

Post-Hurricane Coastal Mapping & Change Analysis

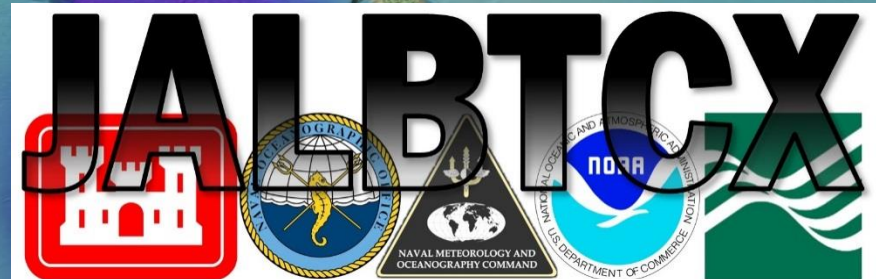
Eve Eisemann, Lauren Dunkin, Michael Hartman, & Jennifer Wozencraft

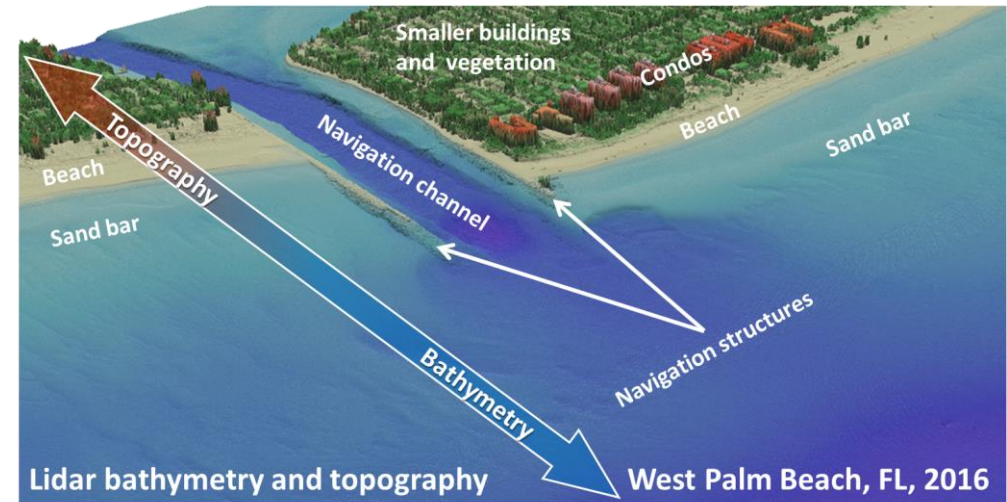
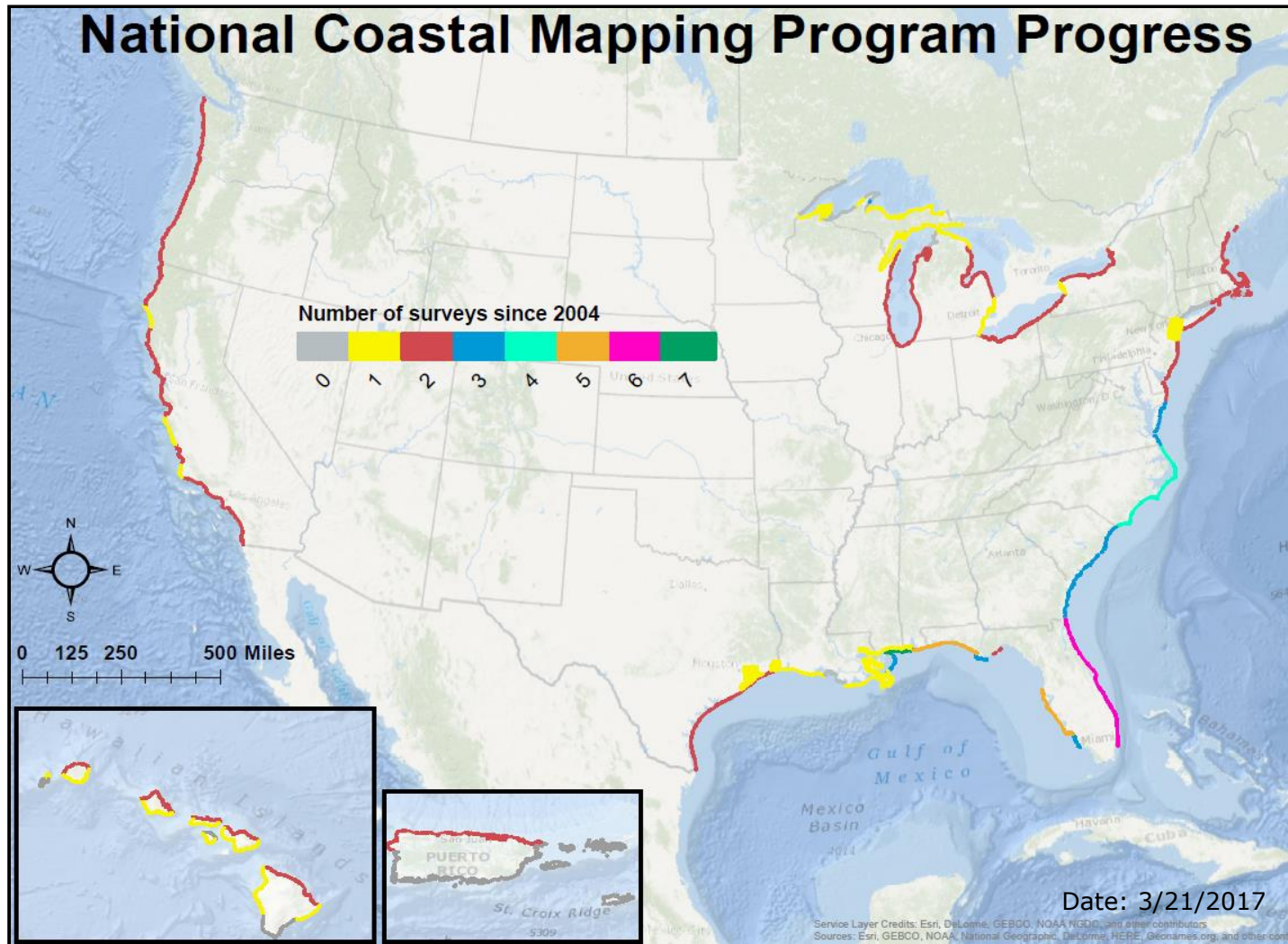
Joint Airborne Lidar Bathymetry Technical Center of Expertise



®

US Army Corps of Engineers
BUILDING STRONG®





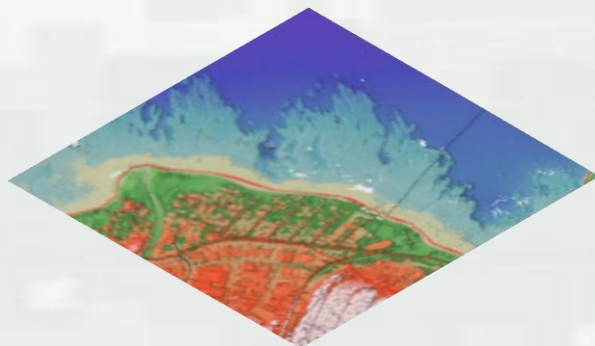
USACE National Coastal Mapping Program

- Executed by the JALBTCX (*Joint Airborne Lidar Bathymetry TCX*)
- Mapping U.S. coastal regions on a 5-year cycle
- Collected over 2500 square miles of coastal lidar data and imagery in TX, MS, AL, and FL in 2016

Metrics/Parameters

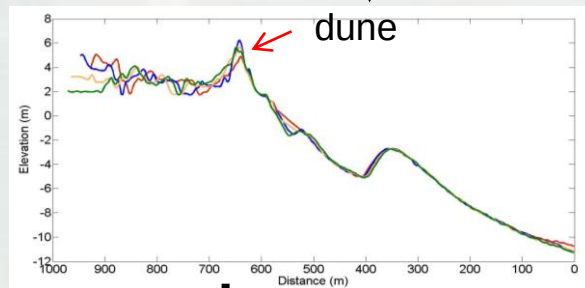
Elevation

Shorelines & shoreline change
Elevation & volume changes



Dune

Elevation (crest/toe)
Continuity
Slope
Volume

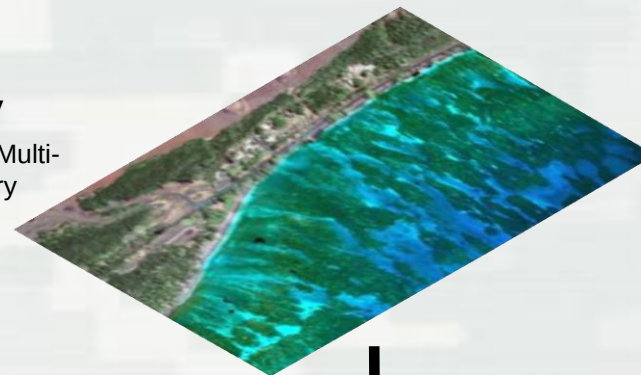


Beach

Width
Slope

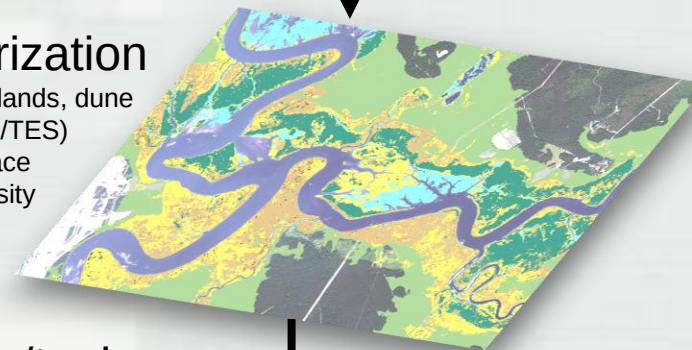
Imagery

Hyperspectral and Multi-Spectral Imagery

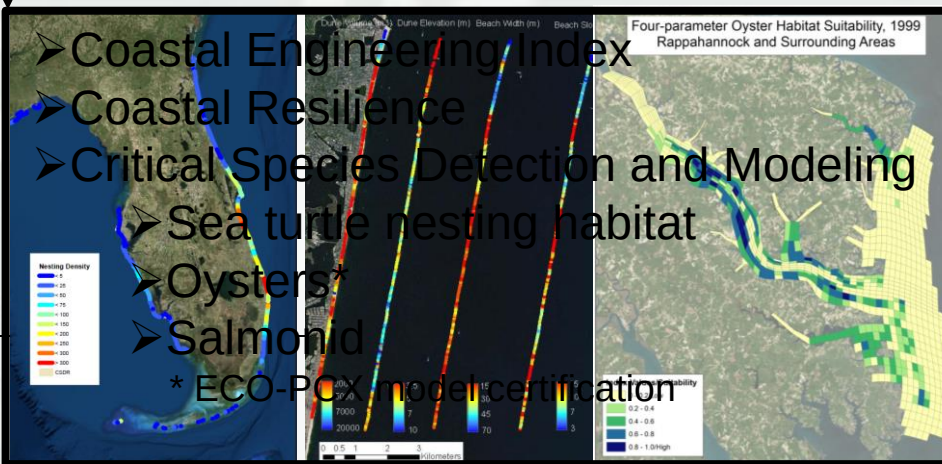
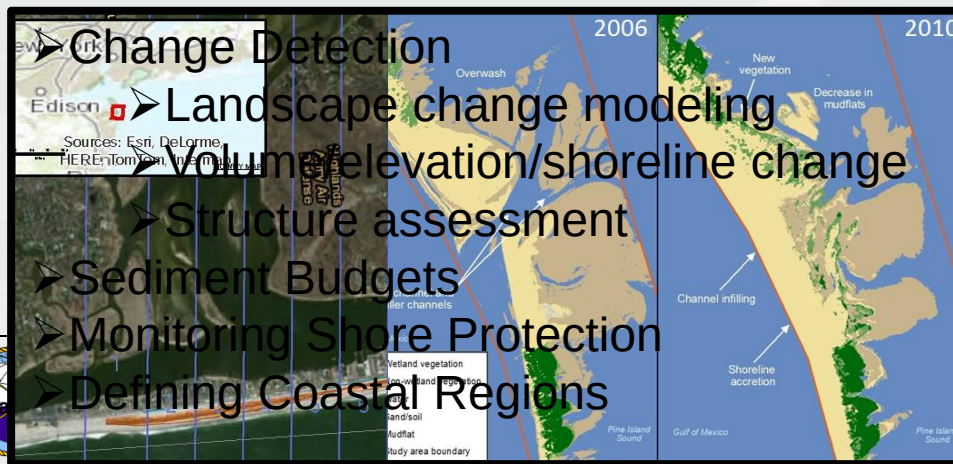


Land characterization

Critical habitat (SAV, wetlands, dune vegetation, invasive/TES)
Impervious surface
Landscape diversity



R&D/Value added products/tools

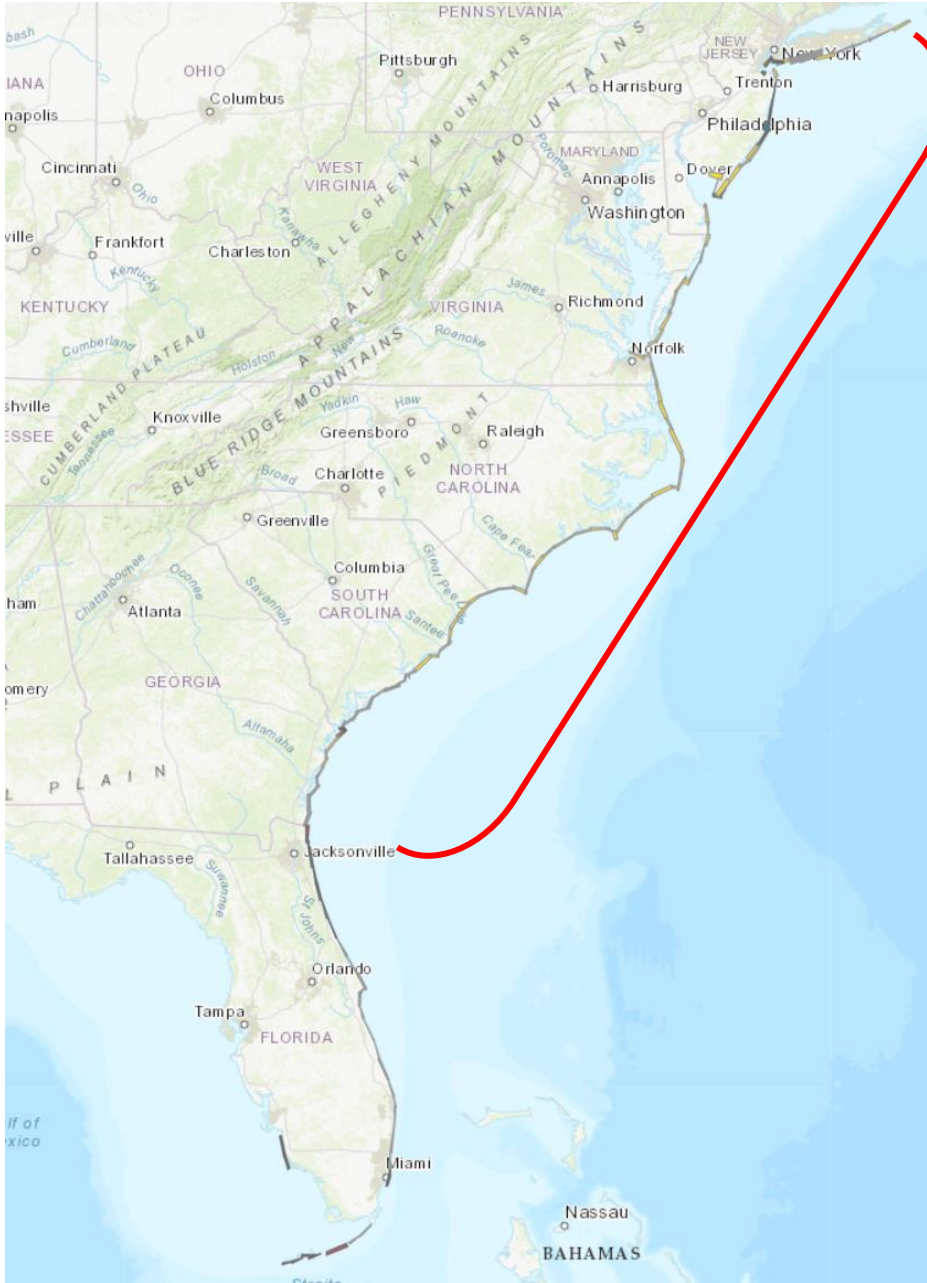


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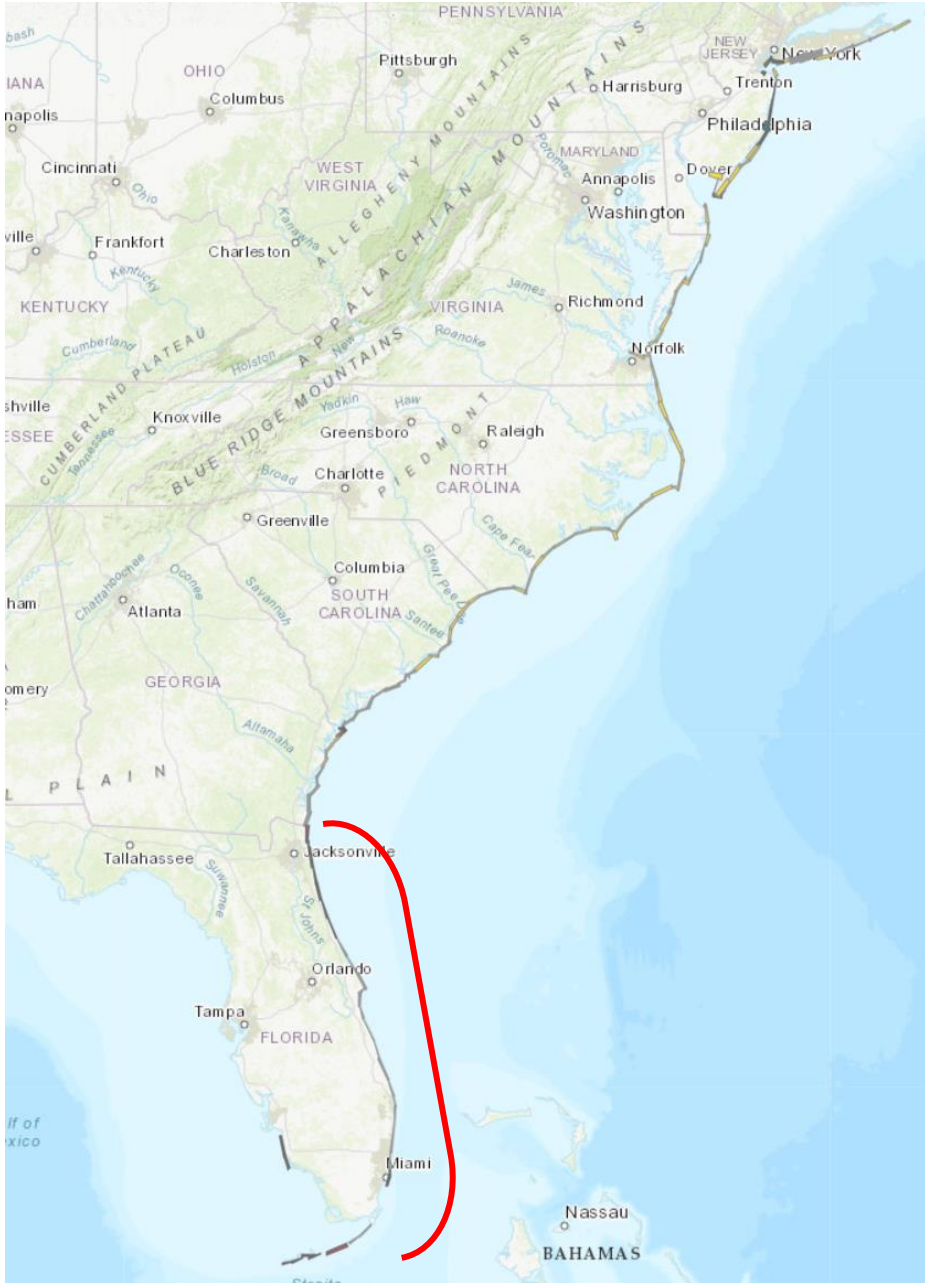
Surveys Underway

- 2017 surveys underway for Atlantic Coast from GA through NY
- Post-Irma response surveys in FL underway. FEMA-funded



Surveys Underway

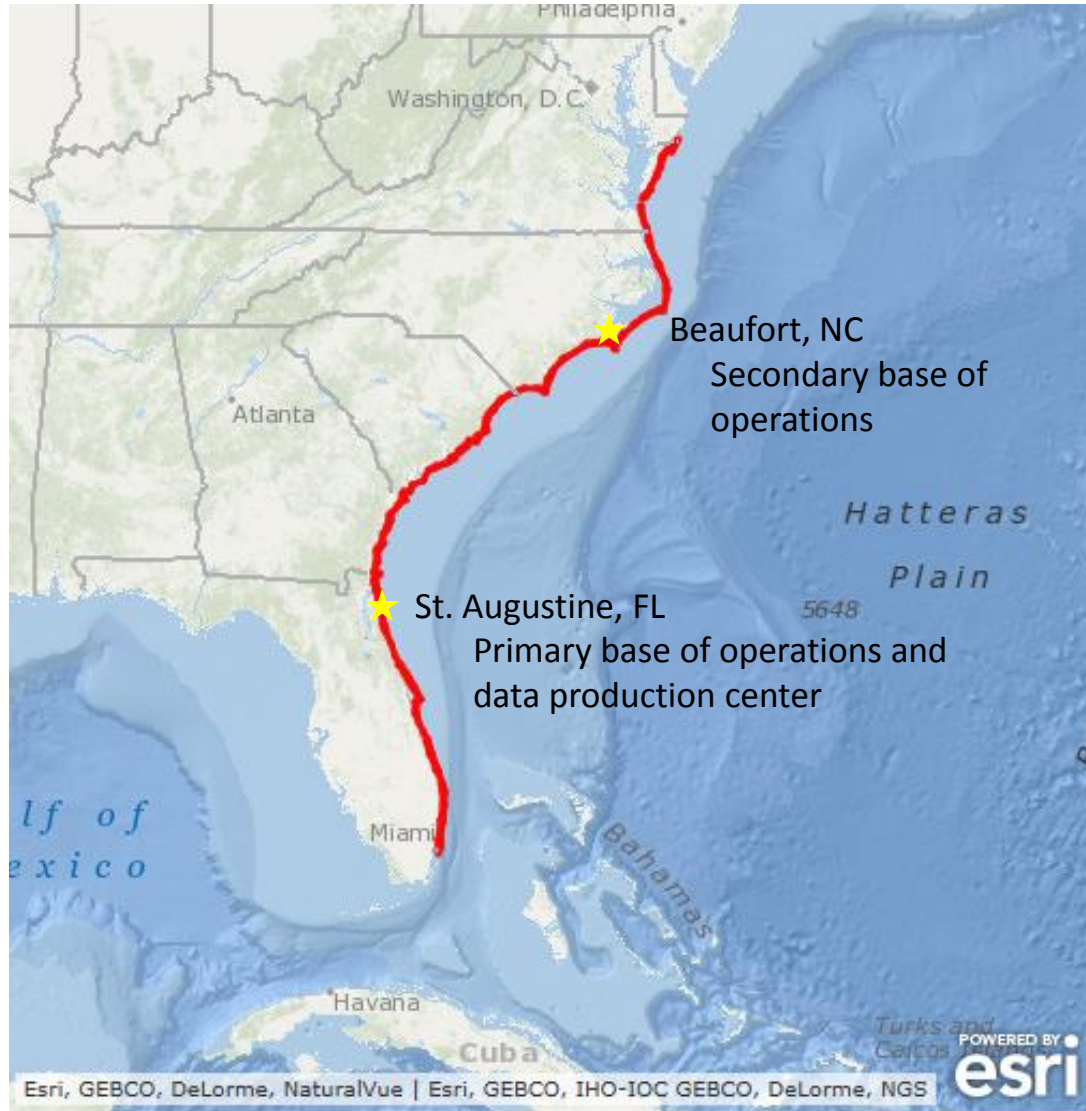
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2016 Post-Matthew Operations



Key Biscayne, FL to VA/MD Border

- District/Division support
- Rapid-response data product deliveries
- Advanced lidar products for emergency response
- Dual aircraft operations
- 991 flight lines
- 27 Oct – 2 Dec
- 36 days
- 76 flights
- 4 ground-truth teams (USGS)
- 24-hr field office

Beach Change Metric Calculation

the JALBTCX ArcGIS toolbox

JALBTCX_Arc102_Rev3

- Batch Import Metadata
- Batch Projection Feature Layer
- Batch Projection Raster
- Make Query Table
- map
- Merge Feature Classes
- Sort
- Step 01. Label Baseline
- Step 02. Generate Transect
- Step 02b. Update Transect Coordinates (if necessary)
- Step 03. Generate Mask Between Transects
- Step 03b. Generate Clip Mask
- Step 04. Generate Difference Grid by Clip Mask
- Step 05. Calculate Difference Grid Volume
- Step 06. Generate Shoreline (optional)
- Step 07. Label Transect and Mask with MHW Value
- Step 08. Generate Mask Between Transect above MHW
- Step 09. Calculate MHW Volume
- Step 09b. Calculate Surface Grid Volume above MHW (3rd Volume)
- Step 10. Calculate MHW Volume Difference
- Step 10b. Calculate Volume Difference above MHW (3rd Volume)
- Step 11. Calculate Shoreline Change
- Step 12. Generate Final Table
- Step 13. Summarize Table

East Coast Volume Change (2005 – 2010)

State	Start Date	End Date	Baseline Length	Number of Transects	Average Shoreline Change Rate	Volume Density Rate	MHW Volume Density Rate	Above MHW Volume Density Rate
			km	n	ft/yr	cy/ft/yr	cy/ft/yr	cy/ft/yr
ME	10/19/2005	6/19/2010	62	633	(0.4)	13.5	0.7	0.6
NH	11/01/2005	6/20/2010	15	152	(1.0)	2.6	(0.5)	(0.5)
MA	11/11/2005	5/26/2010	381	3,834	(2.8)	(2.8)	(0.9)	(0.8)
NY	10/26/2005	8/13/2010	192	1,921	6.9	4.5	4.1	4.2
NJ	9/2/2005	8/28/2010	203	2,034	0.6	2.1	2.2	2.2
DE	9/3/2005	9/11/2010	44	440	5.1	3.9	4.1	4.2
MD	9/3/2005	8/2/2010	50	505	(4.3)	2.8	2.7	2.7
VA	9/8/2005	7/28/2010	183	1,835	7.2	3.1	3.4	2.9
NC_2009	9/28/2005	8/16/2009	272	2,725	3.9	0.6	(1.3)	0.2
NC_2010	9/28/2005	5/4/2010	236	2,369	0.2	2.7	2.5	2.5
SC	1/13/2006	5/4/2010	277	2,778	2.1	2.3	1.3	0.9
GA	1/13/2006	5/4/2010	145	1,452	(0.2)	4.2	3.0	2.8
FL-E	7/1/2004	5/4/2010	587	5,875	(2.7)	6.2	1.0	0.8
FL-W	6/1/2004	6/20/2010	298	2,998	7.7	19.3	2.3	2.4
FL-NW	6/1/2004	6/20/2010	346	3,461	(9.5)	4.6	(0.2)	(0.2)
Total/Average			3,289	33,012	0.9	4.6	1.6	1.7

FLORIDA AND US EAST COAST BEACH CHANGE METRICS DERIVED FROM JALBTCX LIDAR DATA

Prepared for:

USACE JALBTCX
and
Northrop Grumman

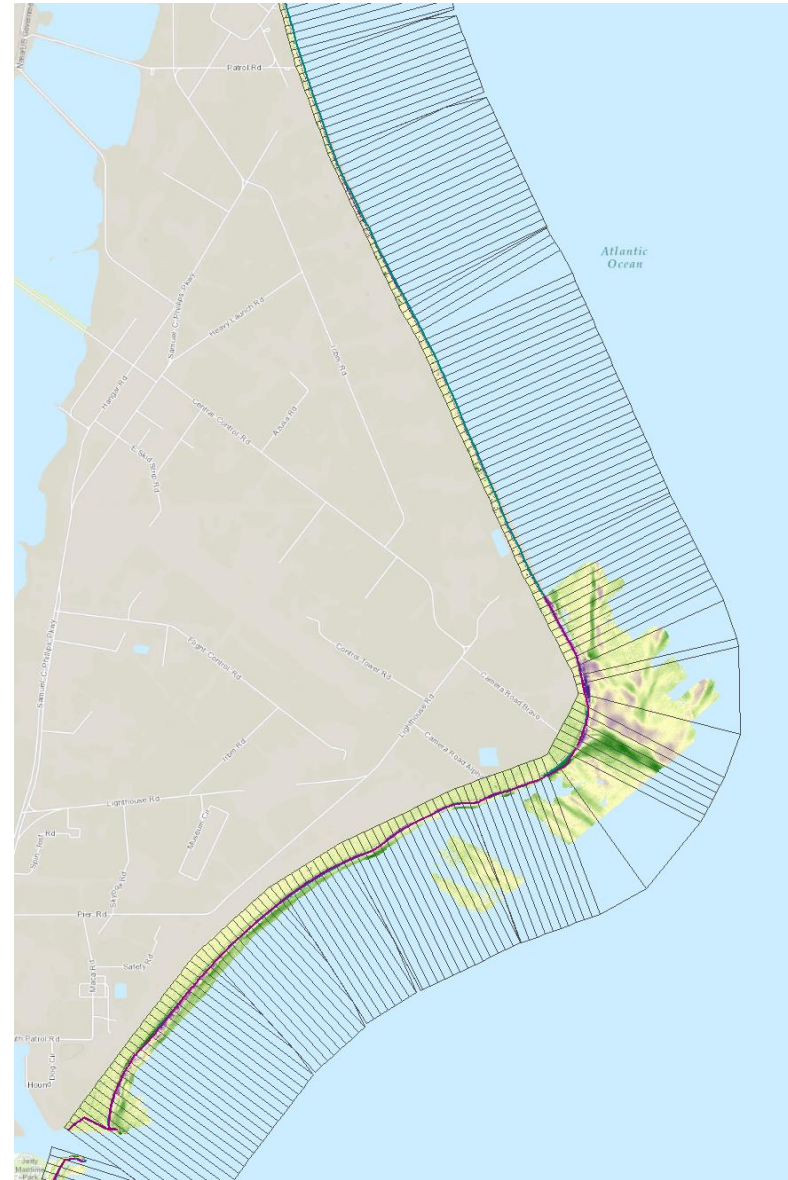
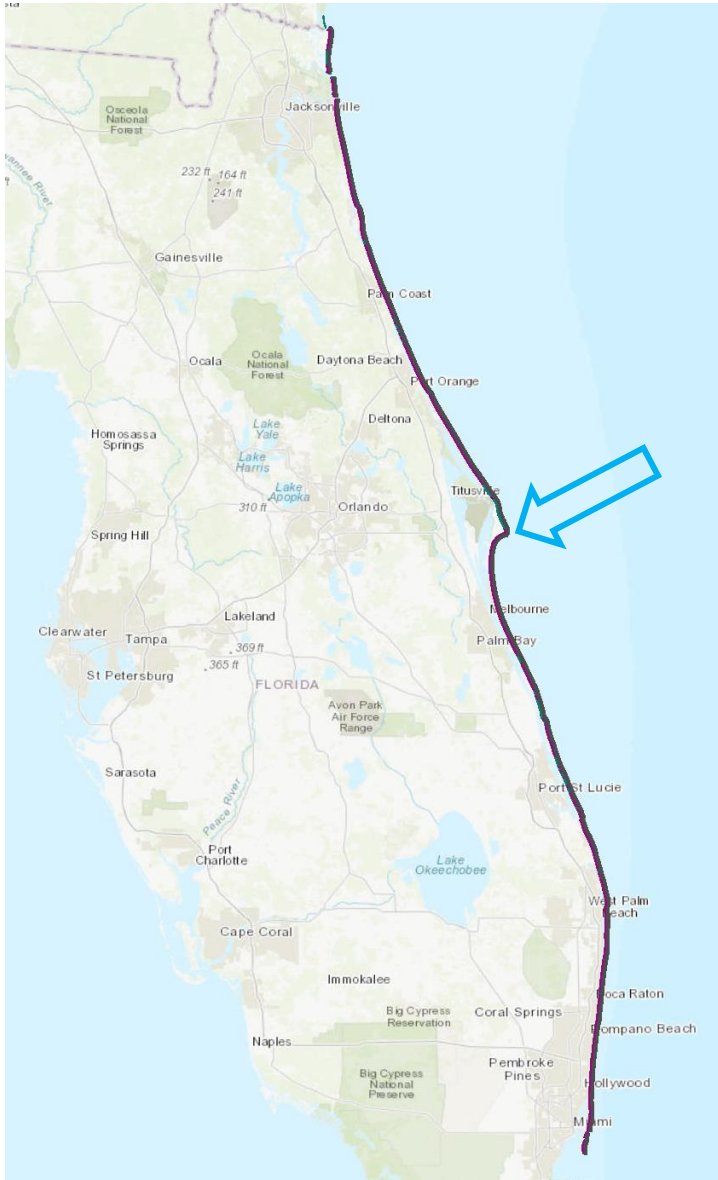


Prepared by:

CB&I Environmental & Infrastructure, Inc.



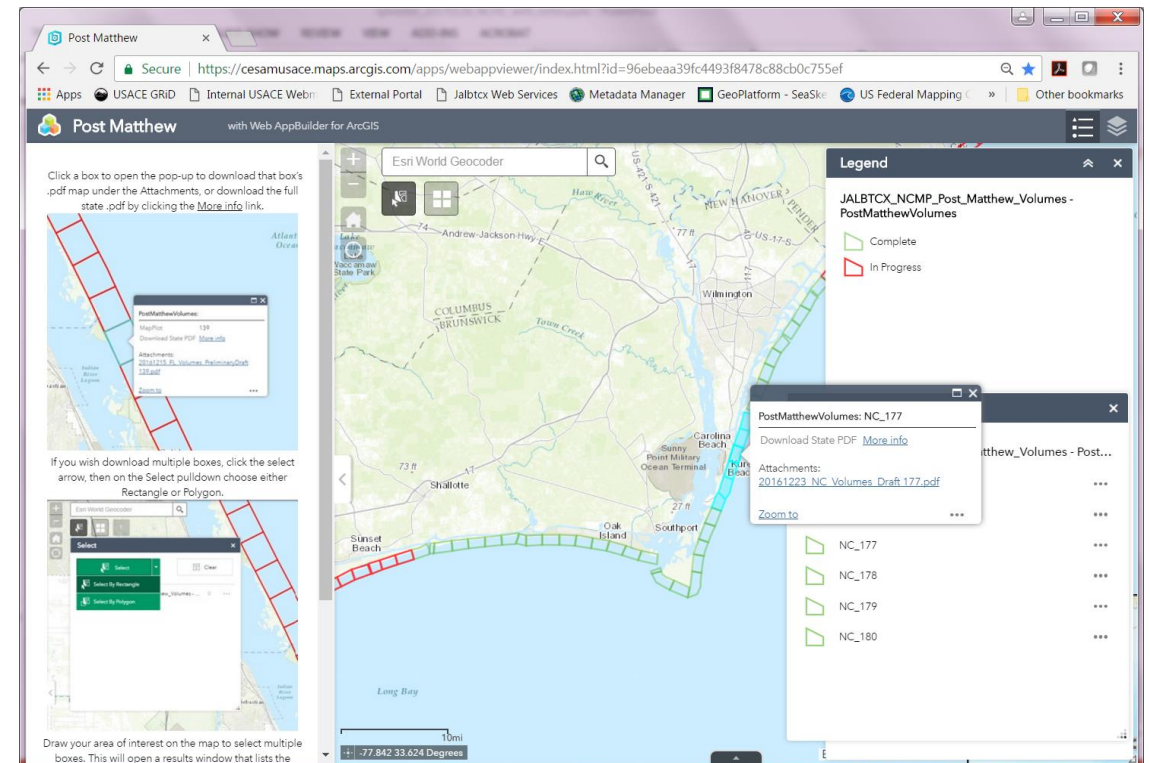
Example Site: Cape Canaveral, FL



- 100 m-wide bins created along baseline
- Bins extend from inland extent of beach to offshore extent of bathy
- Shoreline change in each bin
- Volume change
 - Total in each bin
 - Above & Below Shoreline

- GA_Projects.gdb
 - AnalysisSections
 - GA
 - GA_2010
 - GA_2016_2010_elev_diff
 - GA_Baseline_03
 - GA_shoreline_2010
 - GA_shoreline_2016
 - GA_Transect_03
 - MapBlocks

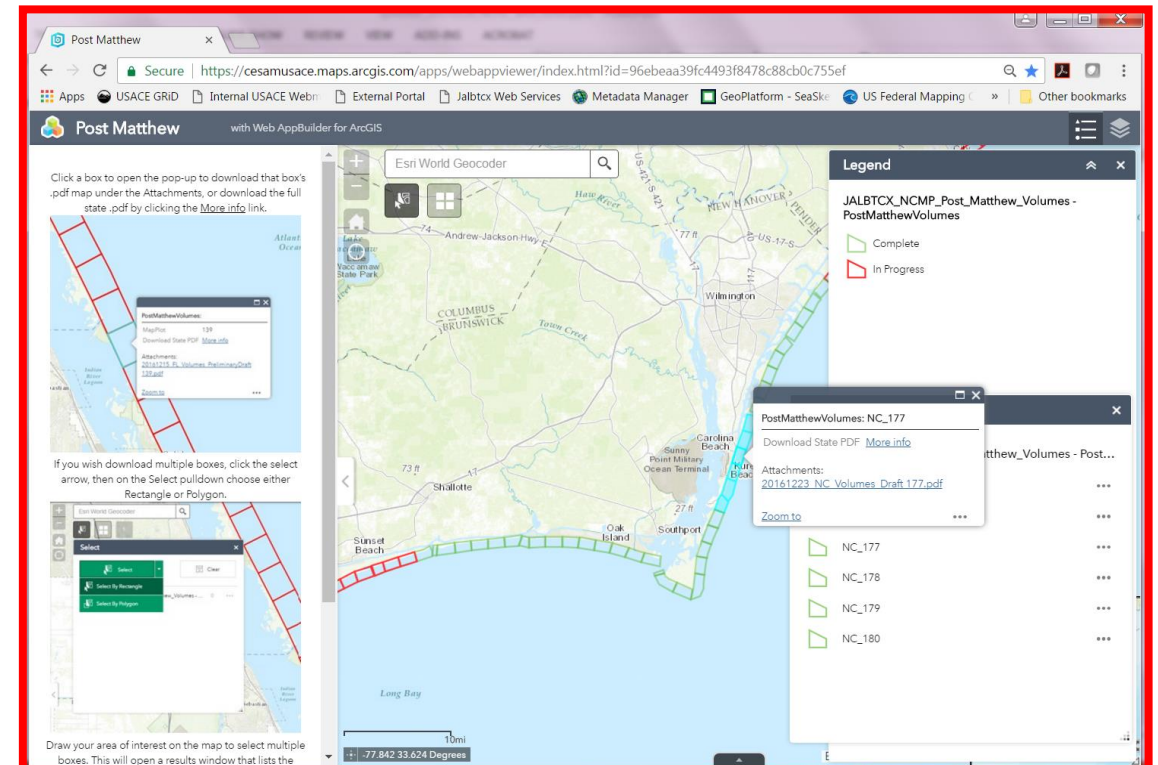
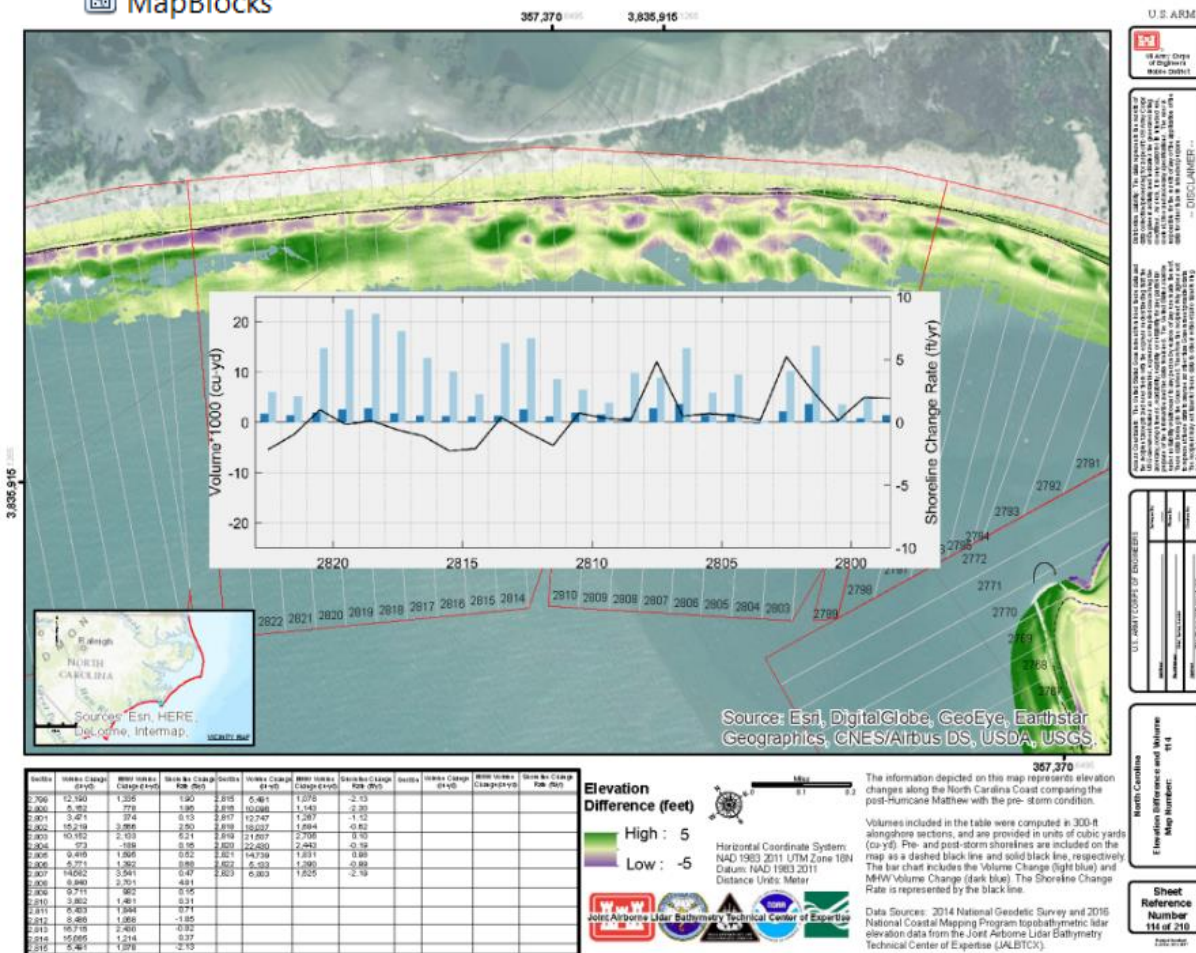
-
- 367.370**
3,836.916
- Volume Change (cu-yd)**
- Shoreline Change Rate (ft/yr)**
- Elevation Difference (feet)**
- High : 5**
Low : -5
- Horizontal Coordinate System:**
NAD 1983 2011 UTM Zone 18N
Datum: NAD 1983 2011
Distance Units: Meter
- Data Sources:** 2014 National Geodetic Survey and 2015 National Coastal Mapping Program topobathymetric lidar elevation data from the Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX).
- North Carolina**
Elevation Difference and Volume
Map Number: 114
Sheet Reference Number
114 of 210

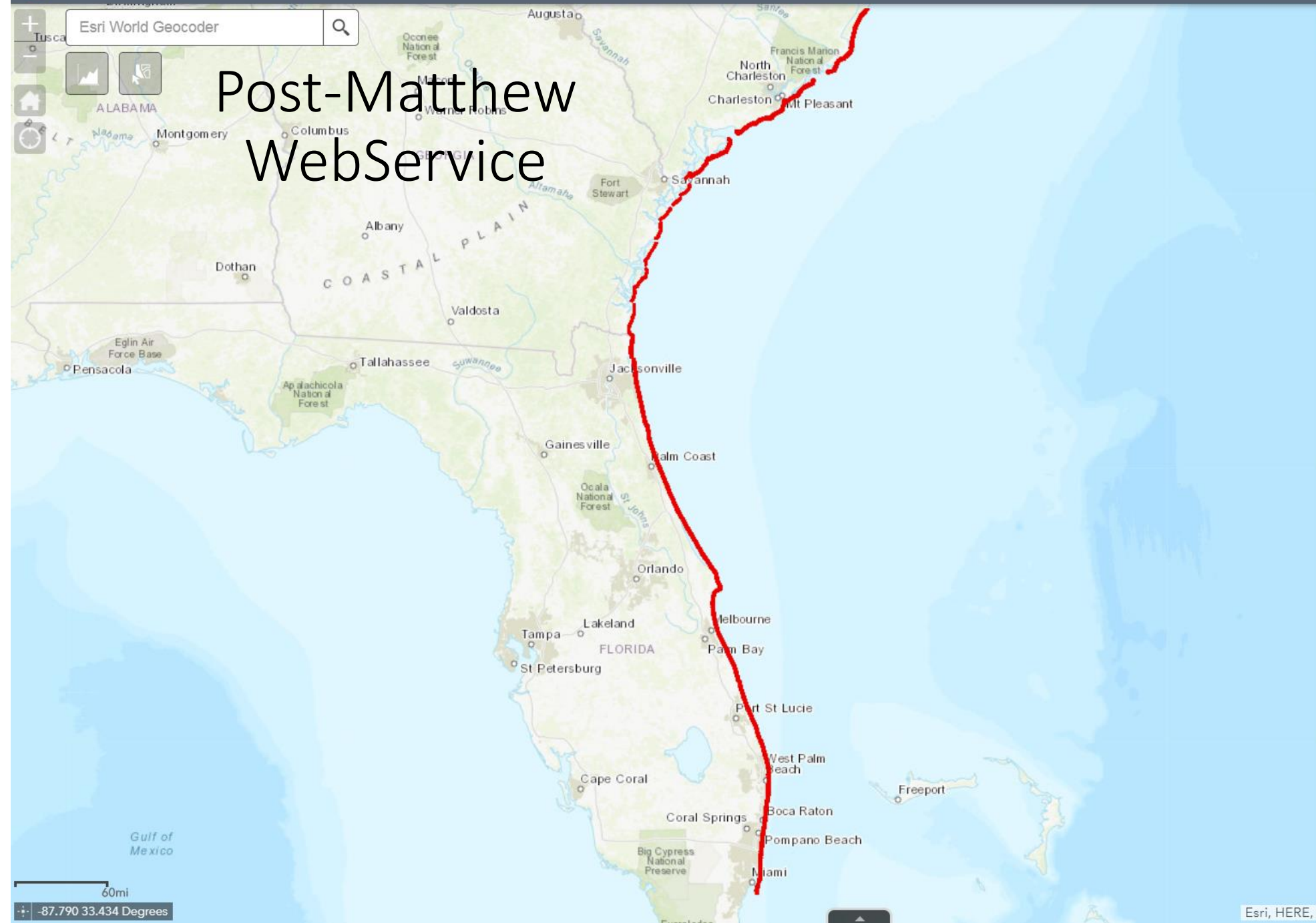


- GA_Projects.gdb
 - AnalysisSections
 - GA
 - GA_2010
 - GA_2016_2010_elev_diff
 - GA_Baseline_03
 - GA_shoreline_2010
 - GA_shoreline_2016
 - GA_Transect_03
 - MapBlocks

Delivering the Data: *GDBs, PDFs, WebService*

- Geodatabase with results
- PDF maps – communication tool
 - Identify priority areas
- Web maps – interactive tool – more detailed analysis





Post-Matthew WebService

Layer List

Operational layers

☒ JALBTCX_NCMP_MapBlocks

☒ Map Blocks



☐ JALBTCX_NCMP_Elevation_Difference_Grids

☐ Volume Change (cy) Post Irma

☐ Volume Change (cy) Post Matthew

☐ Volume Change (cy) 2010- 2006/2004

☒ JALBTCX_NCMP_AnalysisSections

☐ Volume Change (cy) Post Irma

☐ Shoreline Change Rate (ft/yr) Post Irma

☐ MHW Volume (cy) Post Irma

☐ Above MHW Volume (cy) Post Irma

☐ Volume Change (cy) Post Matthew

☐ Volume Change (cy) 2010 - 2006/2004

☐ Shoreline Change Rate (ft/yr) Post Matthew

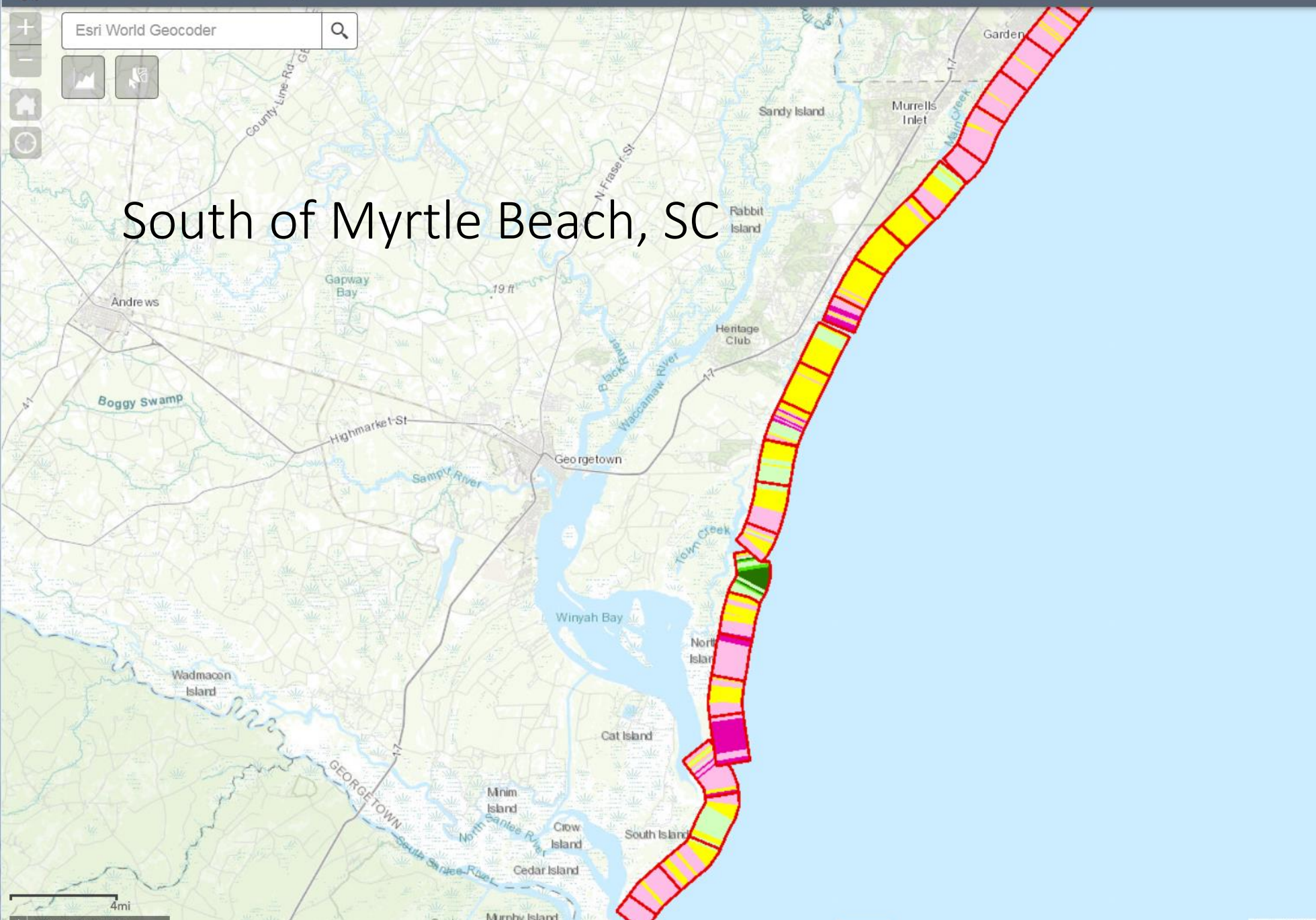
☐ MHW Volume (cy) Post Matthew

☐ Above MHW Volume (cy) Post Matthew

Esri World Geocoder

Map navigation controls: +, -, Home, Full Screen, Refresh

South of Myrtle Beach, SC



Layer List

Operational layers

- ☒ JALBTCX_NCMP_MapBlocks
- ☒ Map Blocks
- ☐ JALBTCX_NCMP_Elevation_Difference_Grids
- ☒ JALBTCX_NCMP_AnalysisSections
 - ☐ Volume Change (cy) Post Irma
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 - ☐ Volume Change (cy) 2010 - 2006/2004
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 - ☐ Above MHW Volume (cy) Post Matthew

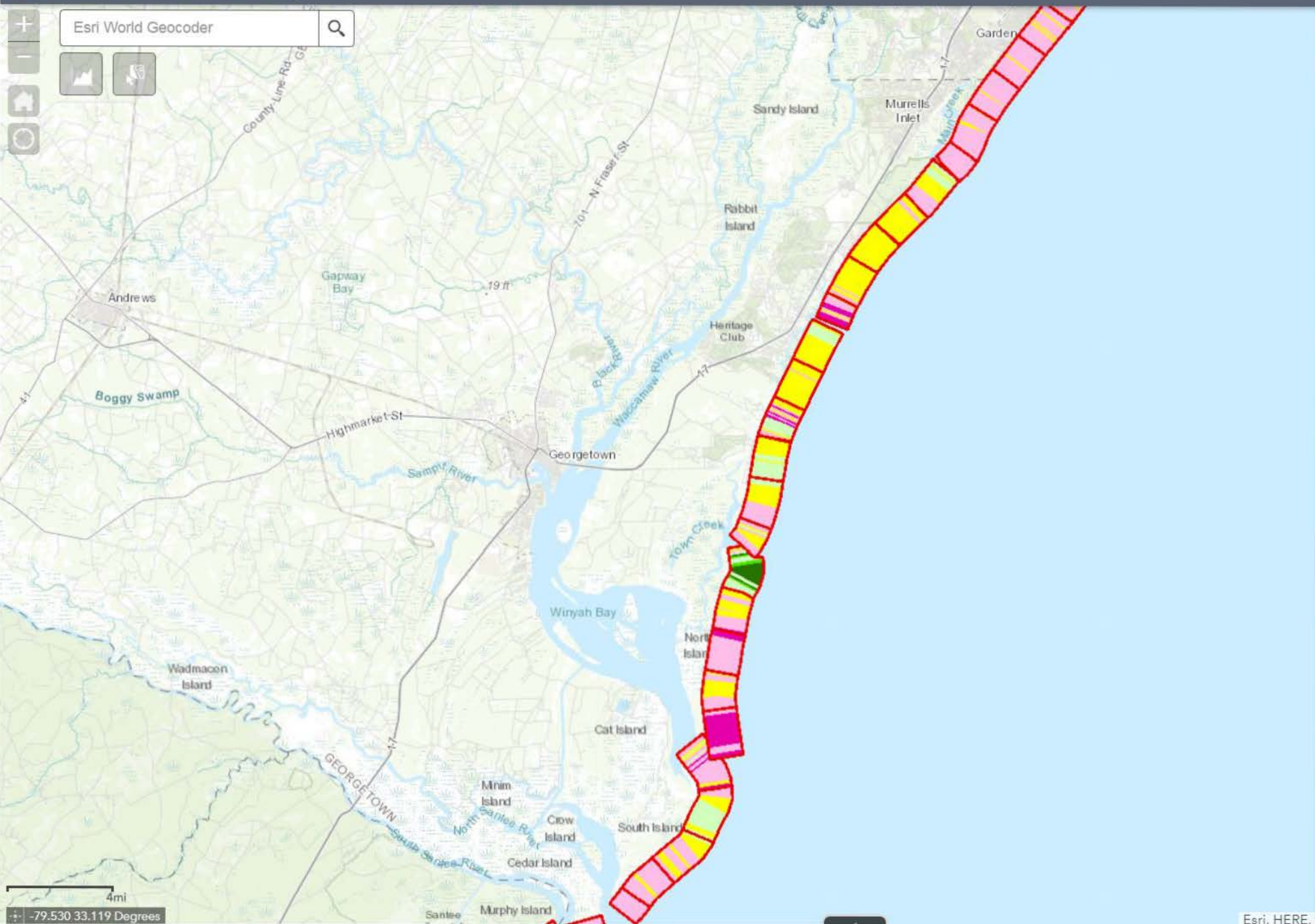
Esri World Geocoder

+

-

Home

Layers



Legend

JALBTCX_NCMP_MapBlocks

Map Blocks

JALBTCX_NCMP_AnalysisSections

Volume Change (cy) Post Matthew

- < -25,000
- 24,999 - -5,000
- 4,999 - 0
- 1 - 5,000
- 5,001 - 25,000
- 25,001 - 50,000
- > 50,000



Map Blocks



Volume Change (cy) Post Matthew

Image

High : 2



Low : -2

SC_37

SC_36

SC_35

North Inlet

Jones Creek

Sixty Bass Cr

Oyster Bay

0.3mi

-79.183 33.297 Degrees

Feri HERE Garmin INCREMI



Legend

JALBTCX_NCMP_MapBlocks

Map Blocks

JALBTCX_NCMP_Elevation_Difference_Grids

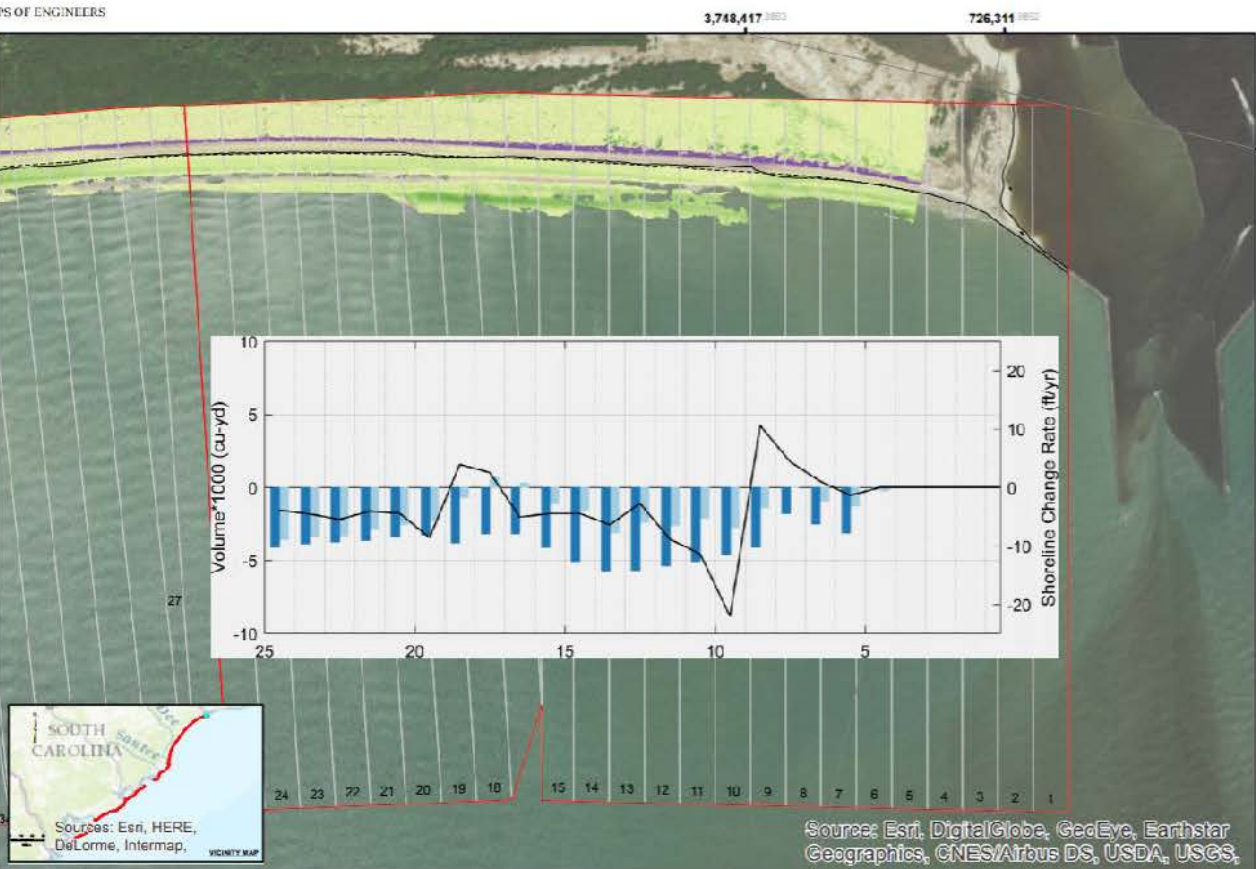
Volume Change (cy) Post Matthew

Image

High : 2

Low : -2

Volume Change (cy) Post Irma													
Map Blocks													
Options Filter by map extent Zoom to Clear selection Refresh													
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Section	Volume Change (cu-yd)	Shoreline Change Rate (ft/yr)	Section	Volume Change (cu-yd)	Shoreline Change Rate (ft/yr)
1	0	0.00	17	328	-3.171
2	0	0.00	18	772	-2.529
3	0	0.00	19	-475	-3.744
4	30	0.00	20	-1,268	-6.62
5	222	0.00	21	-2,632	-7.43
6	-1,261	-1.37	22	-4,893	-9.69
7	914	-2.307	23	-3,303	-5.49
8	-1,806	-4.39	24	-3,318	-5.55
9	-1,370	-1.859	25	-3,681	-5.51
10	-2,720	-4.612			
11	-2,088	-3.970			
12	-2,660	-5.370			
13	-3,300	-6.492			
14	-3,670	-6.727			
15	-1,340	-3.360			
16	-1,111	-4.115			
17	328	-3.171			



The information depicted on this map represents elevation changes along the South Carolina Coast comparing the post-hurricane Matthew with the pre-storm condition.

Volumes included in the table were computed in 300-ft alongshore sections, and are provided in units of cubic yards (cu-yd). Pre- and post-storm shorelines are included on the map as a dashed black line and solid black line, respectively. The bar chart includes the Volume Change (light blue) and MHV Volume Change (dark blue). The Shoreline Change Rate is represented by the black line.

Data Sources: 2014 National Geodetic Survey and 2016 National Coastal Mapping Program bathymetric lidar elevation data from the Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX)

U.S. ARMY
U.S. Army Corps of Engineers
Mobile District

3,748,417
726,311

U.S. ARMY CORPS OF ENGINEERS
Mobile District

South Carolina
Elevation Difference and Volume
Map Number: 1

Sheet Reference Number
1 of 116

Legend

JALBTCX_NCMP_MapBlocks

Map Blocks

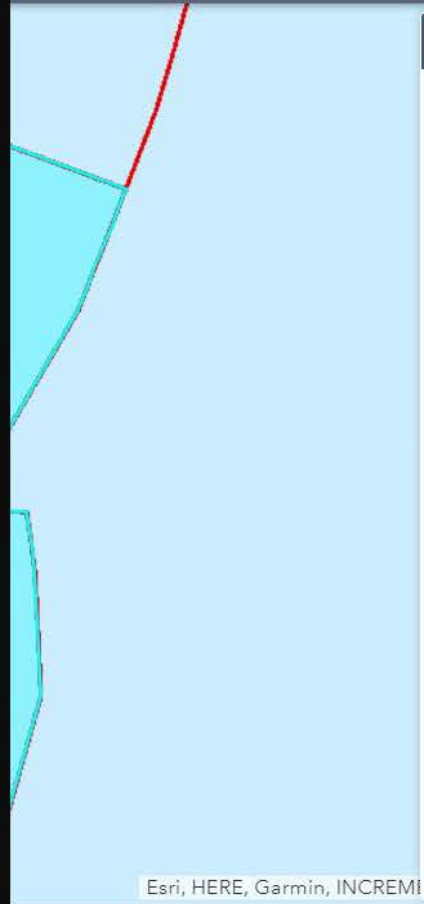
JALBTCX_NCMP_Elevation_Difference_Grids

Volume Change (cy) Post Matthew

Image

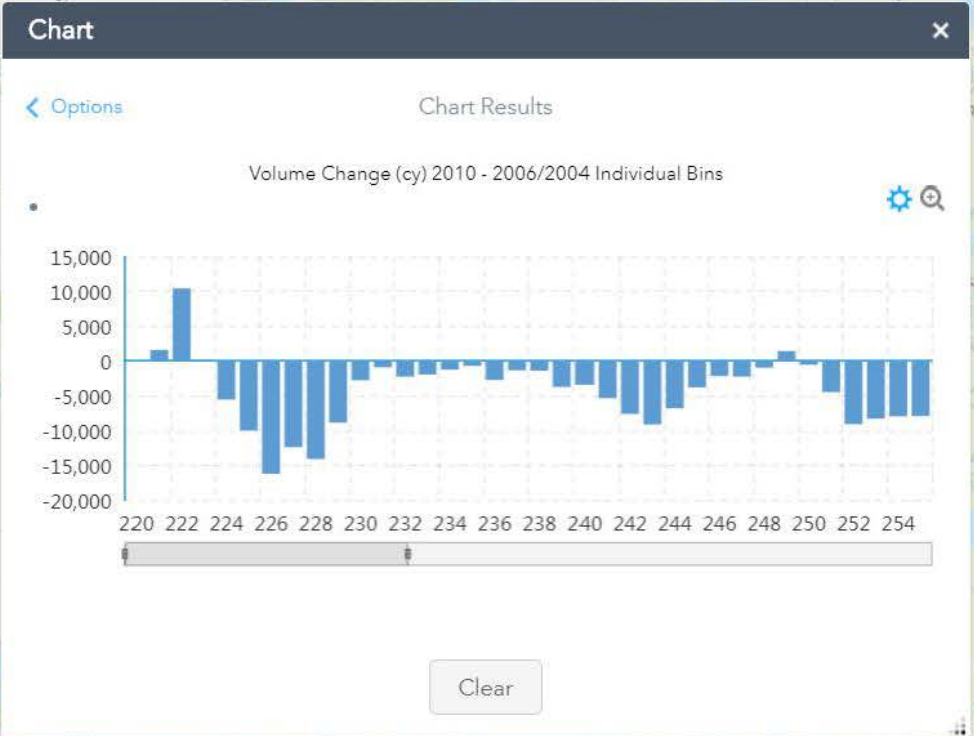
High : 2

Low : -2

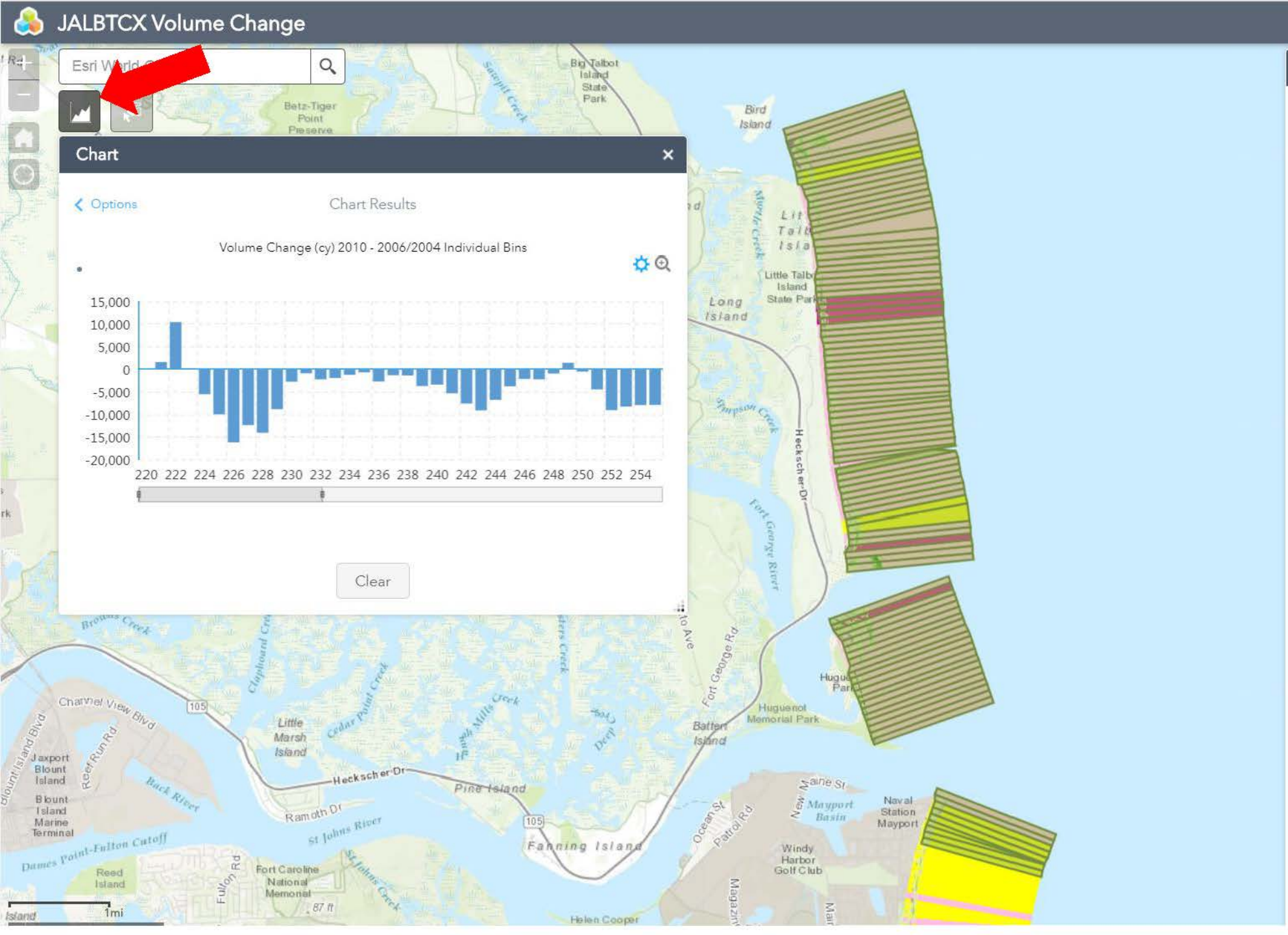


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35	https://cesamusace.m		0.000302293358799	0.070564655348302
36	https://cesamusace.m		0.000486434509184	0.091705185772263
37	https://cesamusace.m		0.000470764368134	0.08573440146814

Esri World Street Map

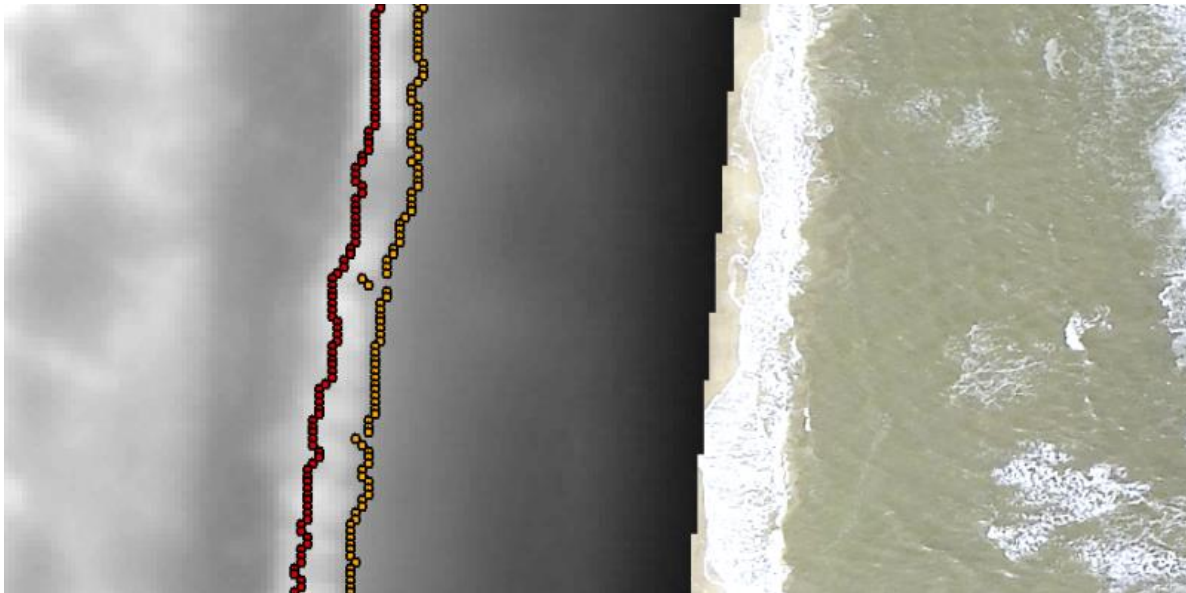
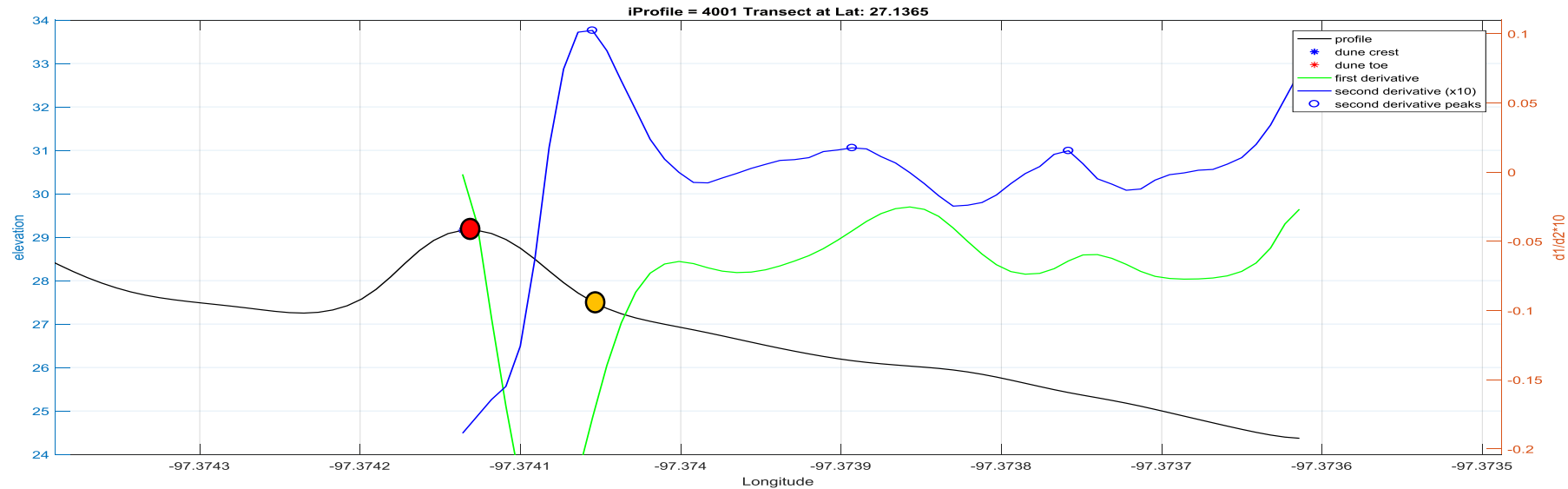


- ### Layer List
- Operational layers
- ☒ Shoreline Change Rate (ft/yr) Post Irma ...
 - ☒ JALBTCX_NCMP_MapBlocks ...
 - ☐ Map Blocks ...
 - ☒ JALBTCX_NCMP_Elevation_Difference_Grids ...
 - ☐ Volume Change (cy) Post Irma ...
 - ☒ Volume Change (cy) Post Matthew ...
 - ☐ Volume Change (cy) 2010- 2006/2004 ...
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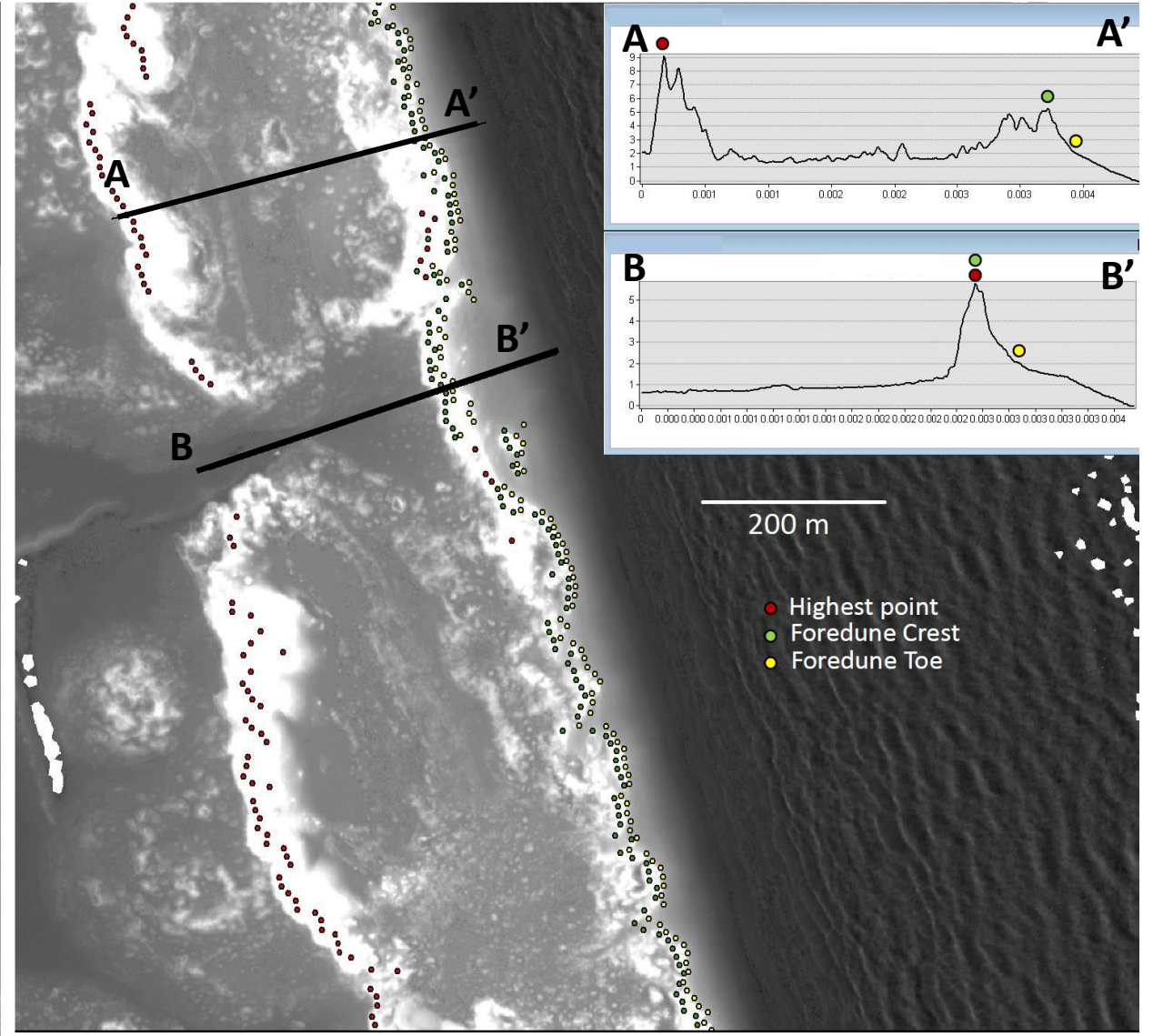


In Development

Automated Feature Detection

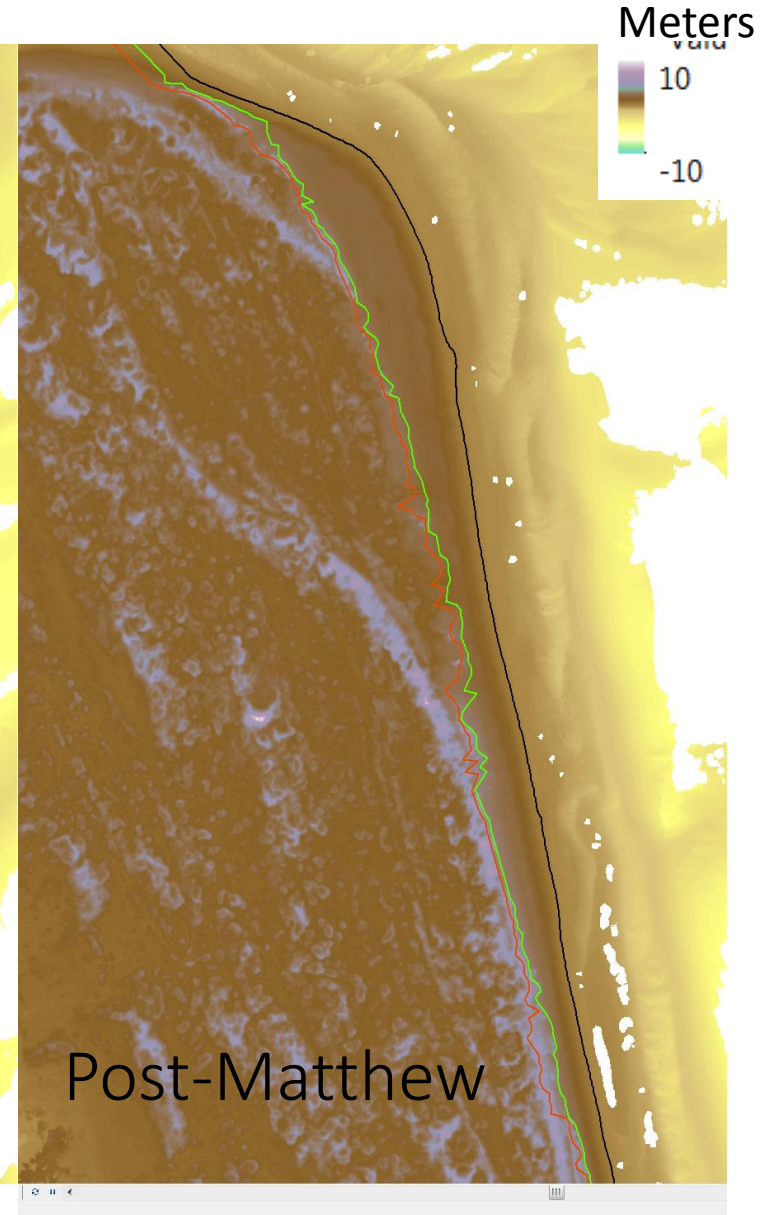
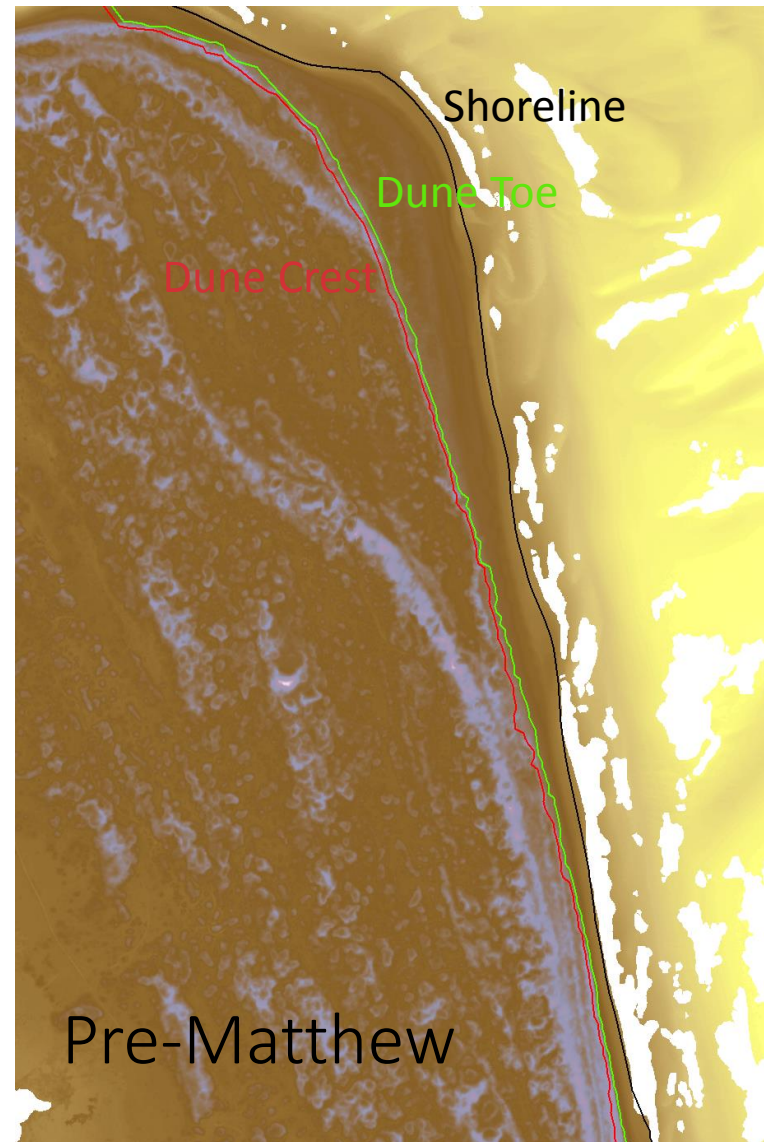
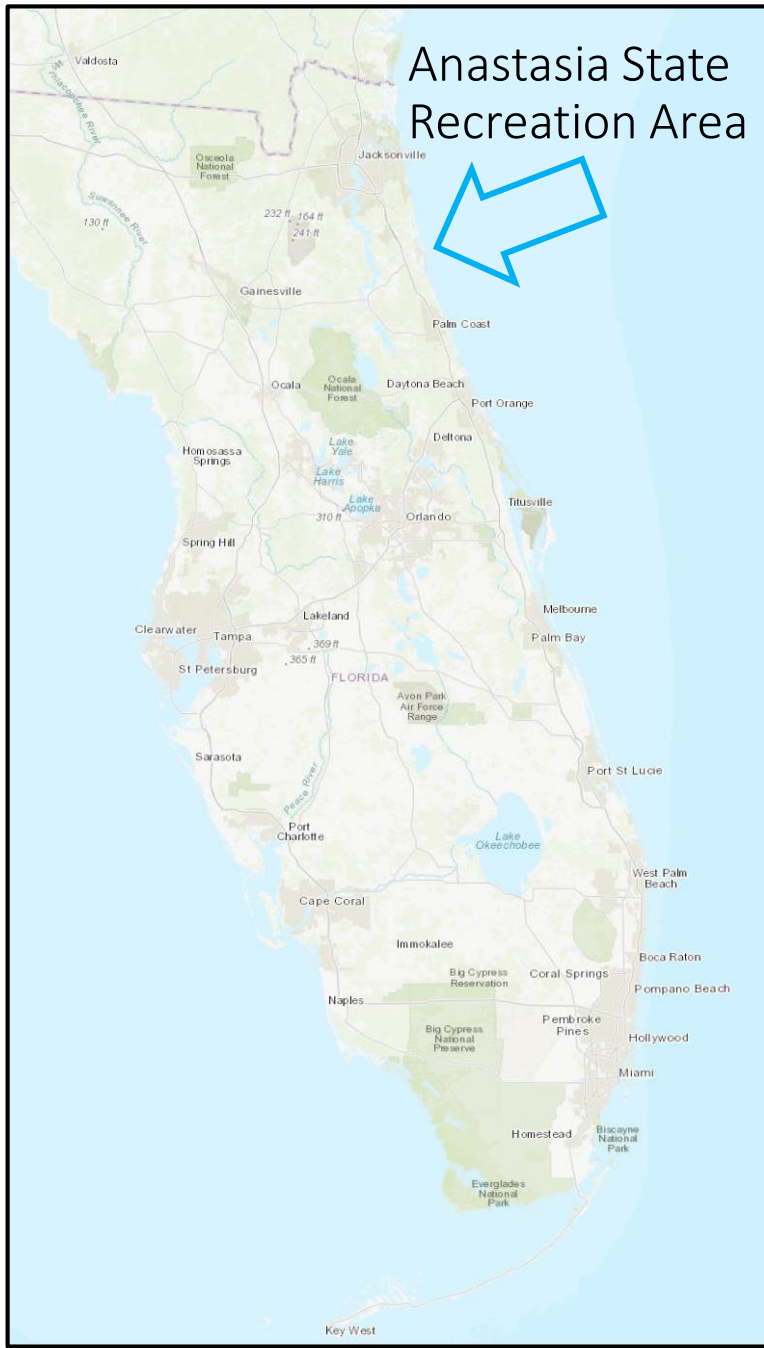


- Coordination with USGS
- Shore-perpendicular transects every 10 m alongshore
- **Dune peak & dune toe** points chosen
- Can be used to extract
 - Dune face slope
 - Dune volume
 - Beach width & slope



Dune Detection

Pre & Post-Matthew



Dune Detection

Pre & Post-Matthew

Anastasia State
Recreation Area



Duneface Slope

Beach Slope

MHW

Beach Width

Meters

10

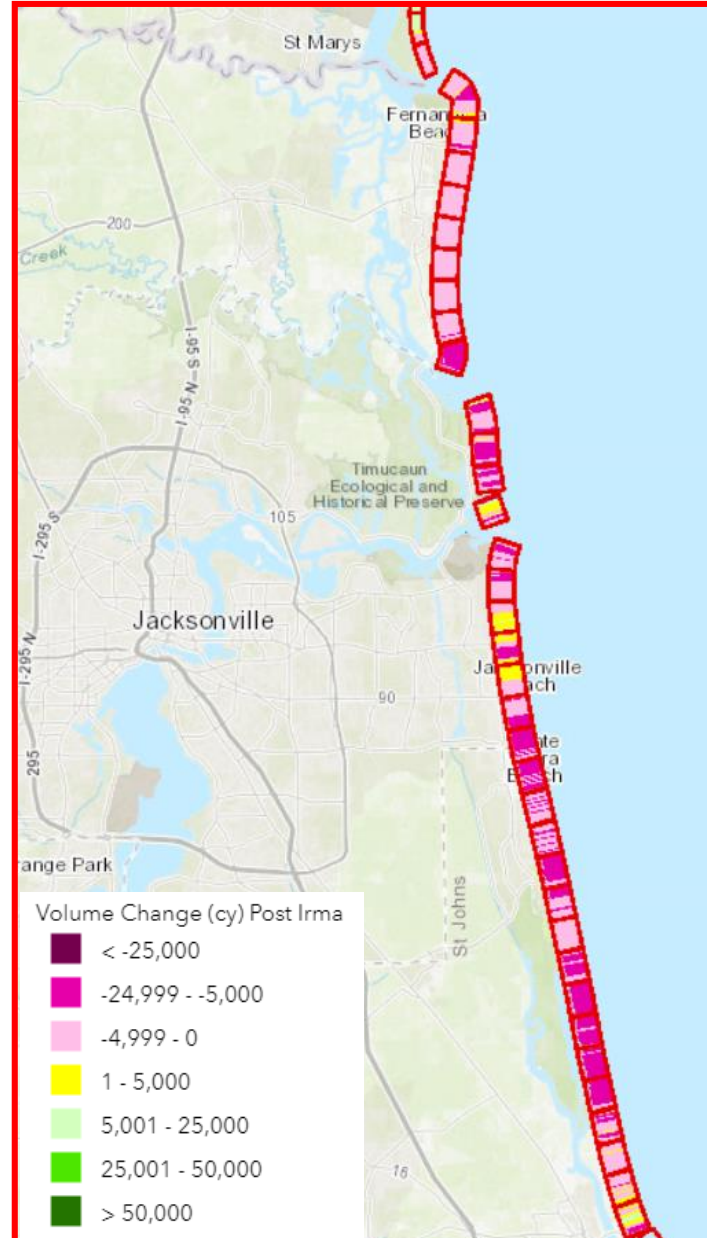
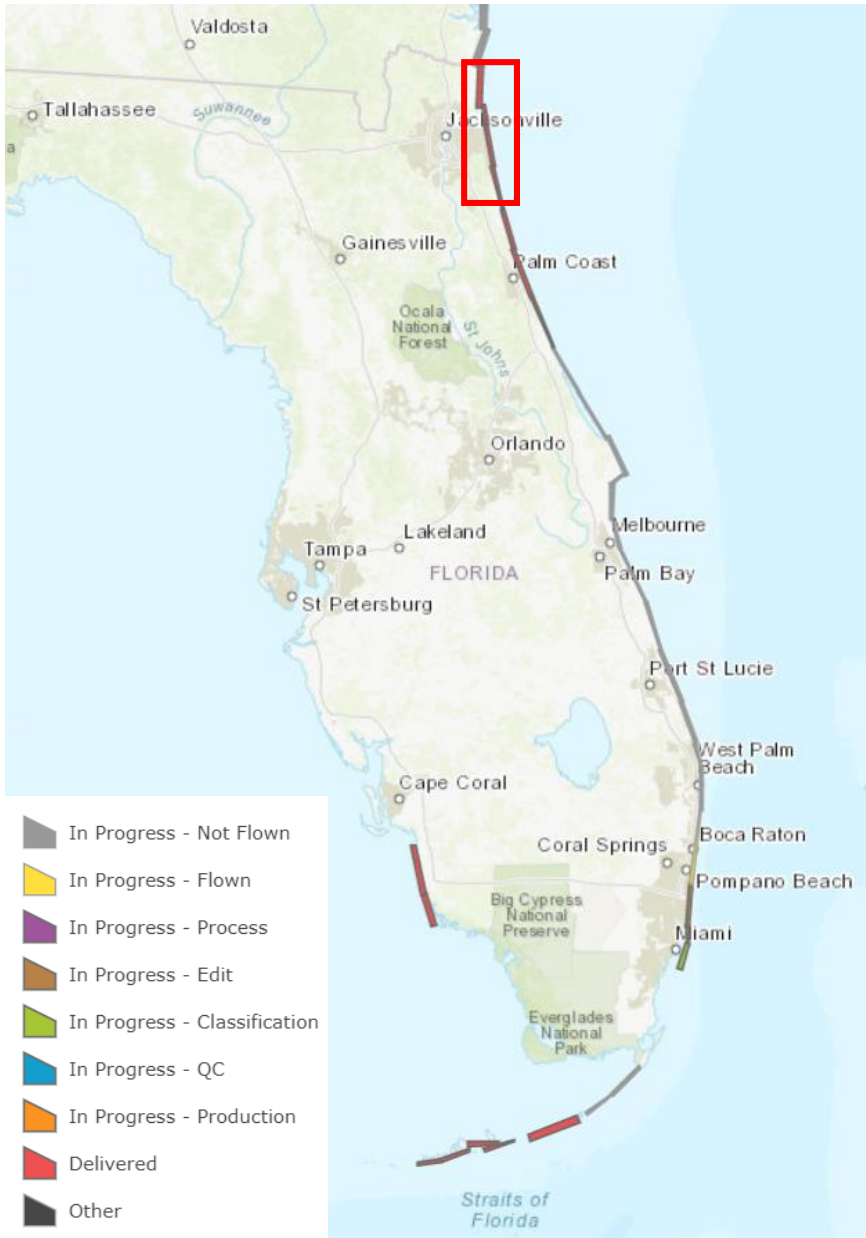
-10

Pre-Matthew

Post-Matthew

Key West

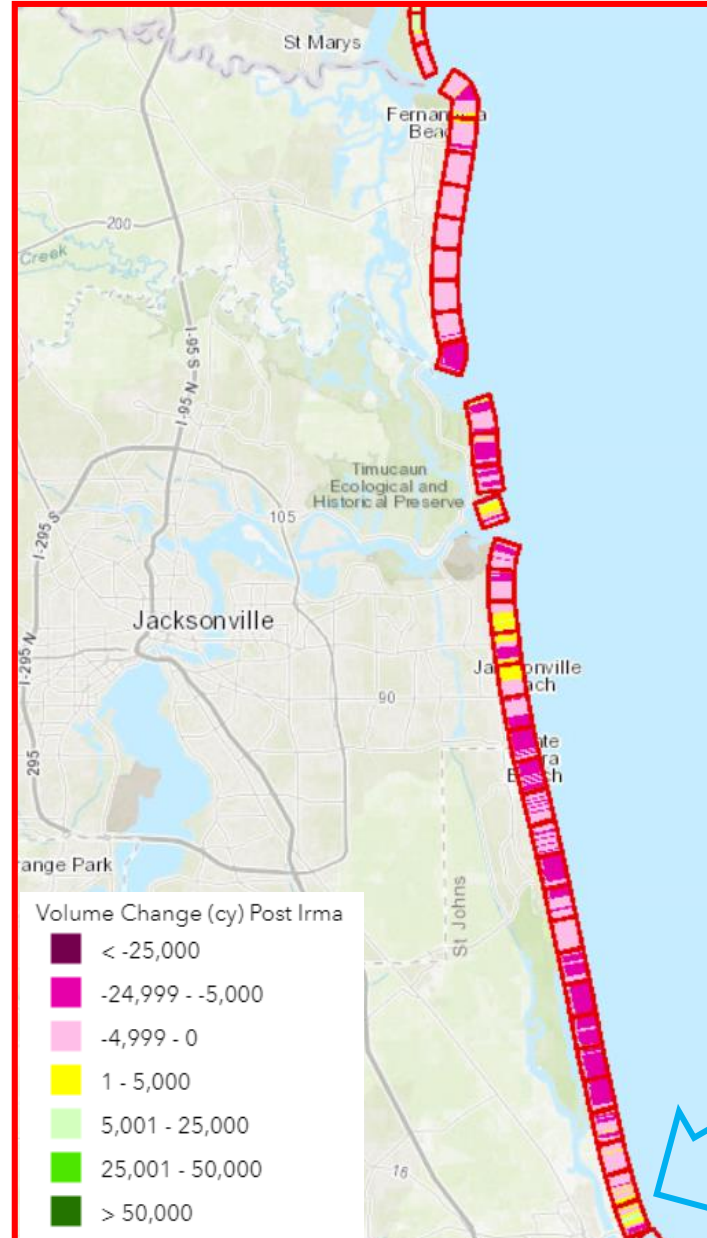
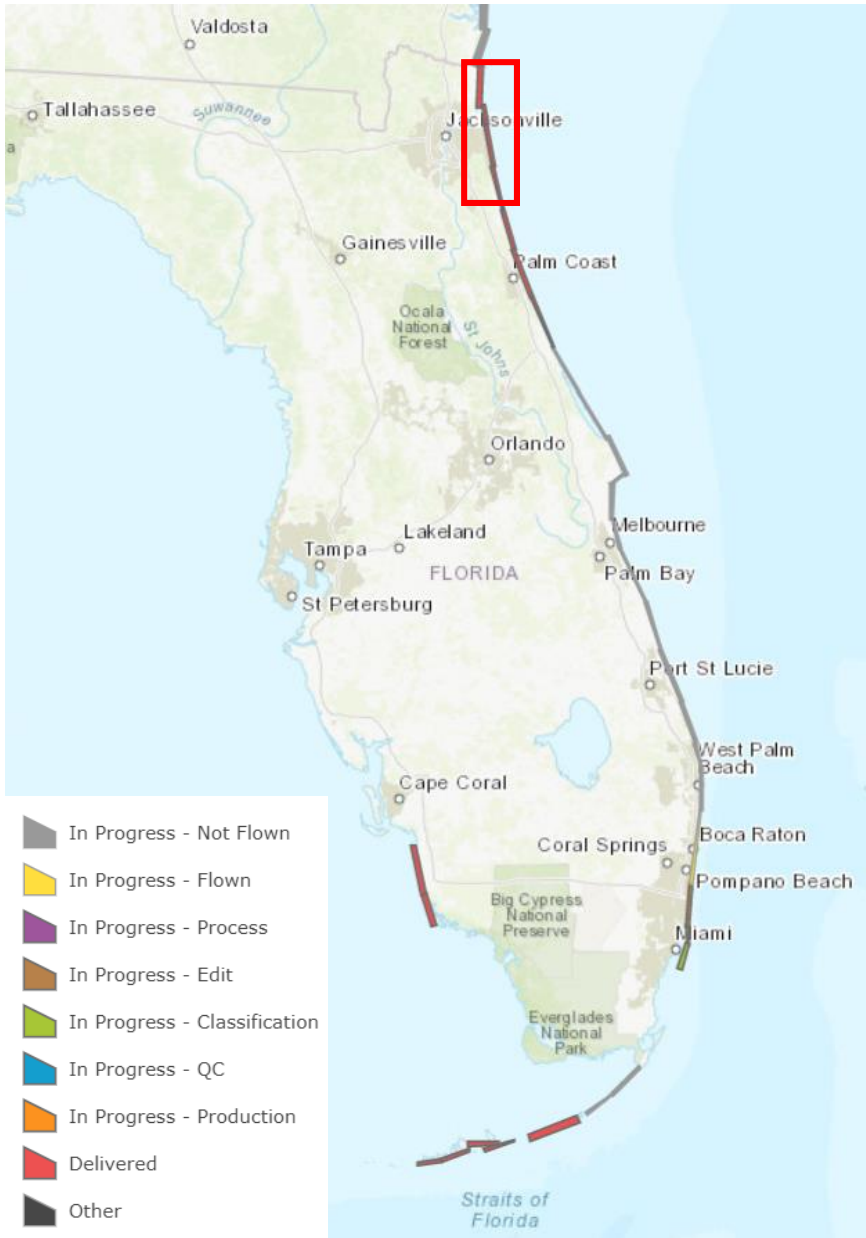
Post-Irma Progress



Beach change metrics available on web app:

<https://usace.maps.arcgis.com/apps/webappviewer/index.html?id=d1ee0da4887046edbc9ff05c66d40708>

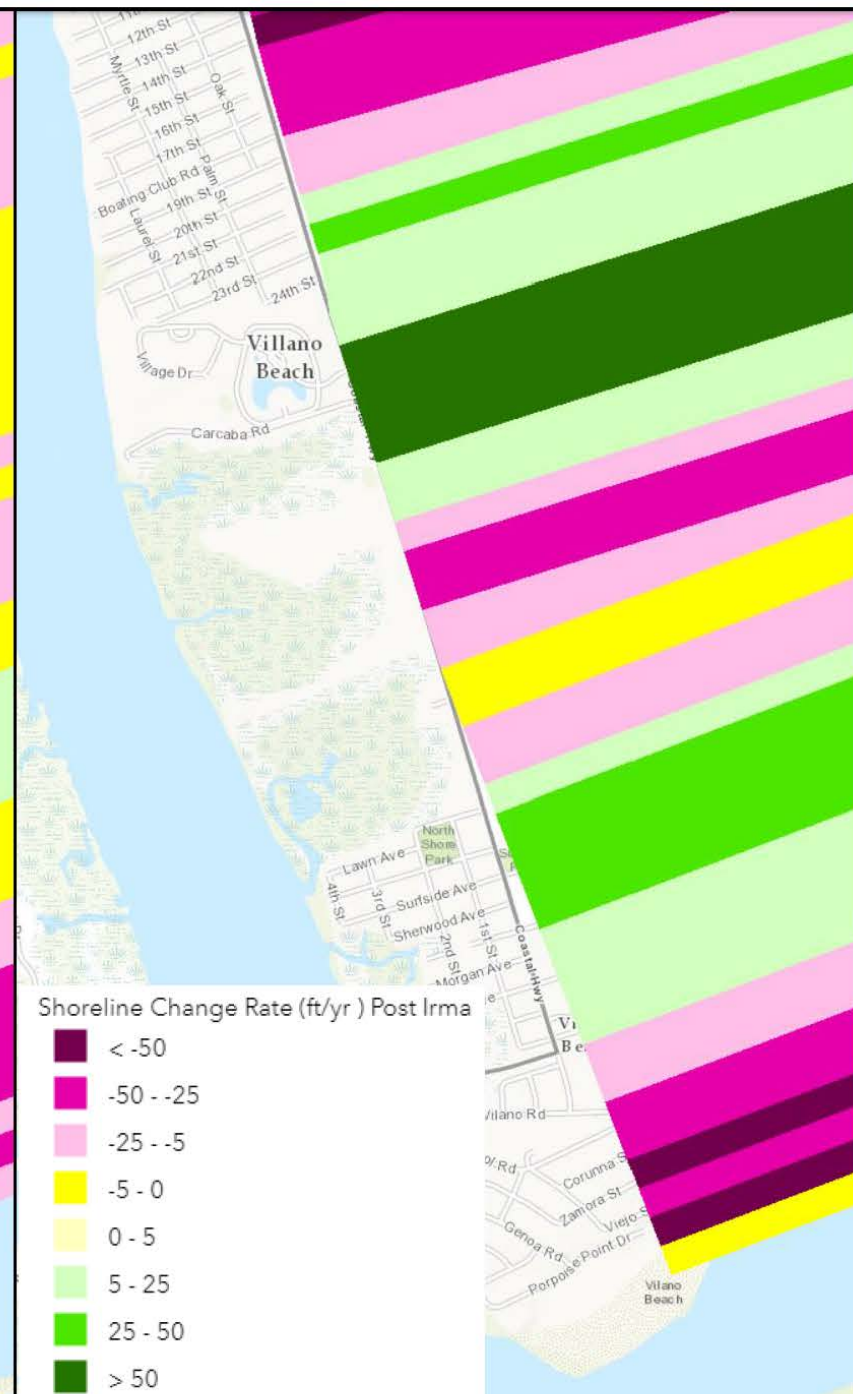
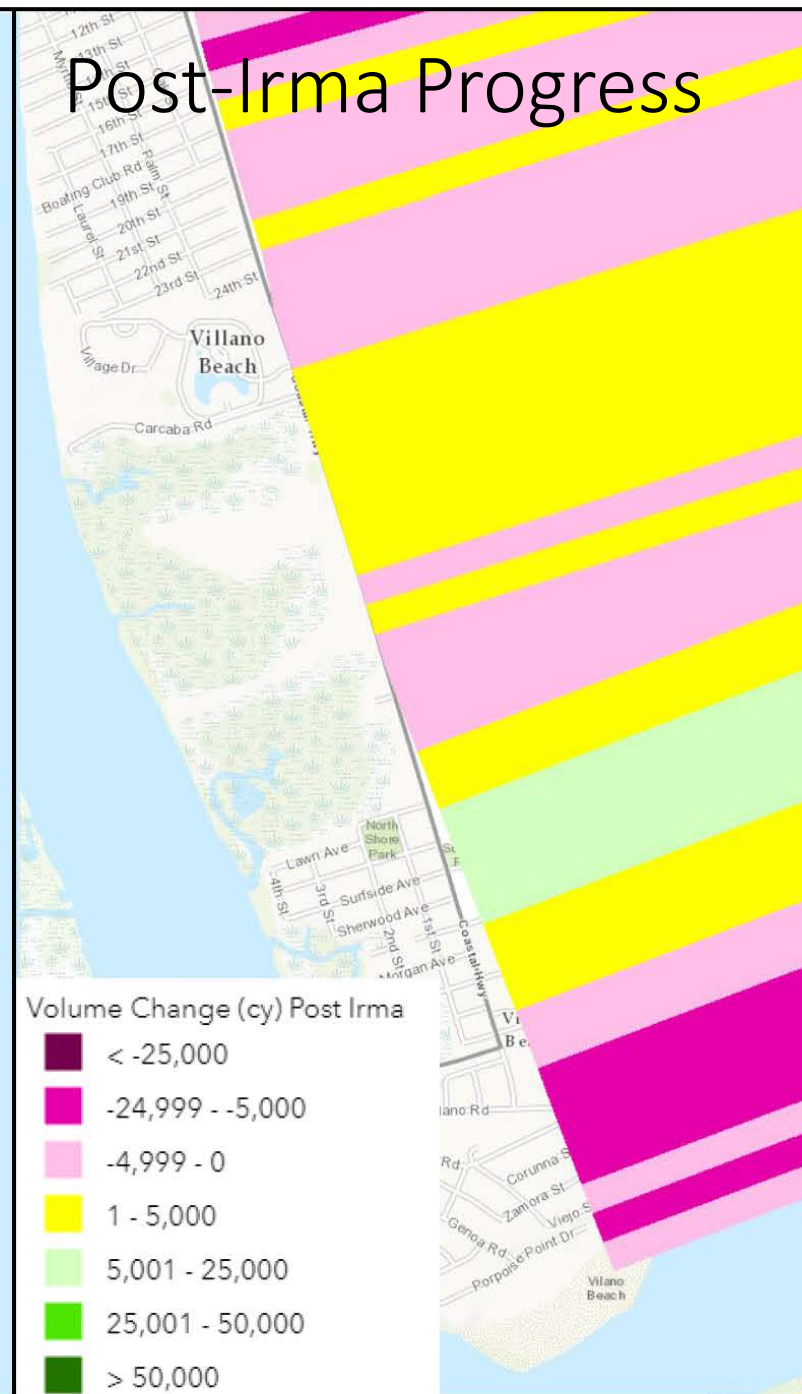
Post-Irma Progress



Beach change metrics available on web app:

<https://usace.maps.arcgis.com/apps/webappviewer/index.html?id=d1ee0da4887046edbc9ff05c66d40708>

Vilano Beach & St. Augustine Inlet

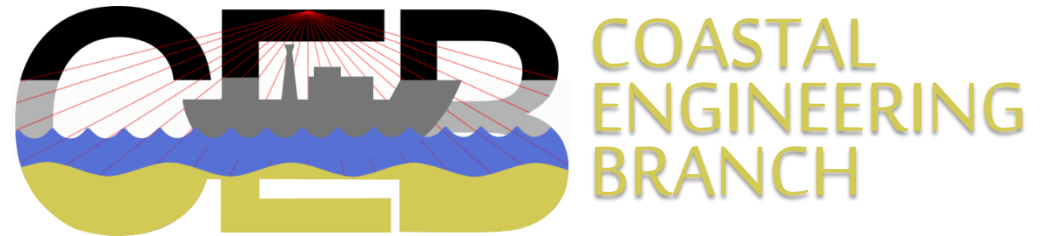


Thank you

Eve Eisemann

Eve.Eisemann@usace.army.mil

228-239-1458



Post-Matthew & Post-Irma Beach Change Metrics Web App:

<https://usace.maps.arcgis.com/apps/webappviewer/index.html?id=d1ee0da4887046edbc9ff05c66d40708>