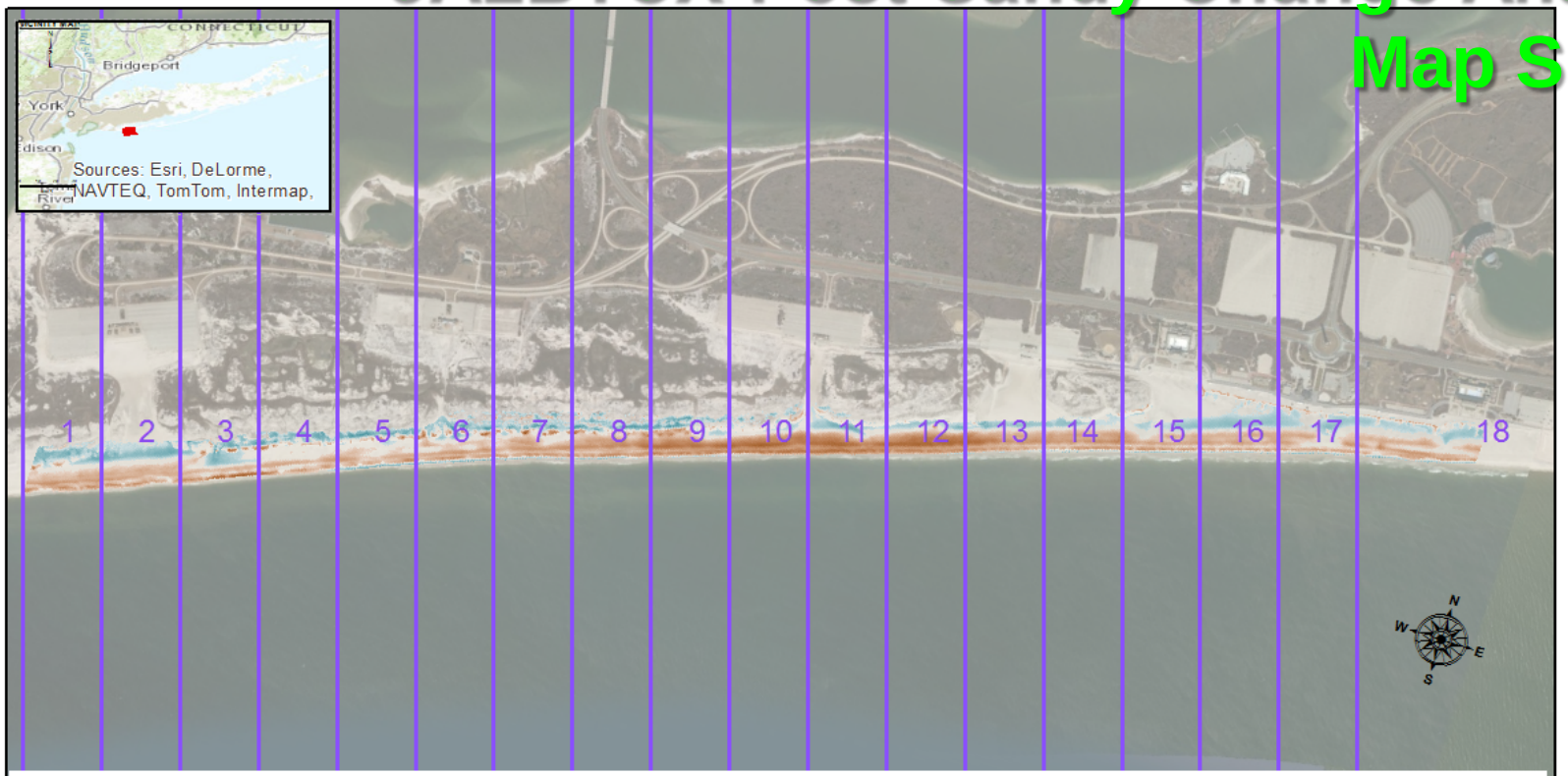
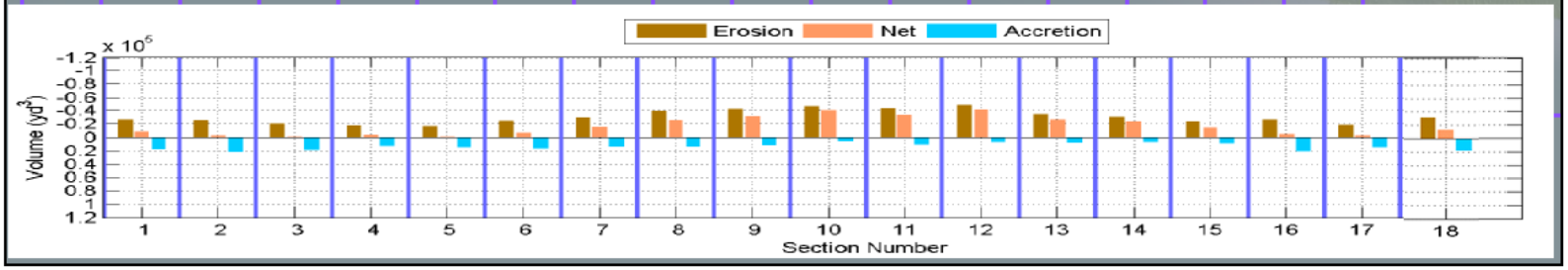
CORPS OF ENGINEERS

JALBTCX Post-Sandy Change Analysis Map Sheets





Section	Net (yd³)	Erosion (yd³)	Accretion (yd³)	Section	Net (yd³)	Erosion (yd³)	Accretion (yd³)
1	-8000	-26000	18000	10	-41000	-47000	6000
2	-3000	-25000	22000	11	-33000	-44000	11000
3	-1000	-20000	19000	12	-42000	-49000	7000
4	-4000	-17000	13000	13	-26000	-34000	8000
5	-1000	-16000	15000	14	-23000	-30000	7000
6	-7000	-24000	17000	15	-14000	-23000	9000
7	-15000	-29000	14000	16	-5000	-26000	21000
8	-25000	-39000	14000	17	-3000	-18000	15000
9	-31000	-43000	12000	18	-13000	-31000	18000

Elevation Difference (yd)

High : 2

Low : -2

Feet

0 1,000 2,000

Joint Airborne Lidar Bathymetry Technical Center of Expertise

Horizontal Coordinate System:
NAD 1983 UTM Zone 18N

Datum: North American 1983

Distance Units: Meter

Vertical Datum:
Elevation differences are shown in yards.

The information depicted on this map represents a comparison of survey data collected by JALBTCX after Superstorm Sandy in late October 2012. The data and comparison are preliminary.

Comparison data source: NY State Department of Environmental Conservation 2012 LIDAR

2012 Aerial Photography data source: NOAA Hurricane Sandy Response Imagery

US Army Corps of Engineers

Distribution Liability: The data represents the results of data collection/processing for a specific US Army Corps of Engineers activity and indicates the general existing conditions. As such, it is only valid for its intended use, content, time and accuracy specifications. The user is responsible for the results of any of the application of the data for other than its intended purpose.

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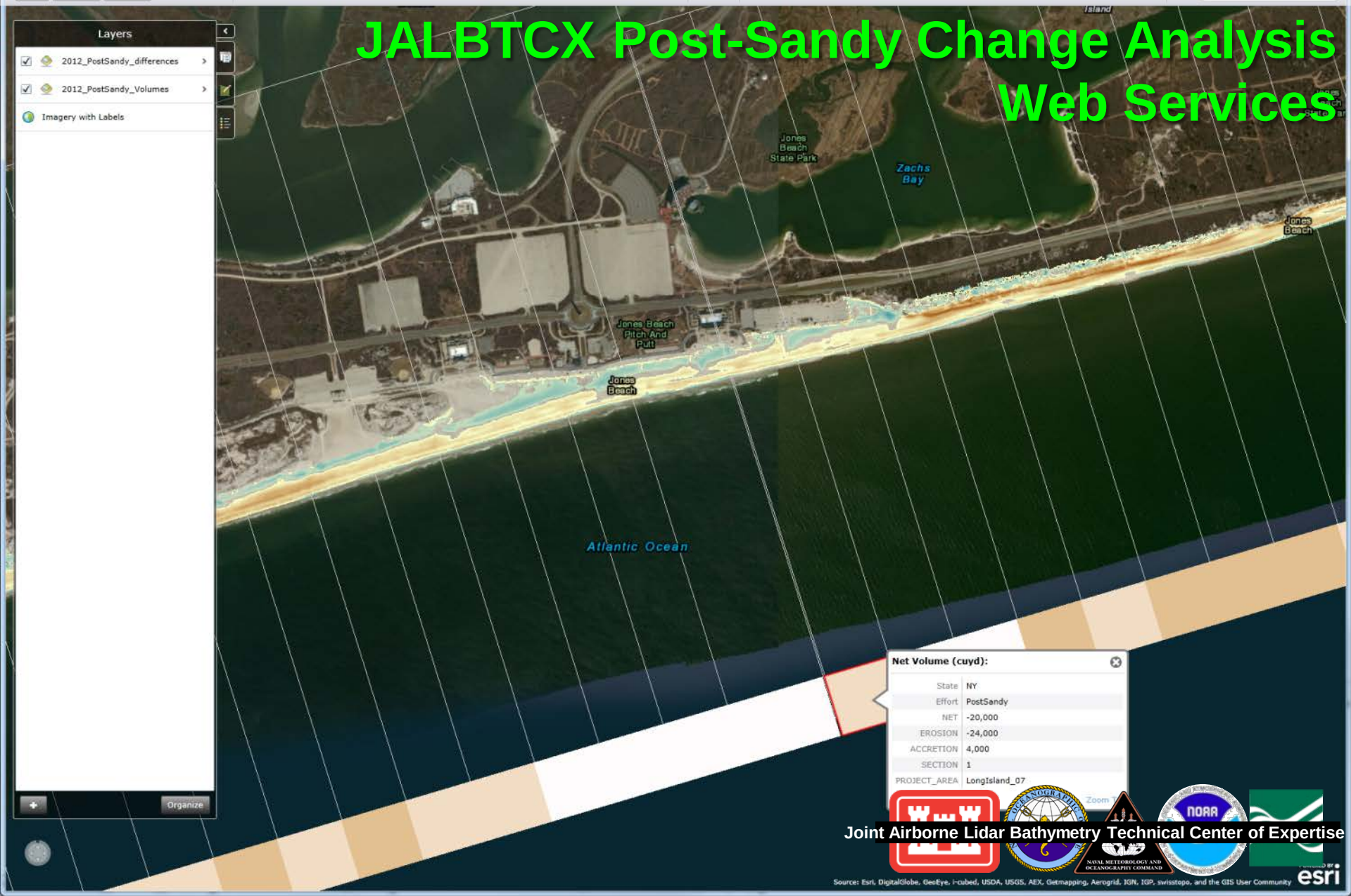
U.S. ARMY CORPS OF ENGINEERS
NEW YORK DISTRICT

National Coastal Mapping Program
Post-Superstorm Sandy
Elevation Differences and Volumes
Long Island 07: 000211

Sheet Reference Number 1 of 1

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

JALBTCX Post-Sandy Change Analysis Web Services



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Data Access

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Coverage Map

Server Selector

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

NCMP Coverage

Planned

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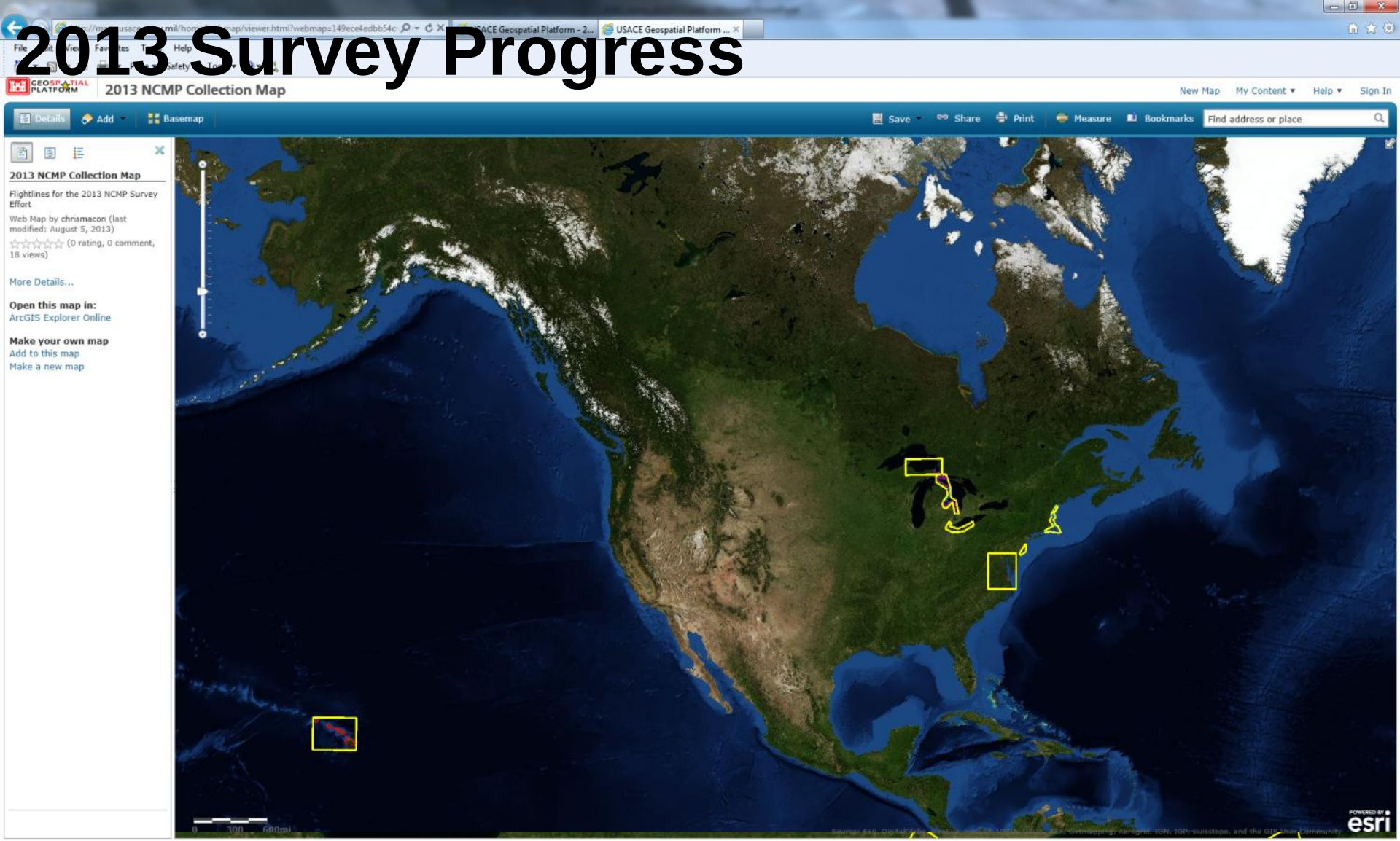
2013 Survey Progress



http://maps.usace.army.mil/home/webmap/viewer.html?webmap=149ece4edbb54cc7b3d224ff229dd7b9

Questions?

www.jalbtcx.org

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