

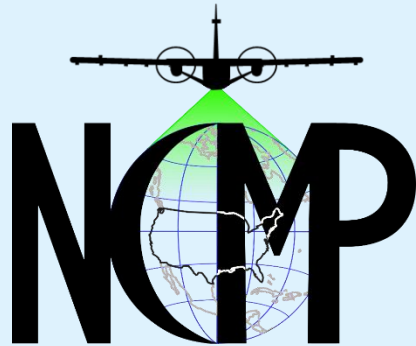


# 36TH INTERNATIONAL CONFERENCE ON COASTAL ENGINEERING 2018

Baltimore, Maryland | July 30 – August 3, 2018

*The State of the Art and Science of Coastal Engineering*

## Post-Hurricane Coastal Mapping and Change Analysis: the National Coastal Mapping Program

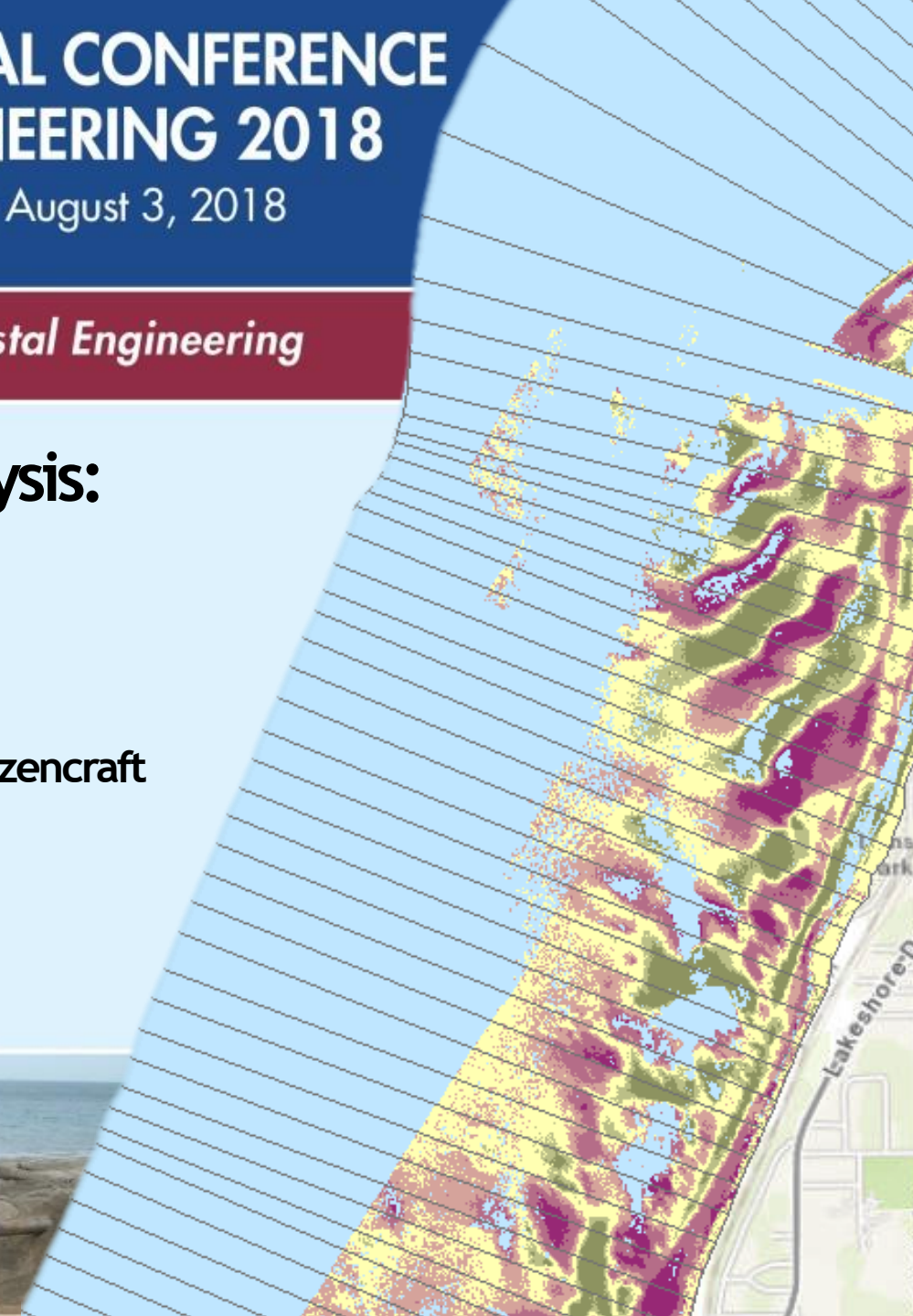


Eve Eisemann

Lauren Dunkin, Michael Hartman, Jennifer Wozencraft

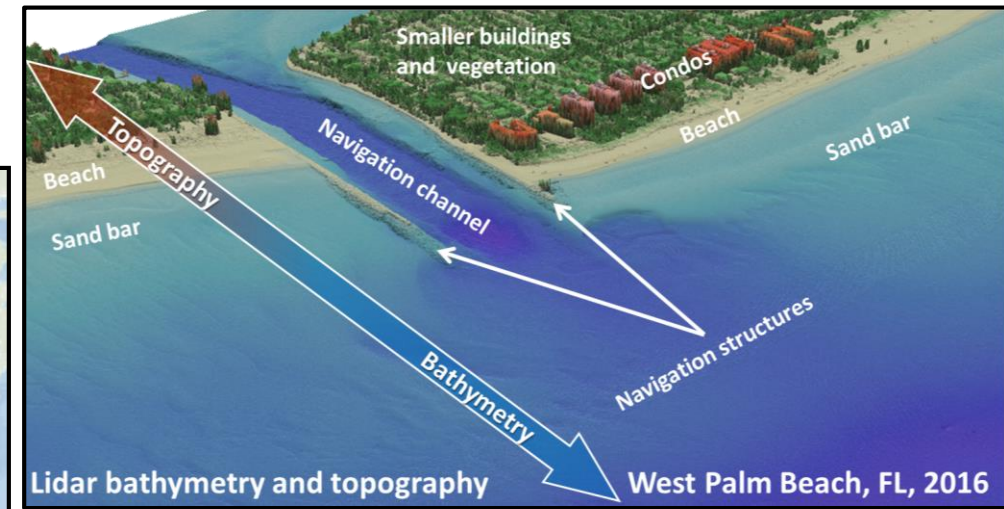
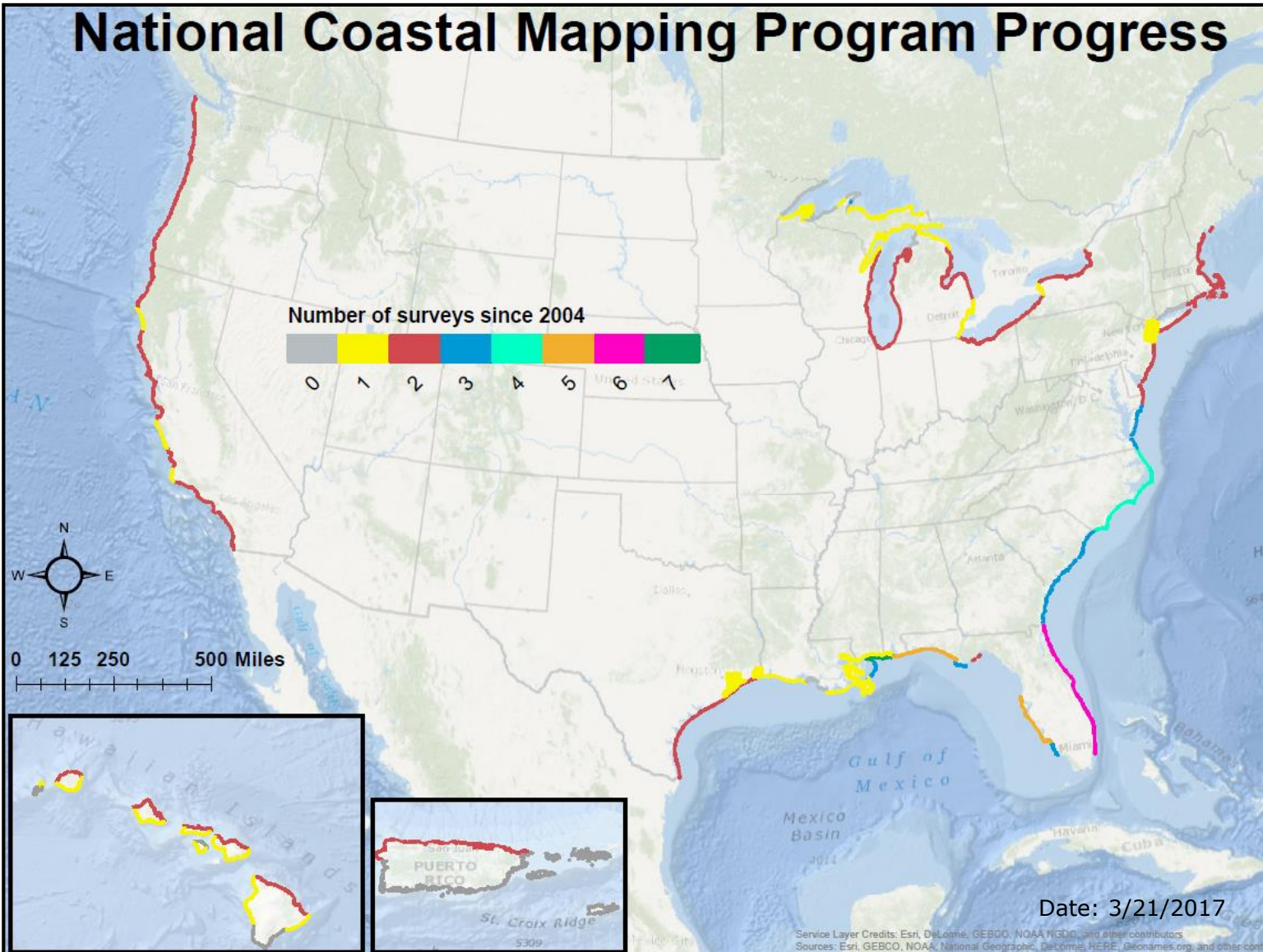
*U.S. Army Engineer Research and Development Center*

*Coastal & Hydraulics Laboratory*



# the USACE NCMP

## National Coastal Mapping Program Progress



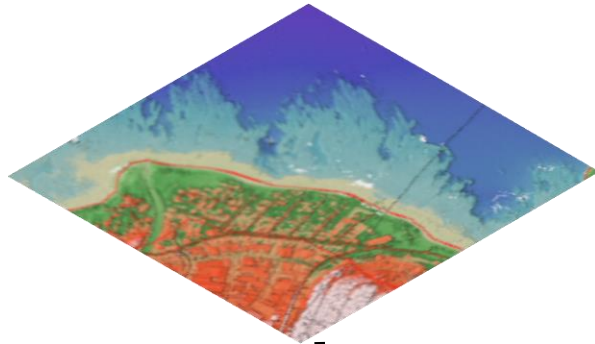
- Executed by the JALBTCX (*Joint Airborne Lidar Bathymetry TCX*)
- Mapping U.S. coastal regions on a 5-year cycle
- Collected over 2500 square miles of coastal lidar data and imagery in TX, MS, AL, and FL in 2016



# NCMP Standard Metrics & Parameters

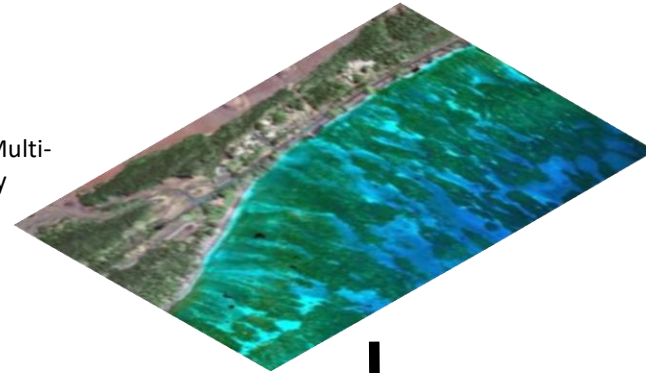
## Elevation

Shorelines & shoreline change  
Elevation & volume changes



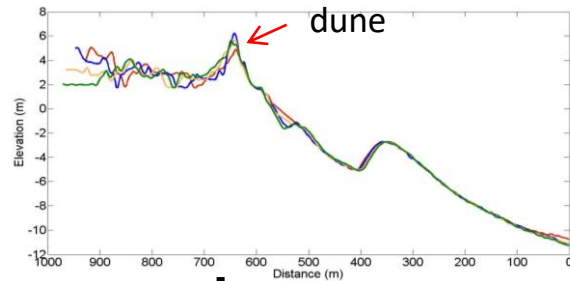
## Imagery

Hyperspectral and Multi-Spectral Imagery



## Dune

Elevation (crest/toe)  
Continuity  
Slope  
Volume

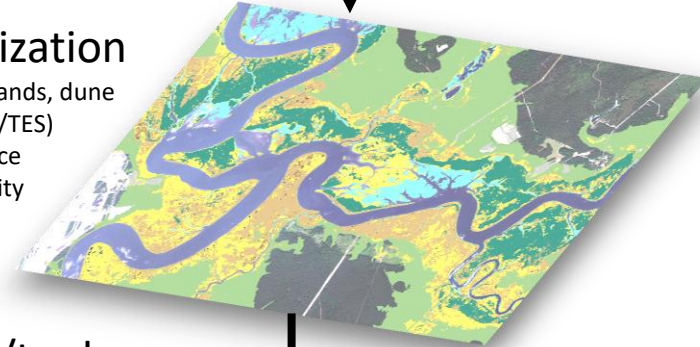


## Beach

Width  
Slope

## Land characterization

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



R&D/Value added products/tools

- Change Detection
- Landscape change modeling
- Volume/elevation/shoreline change
- Structure assessment
- Sediment Budgets
- Monitoring Shore Protection
- Defining Coastal Regions

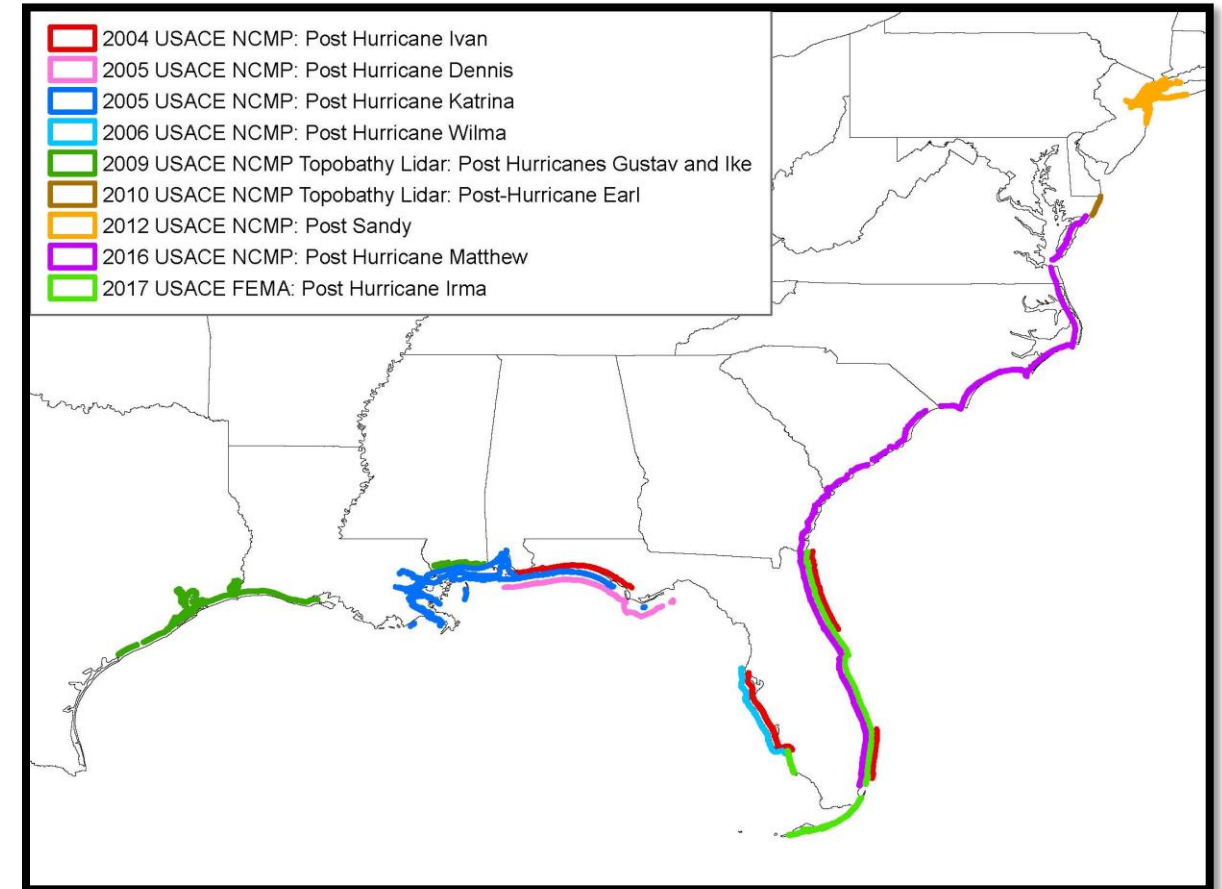
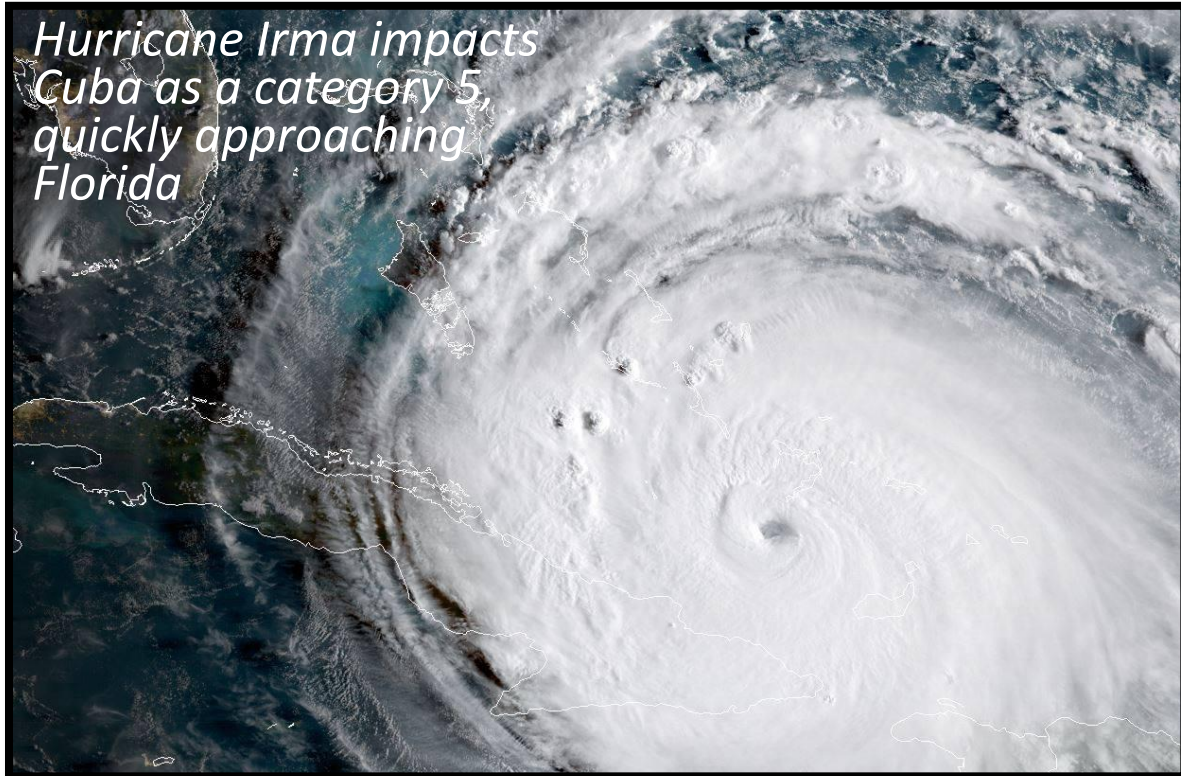
- Coastal Engineering Index
- Coastal Resilience
- Critical Species Detection and Modeling
  - Sea turtle nesting habitat
  - Oysters\*
  - Salmonid

\* ECO-PCX model certification



# Why Regional Post-Hurricane Surveys?

- Determine extent of structure damage
- Assess effects on navigation channels
- Understand impact on both regional and local scales
- Provide a baseline for success of recovery operations
- Prepare for the next storm

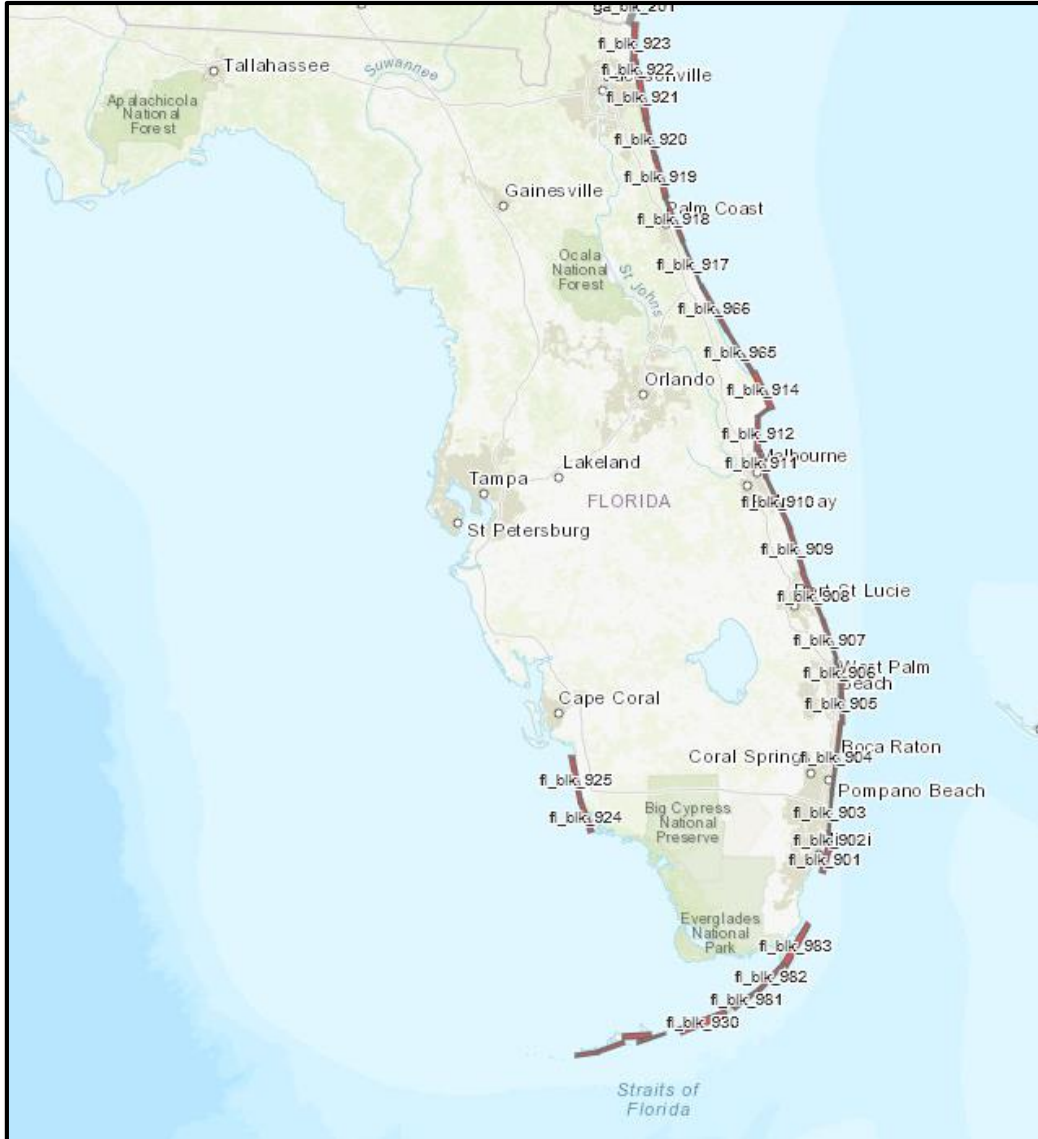


# 2016 Post-Matthew Operations



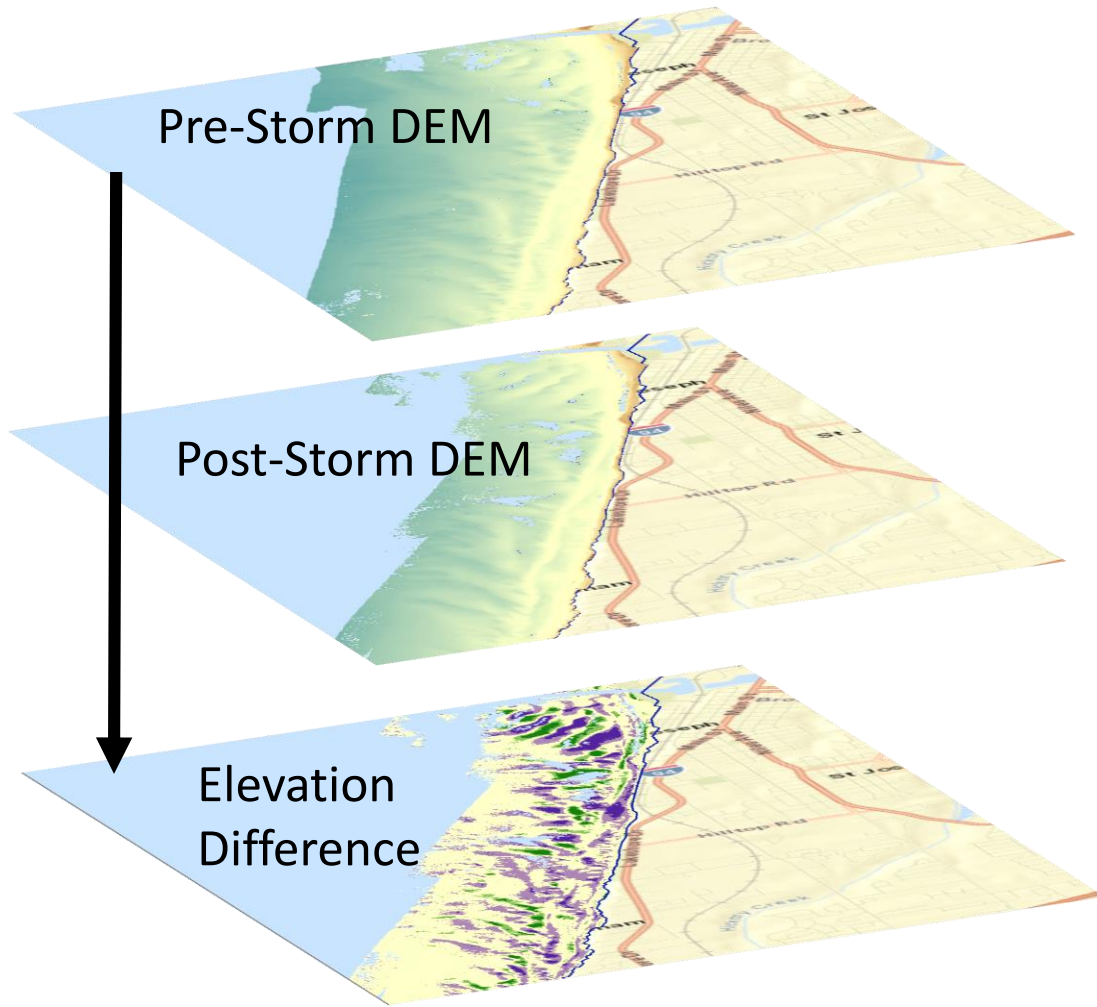
- **Key Biscayne, FL to VA-MD Border**
- District/Division support
- Rapid-response data product deliveries
- Advanced lidar products for emergency response
- Dual aircraft operations
- 991 flight lines
- Surveyed 27 Oct – 2 Dec
- 4 ground-truth teams (USGS)
- 24-hr field office

# 2017 Post-Irma Operations

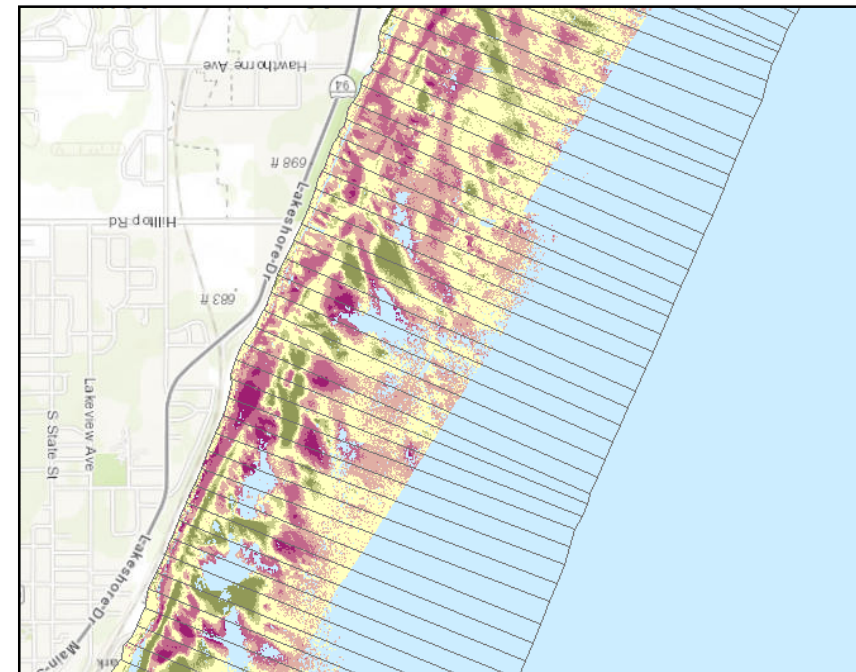


- **Key West to FL-GA Border**
- FEMA support
- Rapid-response data product deliveries
- Advanced lidar products for emergency response
- Surveyed 20 Sept – 27 Oct
- Entire east coast of Florida, Keys & Collier County

# Deriving Emergency Response Data Products



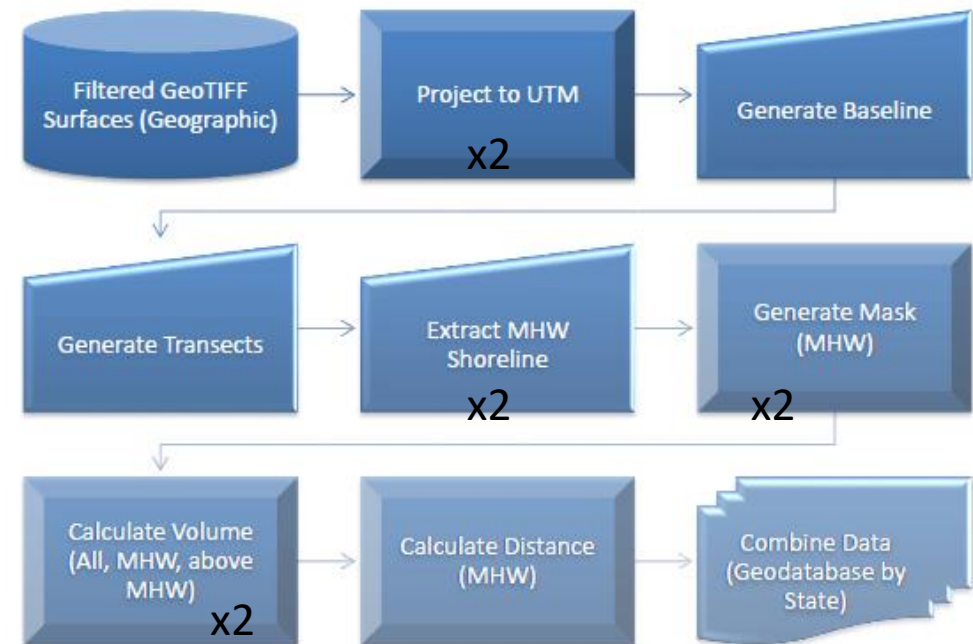
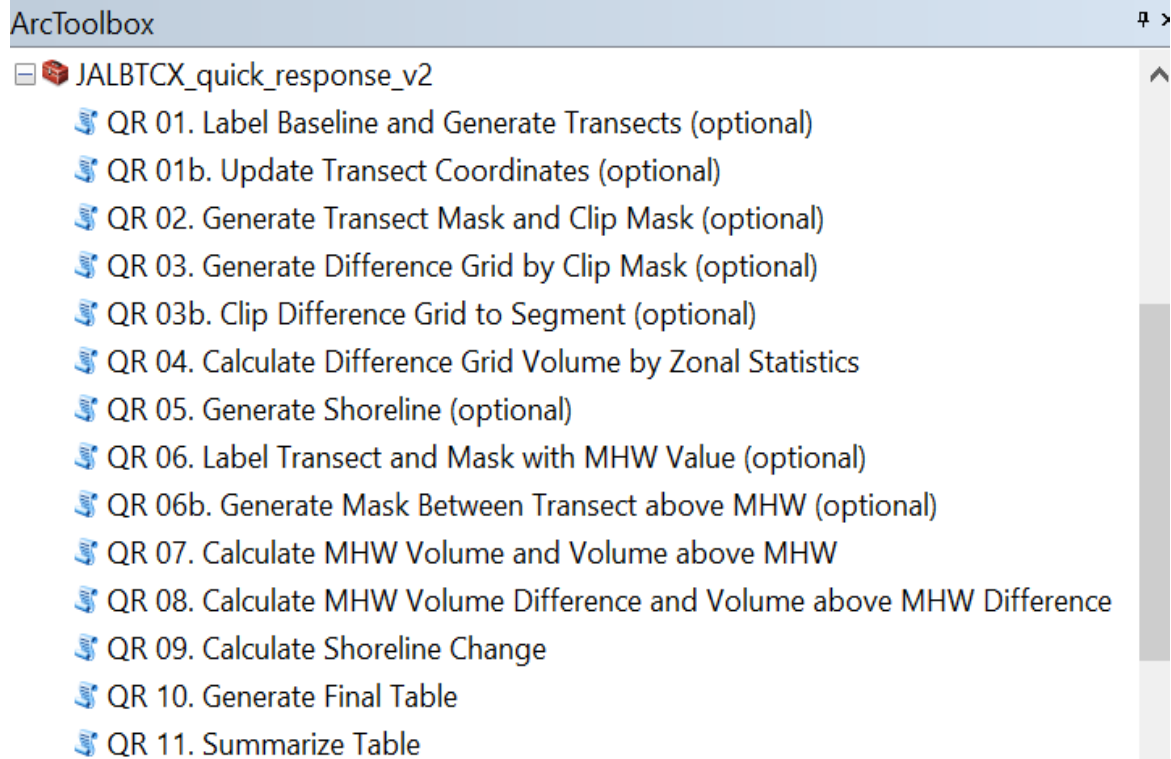
- JALBTCX\_quick\_response\_v2.tbx
  - QR 01. Label Baseline and Generate Transects (optional)
  - QR 01b. Update Transect Coordinates (optional)
  - QR 02. Generate Transect Mask and Clip Mask (optional)
  - QR 03. Generate Difference Grid by Clip Mask (optional)
  - QR 03b. Clip Difference Grid to Segment (optional)
  - QR 04. Calculate Difference Grid Volume by Zonal Statistics
  - QR 05. Generate Shoreline (optional)
  - QR 06. Label Transect and Mask with MHW Value (optional)
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  - QR 08. Calculate MHW Volume Difference and Volume above MHW Difference
  - QR 09. Calculate Shoreline Change
  - QR 10. Generate Final Table
  - QR 11. Summarize Table



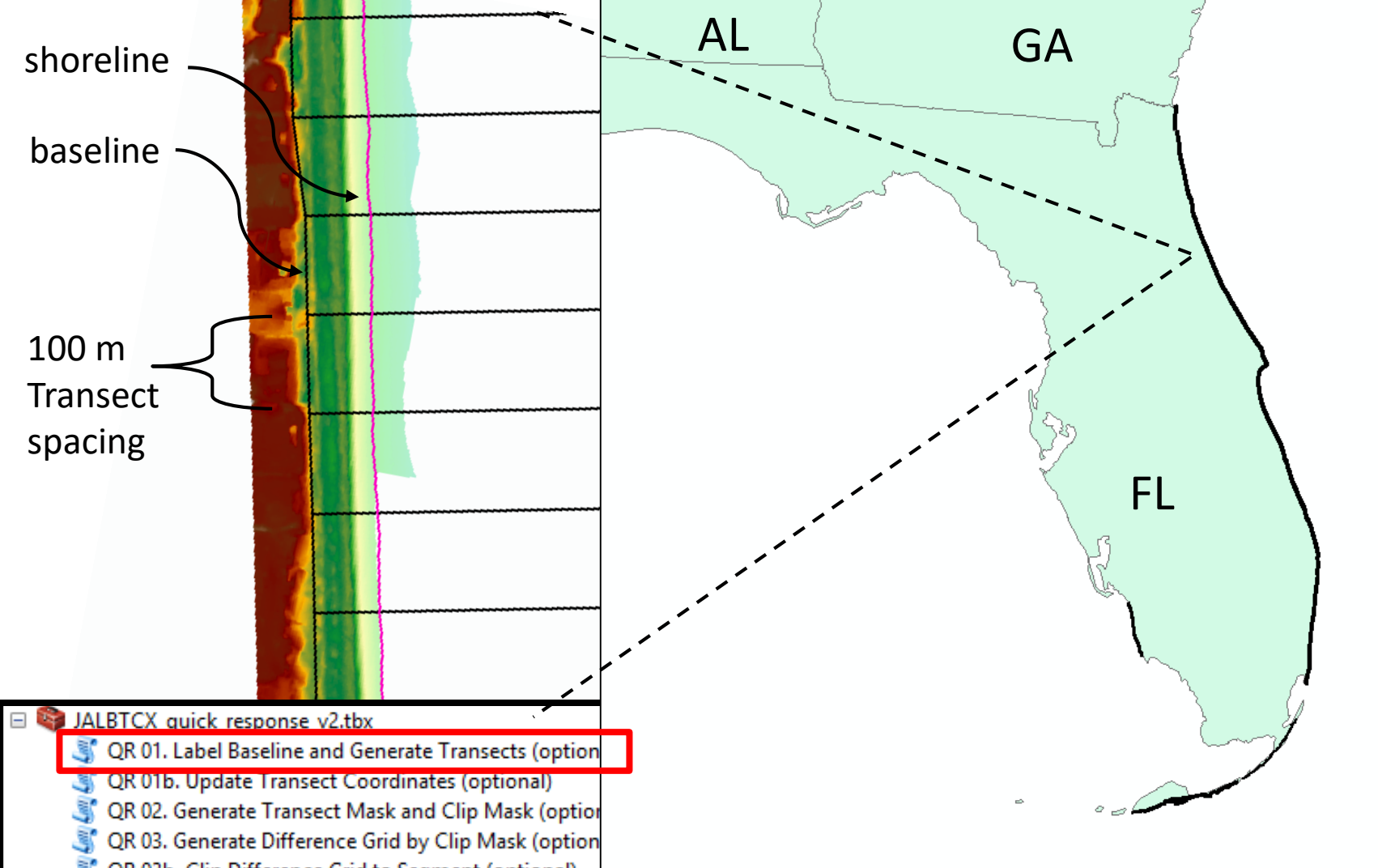
# JALBTCX Volume Change Toolbox

## Quick Response Updates & Improvements

- Overall reduction in runtime
- Code Improvements
  - E.g. Clipping each bin vs Zonal Statistics → Additional 50% Speed Up

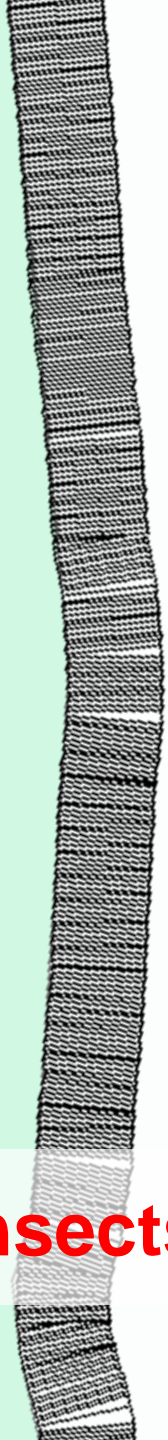


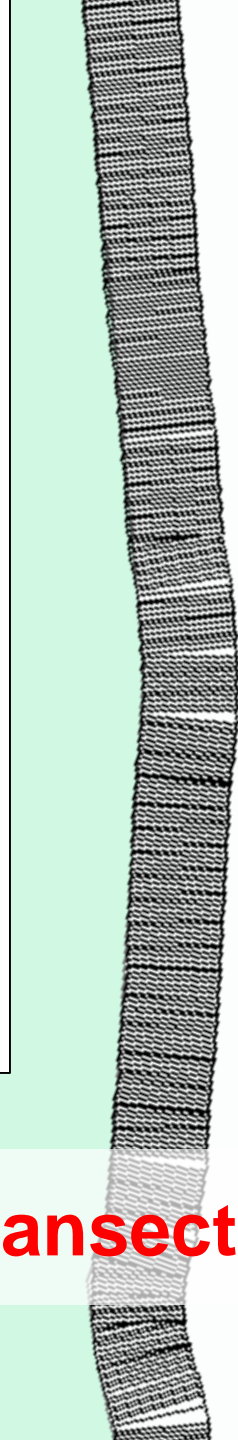
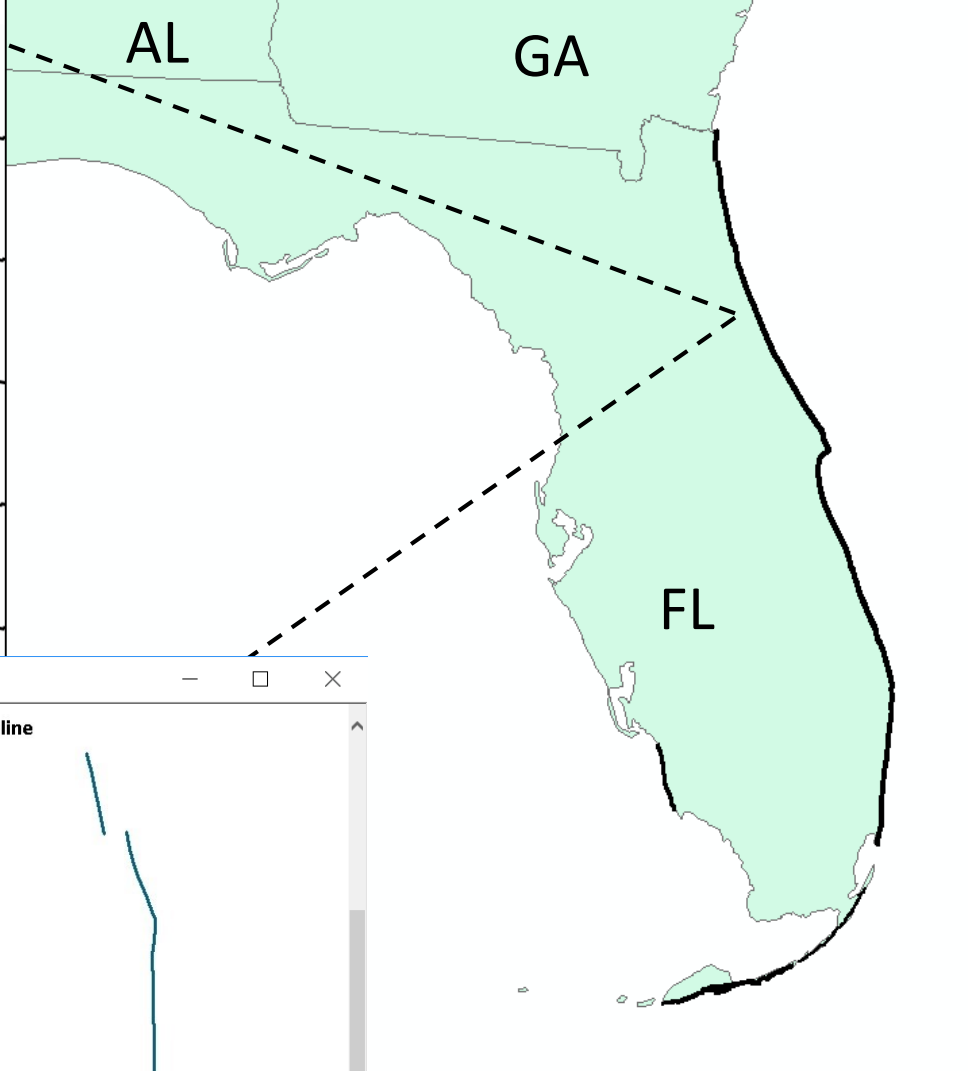
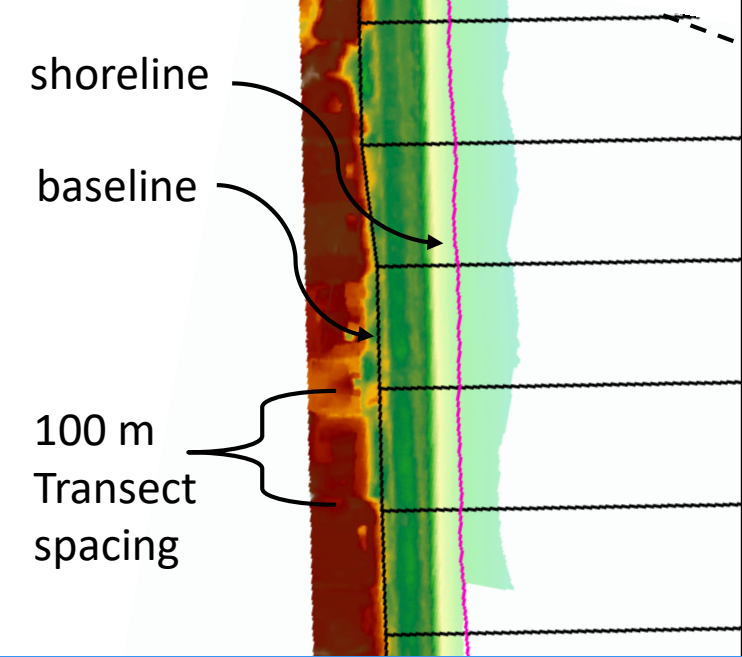




- JALBTCX quick response v2.tbx
- QR 01. Label Baseline and Generate Transects (optional)
- QR 01b. Update Transect Coordinates (optional)
- QR 02. Generate Transect Mask and Clip Mask (optional)
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- QR 09. Calculate Shoreline Change
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# Baseline, Transects & Bins





QR 01. Label Baseline and Generate Transects (optional)

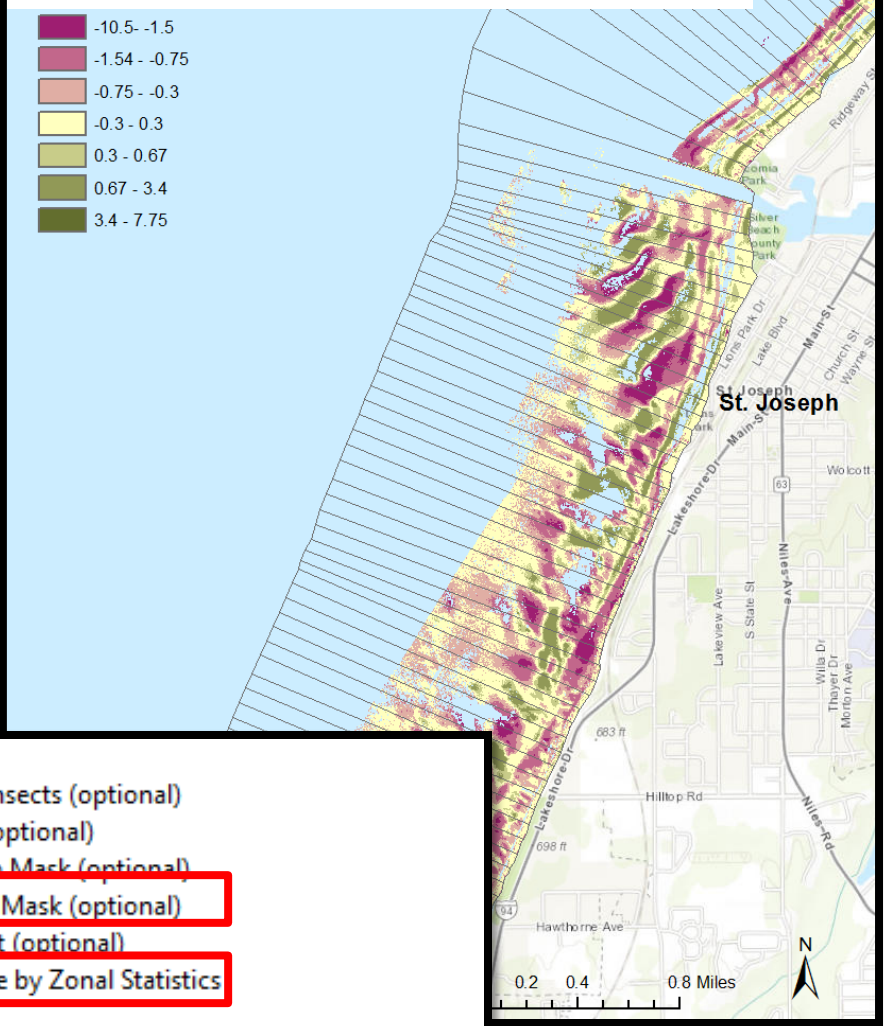
- workspace (GDB required)
- Baseline\_feature\_input
- Column Number in Input Baseline as Label: 1
- State Name
- Revision Number of Baseline (type '1' for first time revision)
- Transect interval: 100
- Transect length: 2000
- Transect length unit: METERS
- Which side of baseline to generate transect?: Right
- Trim Intersecting lines with baseline?: YES
- Transect Revision Number (type "1" for first revision)

Input: Baseline

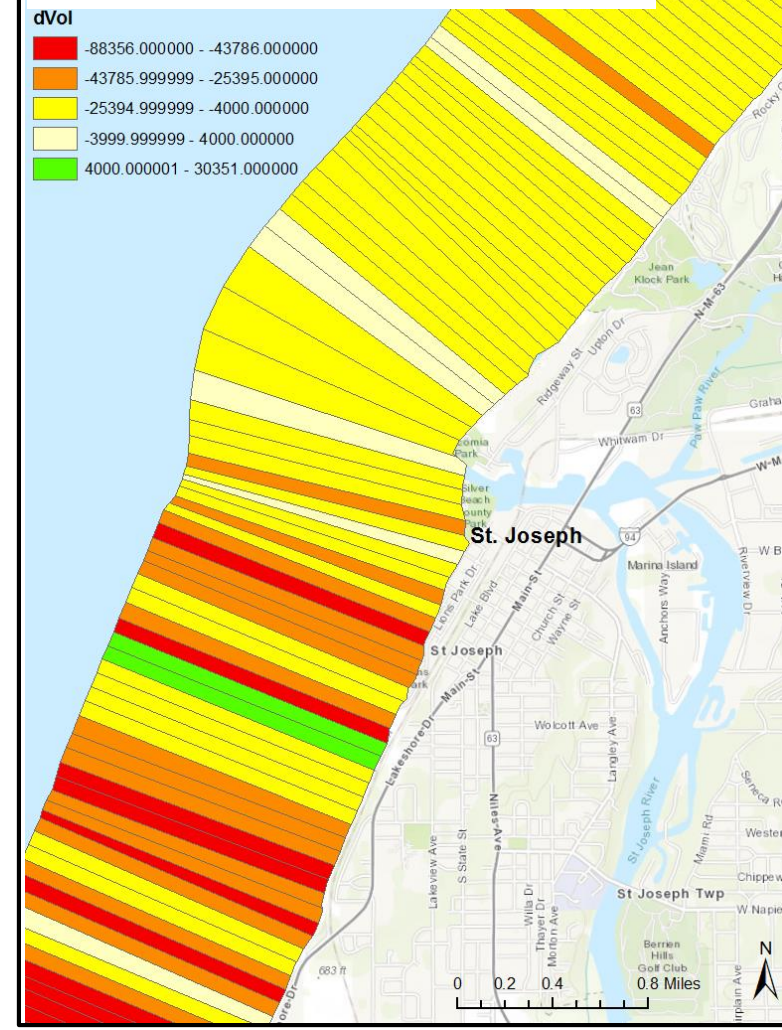
Output: Transects on either side

# Baseline, Transects & Bins

Meters of Change 2008-2012



Total Volume Change 2008-2012



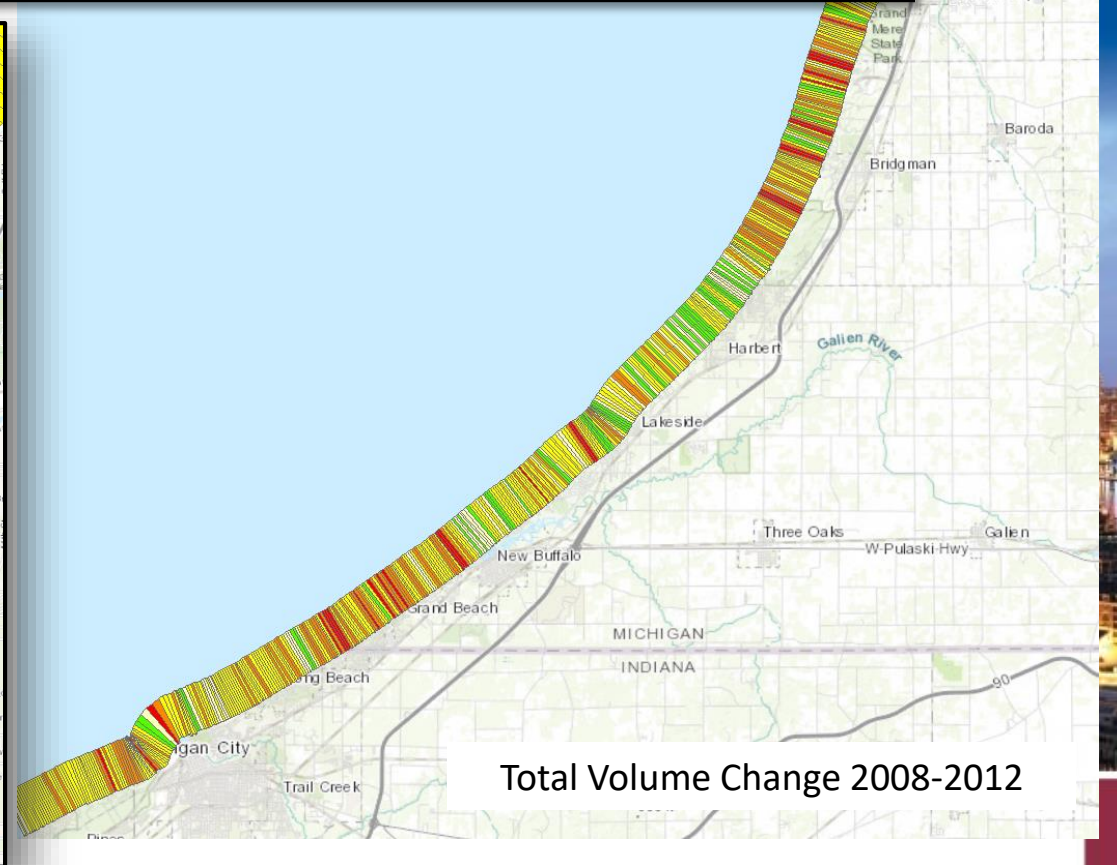
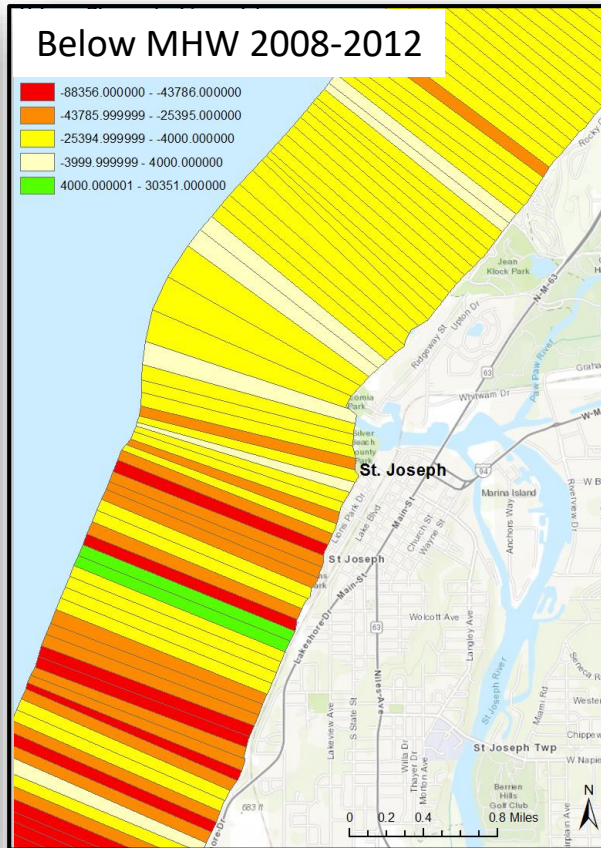
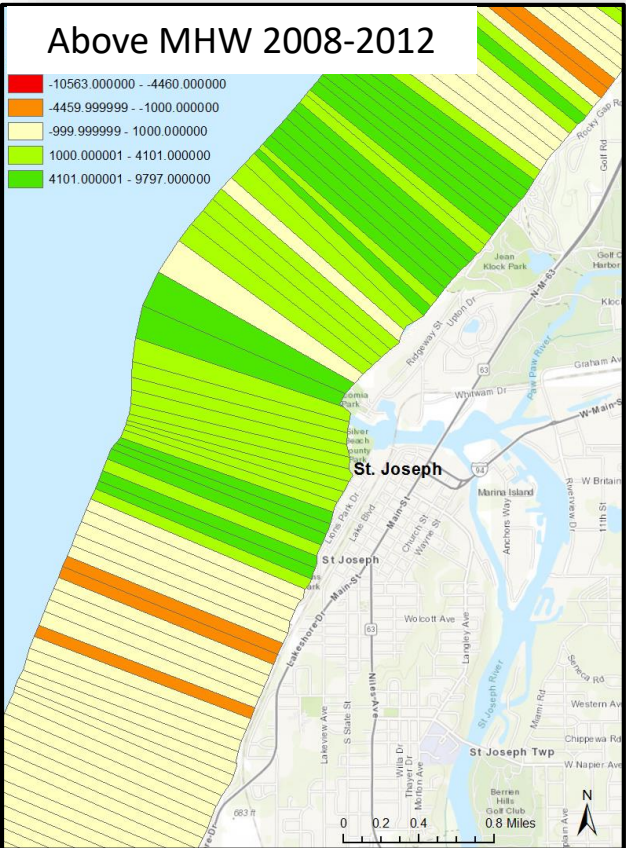
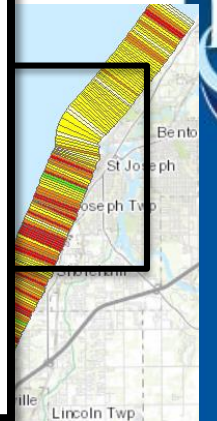
- JALBTCX\_quick\_response\_v2.tbx
- QR 01. Label Baseline and Generate Transects (optional)
  - QR 01b. Update Transect Coordinates (optional)
  - QR 02. Generate Transect Mask and Clip Mask (optional)
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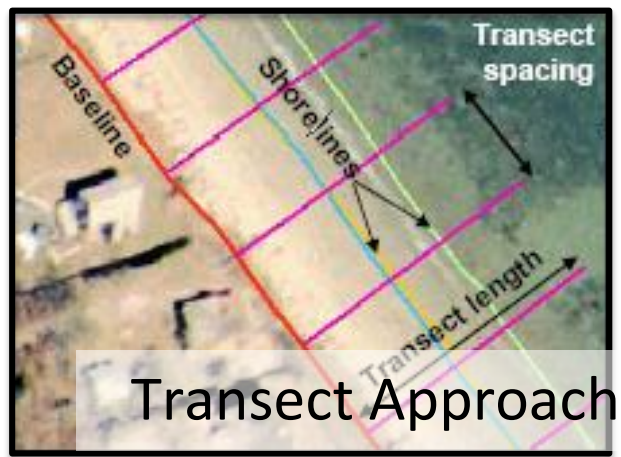
# Difference Grid & Volume



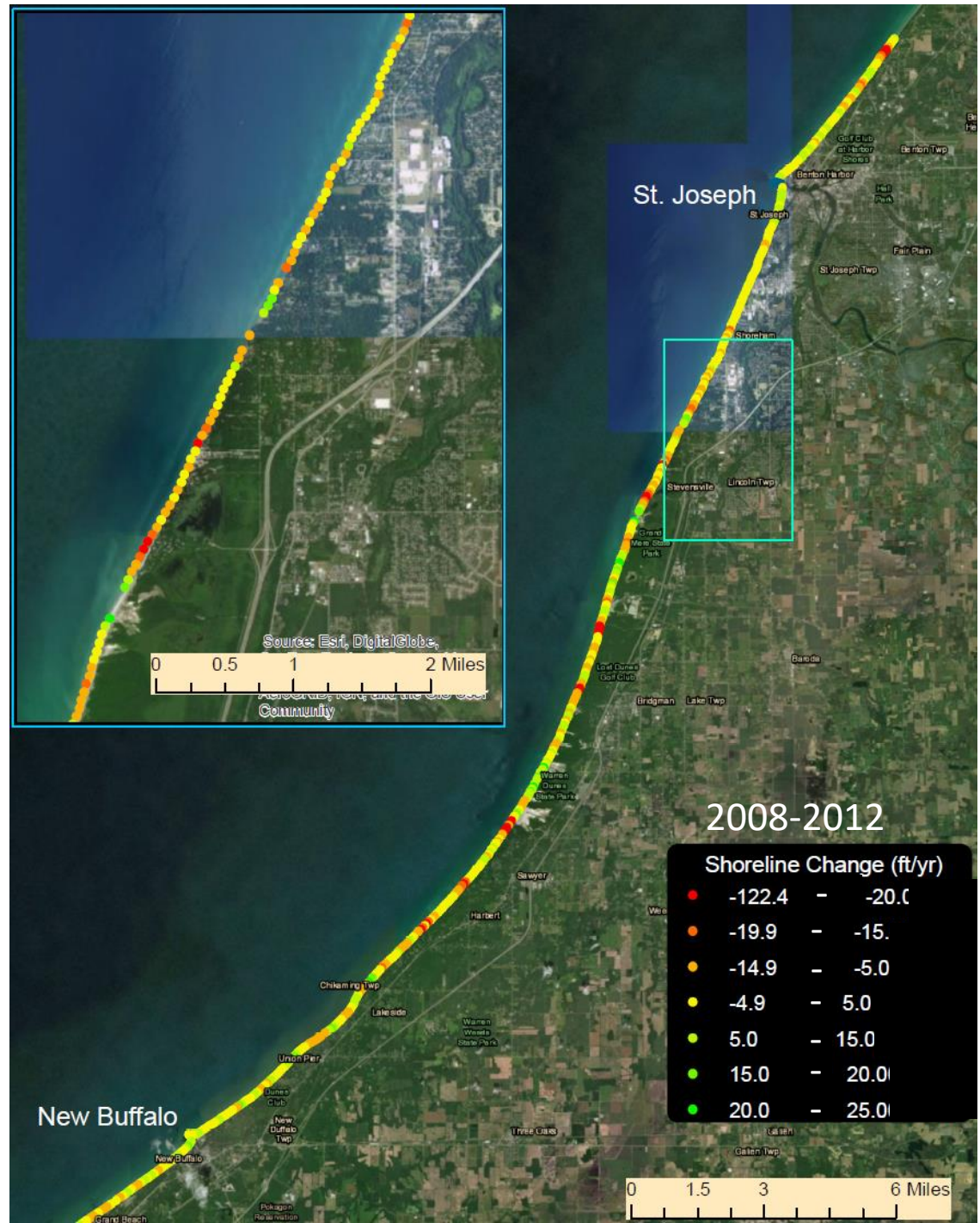
# Above & Below MHW Volume Change

- JALBTCX\_quick\_response\_v2.tbx
- QR 01. Label Baseline and Generate Transects (optional)
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  - QR 02. Generate Transect Mask and Clip Mask (optional)
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# Shoreline Change



2008-2012

Shoreline Change (ft/yr)

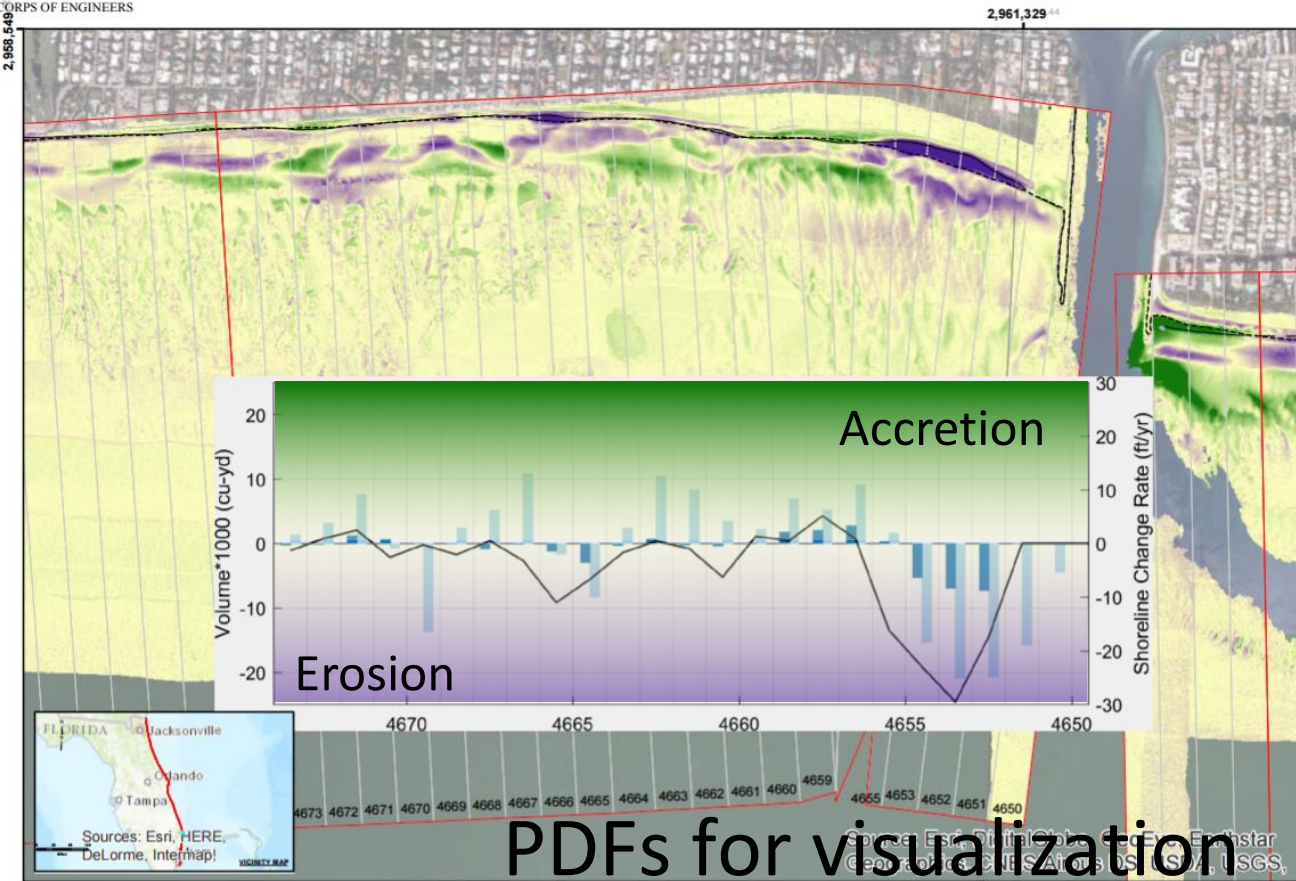
Red	-122.4	-20.0
Orange	-19.9	-15.0
Yellow	-14.9	-5.0
Light Green	-4.9	5.0
Green	5.0	15.0
Dark Green	15.0	20.0
Light Blue	20.0	25.0

- JALBTCX\_quick\_response\_v2.tbx
- QR 01. Label Baseline and Generate Transects (optional)
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# Data Access

U.S. ARMY CORPS OF ENGINEERS



PDFs for visualization

Section	Volume Change (cu-yd)	MHW Volume Change (cu-yd)	Shoreline Change Rate (ft/yr)	Section	Volume Change (cu-yd)	MHW Volume Change (cu-yd)	Shoreline Change Rate (ft/yr)
4,650	-8,219	0	0.00	4,666	+1,824	-1,183	-11.02
4,651	-4,452	0	0.00	4,667	19,932	-79	-3.18
4,652	-15,720	-7,266	-17.43	4,668	5,205	-805	0.48
4,653	-20,695	-7,266	-17.43	4,669	2,481	-15	-2.08
4,654	-20,922	-8,897	-23.53	4,670	-13,684	16	-4.25
4,655	-15,268	-5,257	-23.03	4,671	-598	610	-2.56
4,656	1,603	260	-16.13	4,672	7,638	1,244	2.48
4,657	9,187	2,798	0.84	4,673	3,232	-99	0.90
4,658	5,278	2,087	5.13	4,674	1,350	-198	-1.34
4,659	6,955	1,752	0.52				
4,660	2,789	76	1.34				
4,661	3,469	-370	-6.26				
4,662	8,359	-222	-6.97				
4,663	10,522	662	6.43				
4,664	2,470	-297	-1.71				
4,665	-8,272	-2,947	-6.73				
4,666	+1,824	-1,183	-11.02				

**Elevation Difference (feet)**

High : 5  
Low : -5

Horizontal Coordinate System:  
NAD 1983 UTM Zone 17N  
Datum: North American 1983  
Distance Units: Meter

Florida Elevation Difference and Volume Map Number: 191

Sheet Reference Number 191 of 242

Joint Airborne Lidar Bathymetry Technical Center of Expertise

The information depicted on this map represents elevation changes along the Florida 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 MHW Volume Change (dark blue). The Shoreline Change Rate is represented by the black line.

Data Sources: 2016 pre storm and 2016 National Coastal Mapping Program topobathymetric lidar elevation data from the Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX).

U.S. ARMY CORPS OF ENGINEERS  
US Army Corps of Engineers  
Mobile District

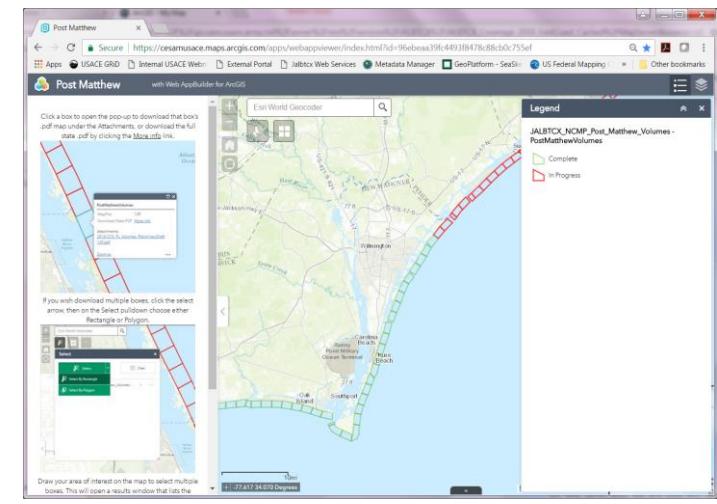
DISCLAIMER  
The user represents the user of the data and is responsible for the use of the data. The user is not authorized to use the data for any purpose other than that for which it was provided. The user is not authorized to use the data for any purpose other than that for which it was provided. The user is not authorized to use the data for any purpose other than that for which it was provided.

U.S. ARMY CORPS OF ENGINEERS  
Mobile District  
Map Number: 191

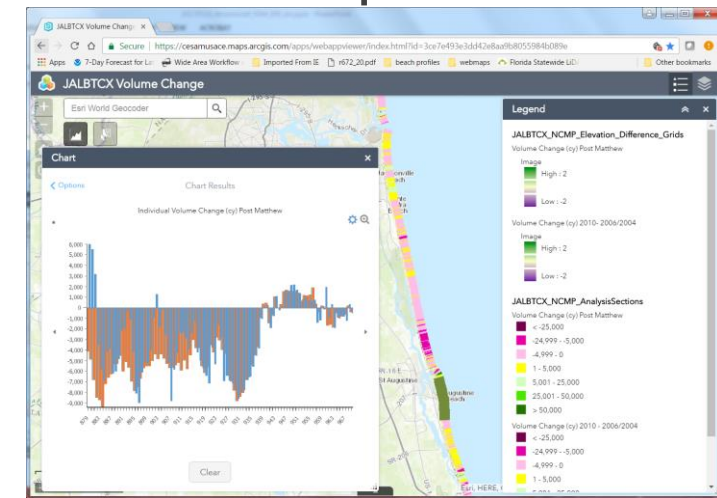
Florida Elevation Difference and Volume Map Number: 191  
Sheet Reference Number 191 of 242

Delivered by:

- Geodatabase FTP
- Web viewer



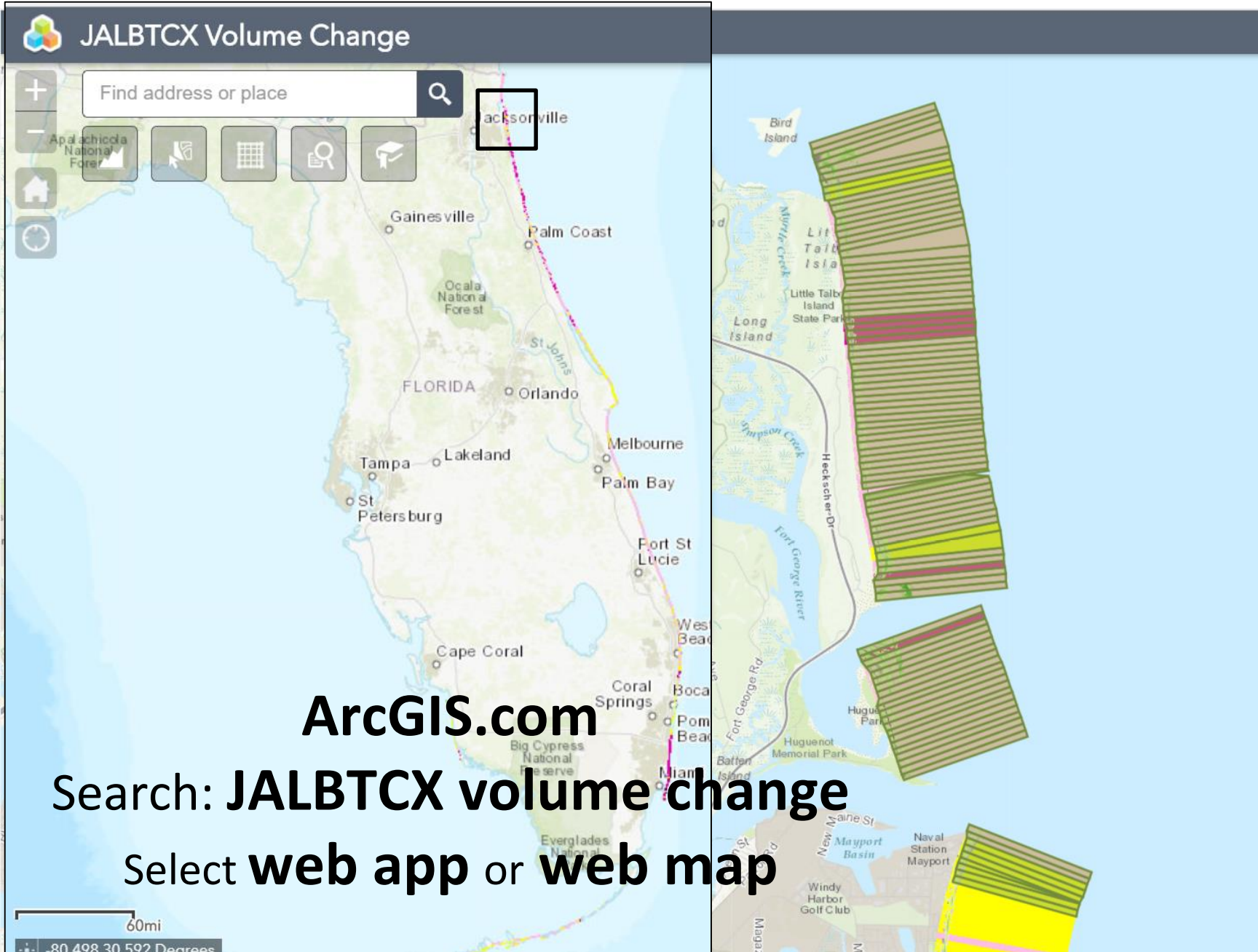
- Interactive web map



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



# Web Map - Volume and Shoreline Change



ArcGIS.com

Search: **JALBTCX volume change**

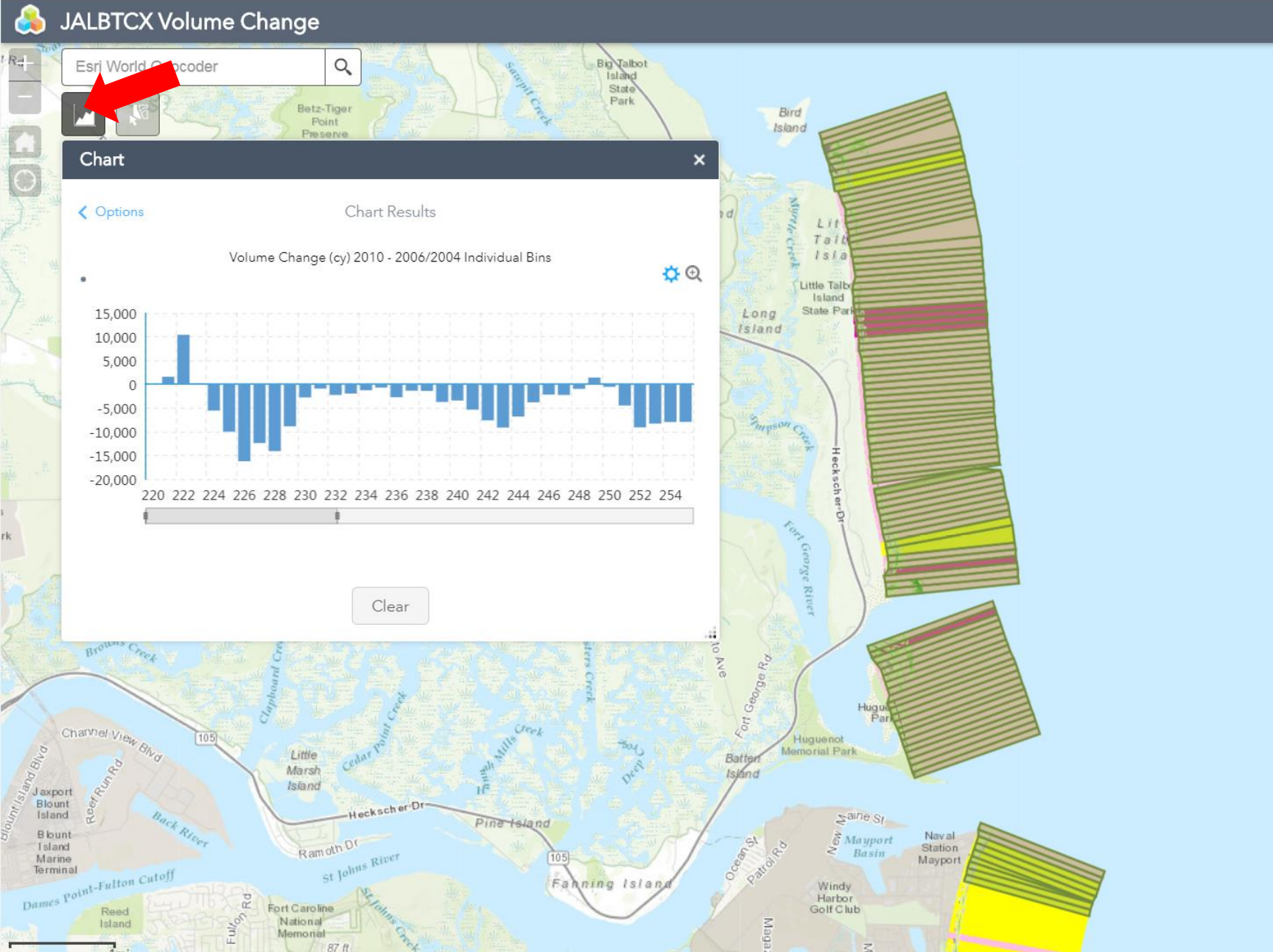
Select **web app** or **web map**

### Layer List

Operational layers

- Map Blocks
- Geomorphic\_Features
- Elevation\_Difference\_Grids
- Analysis\_Sections
- Volume Change (cy) Post Maria
- 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
- Shoreline Change Rate (ft/yr ) Post Matthew
- MHW Volume (cy) Post Matthew
- Above MHW Volume (cy) Post Matthew

# Web Map - Volume and Shoreline Change



### Layer List

- Operational layers
  - Map Blocks
  - Geomorphic\_Features
  - Elevation\_Difference\_Grids
  - Analysis\_Sections
    - Volume Change (cy) Post Maria
    - Volume Change (cy) Post Irma
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    - MHW Volume (cy) Post Irma
    - Above MHW Volume (cy) Post Irma
    - Volume Change (cy) Post Matthew
    - Shoreline Change Rate (ft/yr ) Post Matthew
    - MHW Volume (cy) Post Matthew
    - Above MHW Volume (cy) Post Matthew



# Web Map - Volume and Shoreline Change

JALBTCX Volume Change

Esri World Geocoder

Select features.

Select Clear

Layer	Count
<input checked="" type="checkbox"/> Shoreline Change Rate (ft/yr ) Post Irma	0
<input checked="" type="checkbox"/> MHW Volume (cy) Post Irma	0
<input checked="" type="checkbox"/> Above MHW Volume (cy) Post Irma	0
<input type="checkbox"/> Volume Change (cy) Post Matthew	0
<input type="checkbox"/> Shoreline Change Rate (ft/yr ) Post Matthew	0
<input type="checkbox"/> MHW Volume (cy) Post Matthew	0
<input type="checkbox"/> Above MHW Volume (cy) Post Matthew	0

Layer List

Operational layers

- Map Blocks
- Geomorphic\_Features
- Elevation\_Difference\_Grids
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  - Volume Change (cy) Post Maria
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  - MHW Volume (cy) Post Matthew
  - Above MHW Volume (cy) Post Matthew

# Web Map - Volume and Shoreline Change

JALBTCX Volume Change

Esri World Geocoder

Select features.

Select Clear

Layer

- Shoreline Change Rate (ft/yr) Post Irma
- MHW Volume (cy) Post Irma
- Above MHW Volume (cy) Post Irma
- Volume Change (cy) Post Irma
- Shoreline Change Rate (ft/yr) Post Irma
- MHW Volume (cy) Post Matthew
- Above MHW Volume (cy) Post Matthew

Selection actions

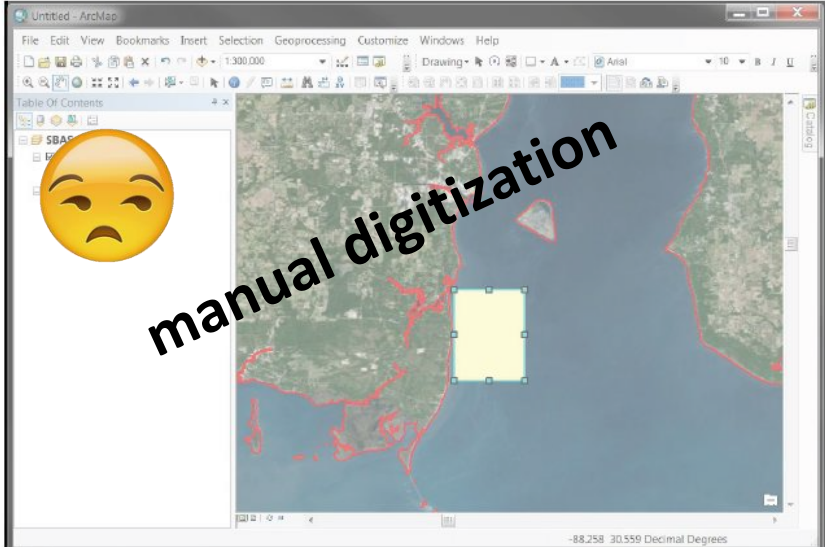
- Zoom to
- Pan to
- Export to CSV file
- Export to feature collection
- Export to GeoJSON
- Statistics...
- Create layer
- Save to My Content
- View in Attribute Table

Layer List

Operational layers

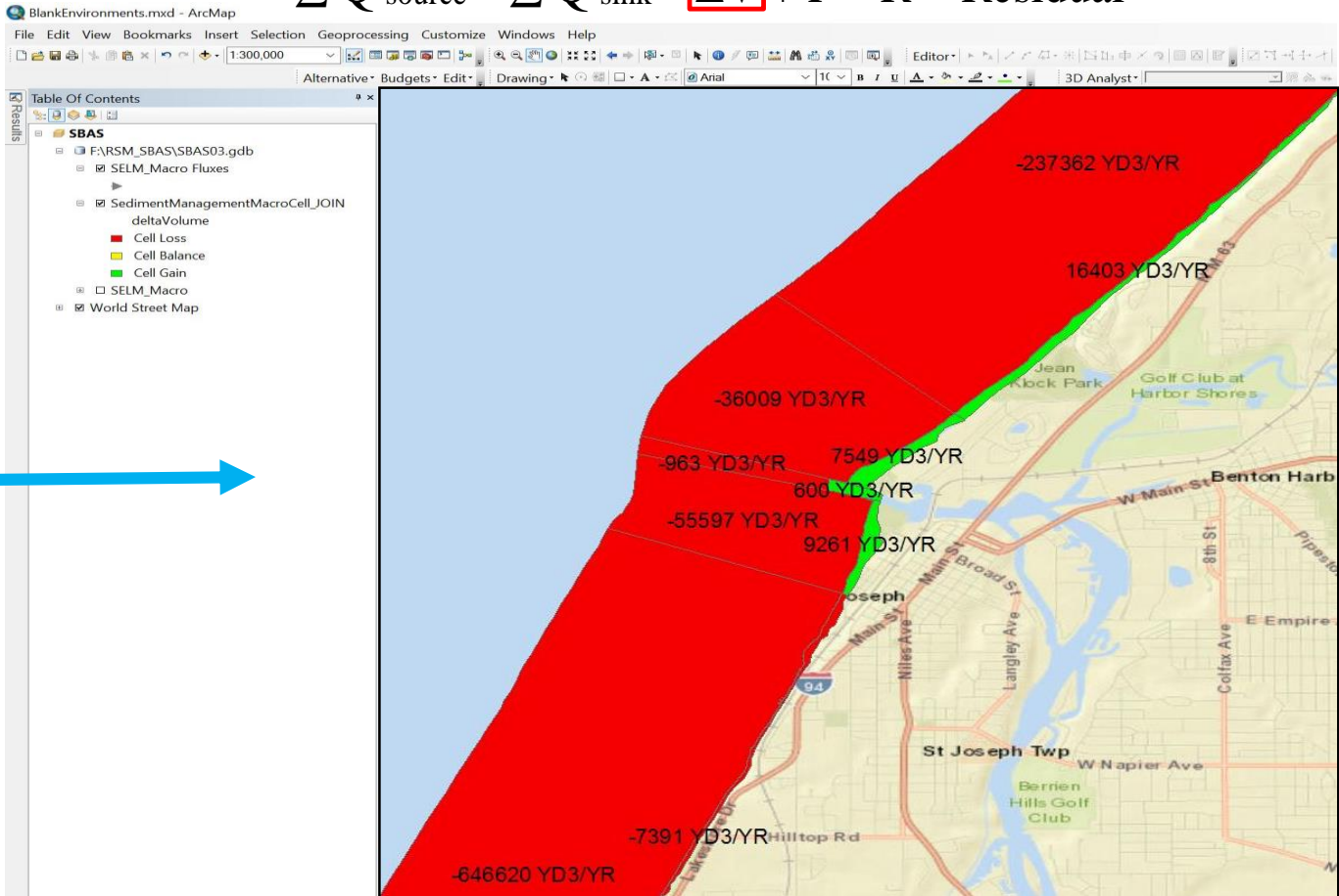
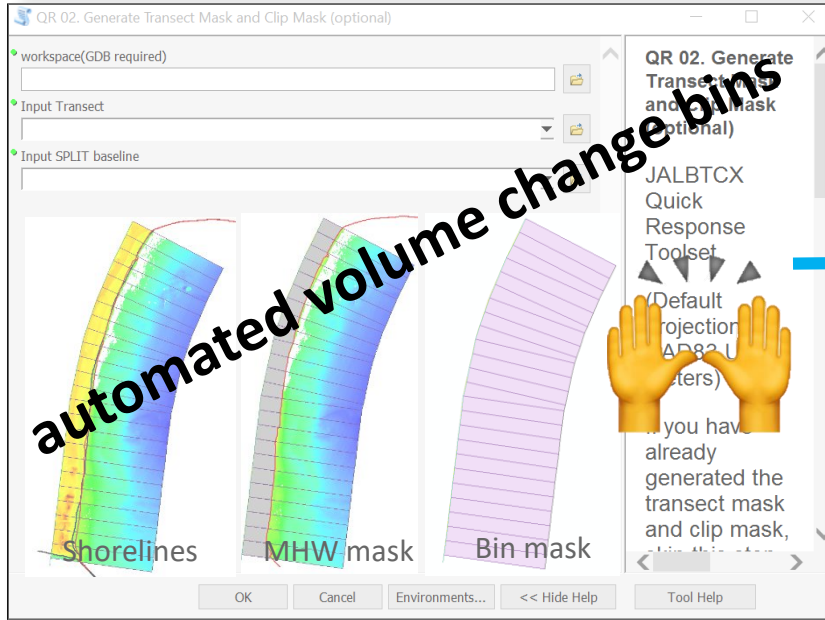
- Map Blocks
- Geomorphic\_Features
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- Shoreline Change Rate (ft/yr) Post Irma
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- Volume Change (cy) Post Matthew
- Shoreline Change Rate (ft/yr) Post Matthew
- MHW Volume (cy) Post Matthew
- Above MHW Volume (cy) Post Matthew

# Sediment Budget Analysis Systems (SBAS)



- Smoothly integrate volume change data
- JALBTCX volume change cells → SBAS cells

$$\sum Q_{\text{source}} - \sum Q_{\text{sink}} - \Delta V + P - R = \text{Residual}$$



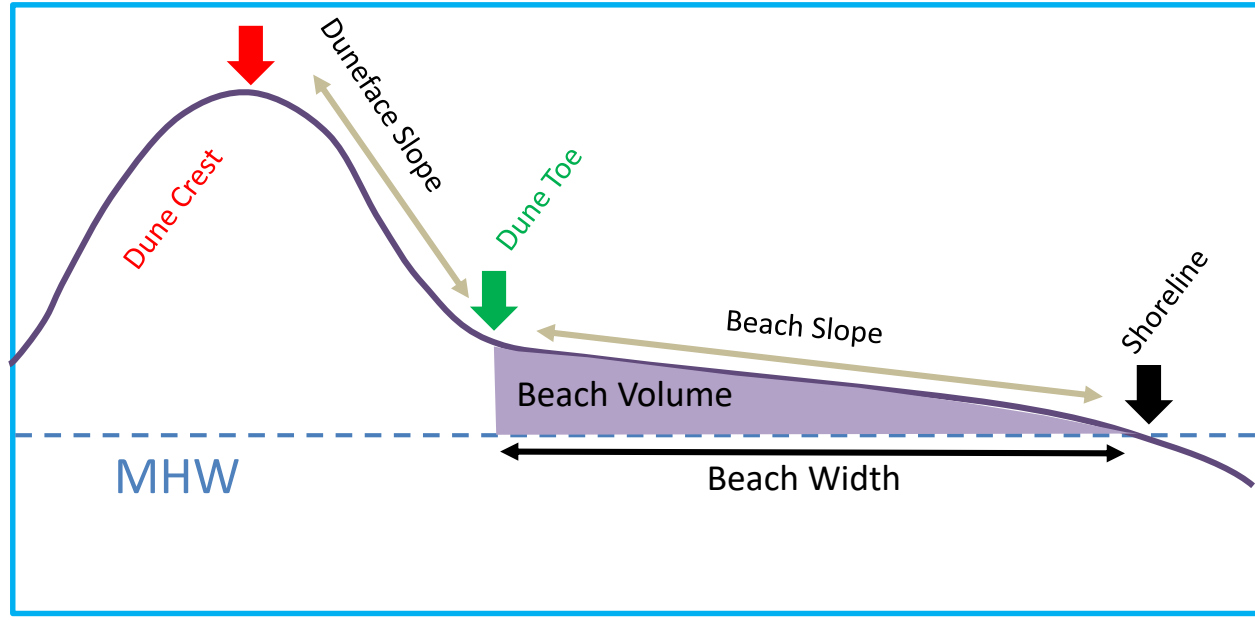


**protec  
the coast!**

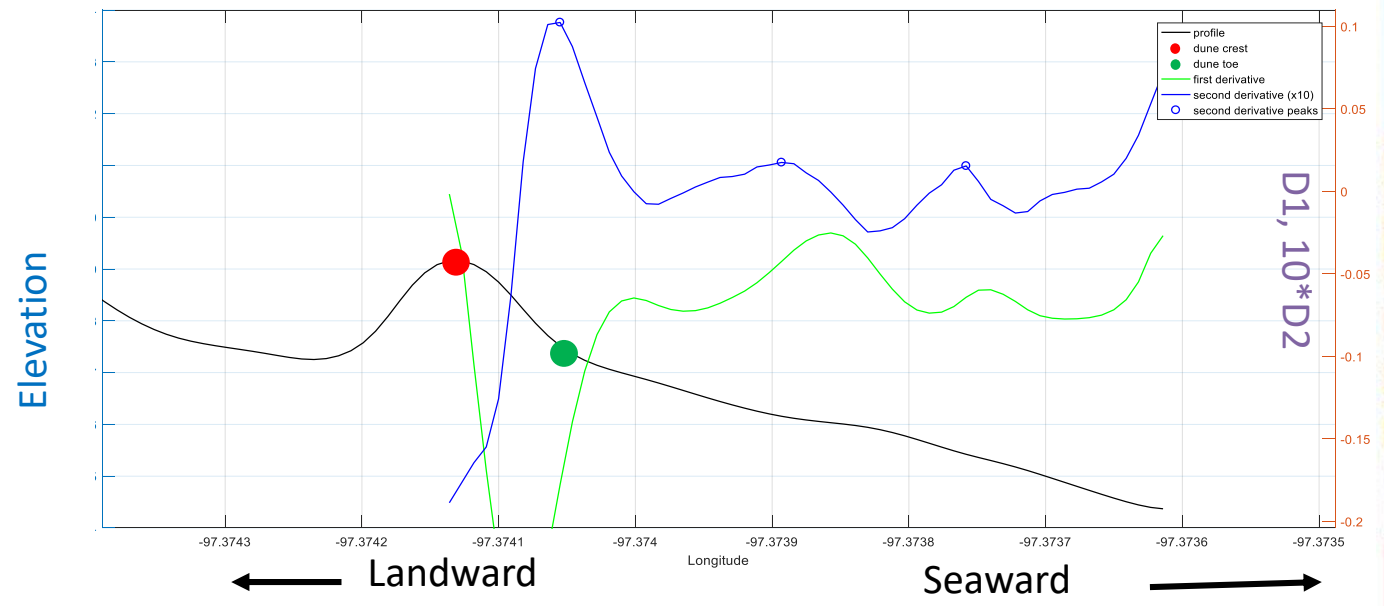
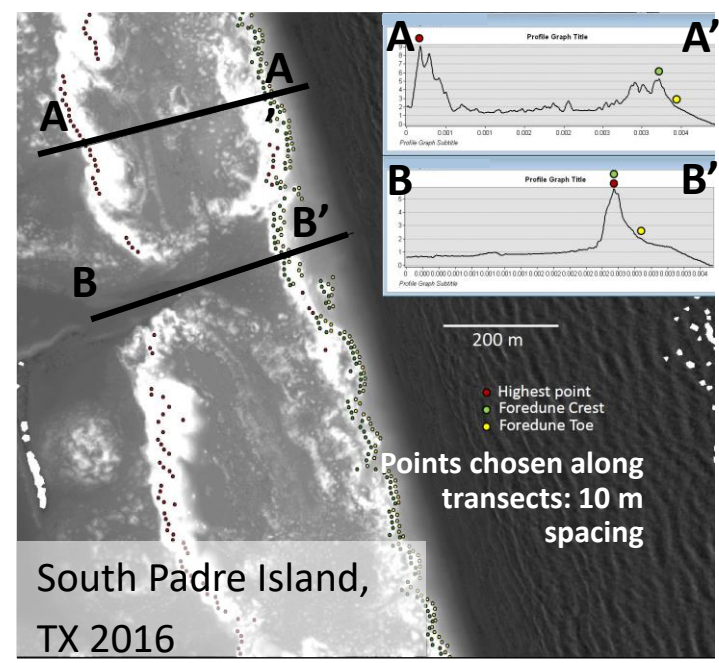
# Coastal Feature Detection

to supplement post-storm assessments

- Foredune Crest & Toe
- Duneface slope
- Beach width & slope
- Beach volume
- Highest Dune Ridge

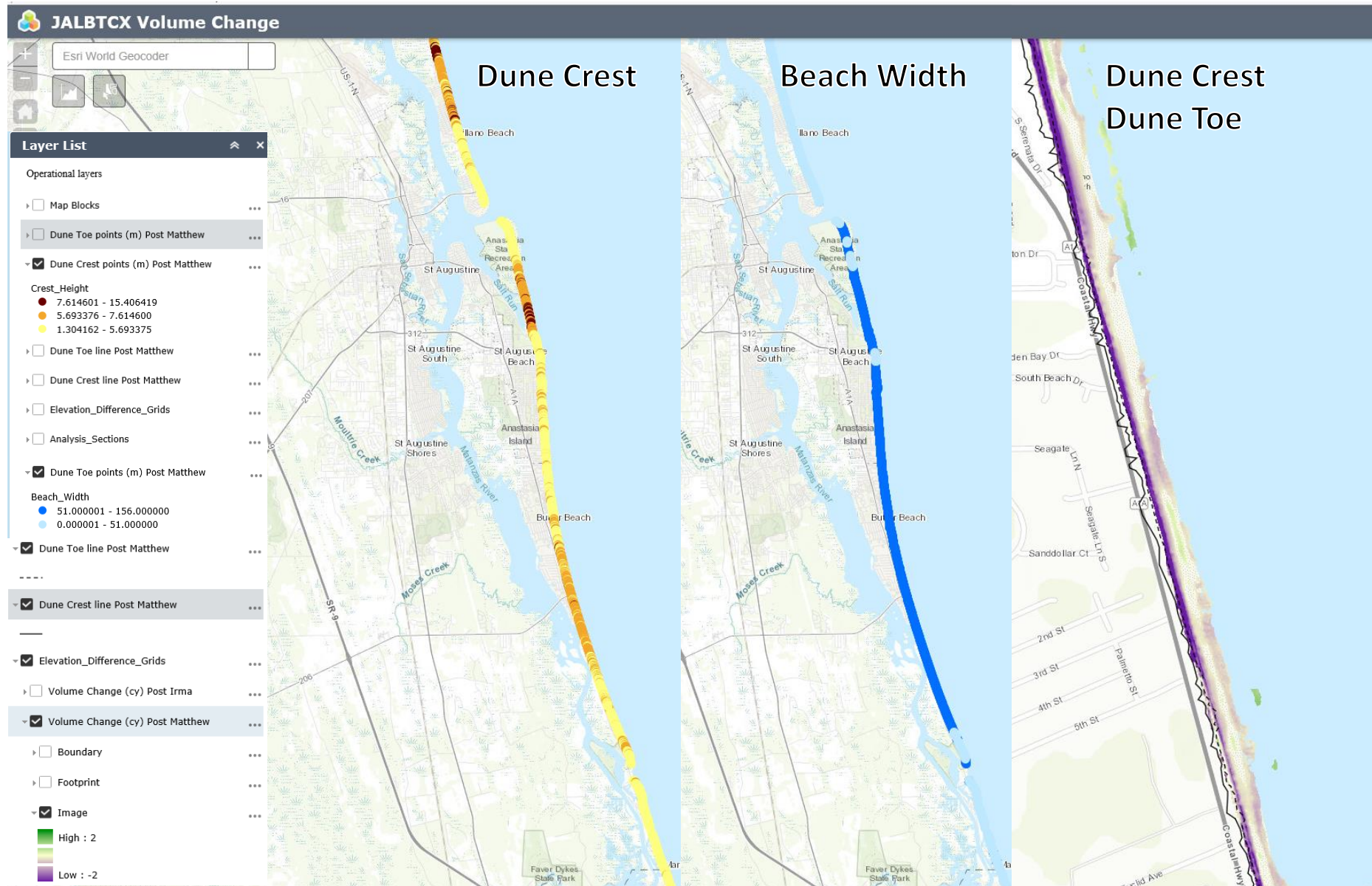


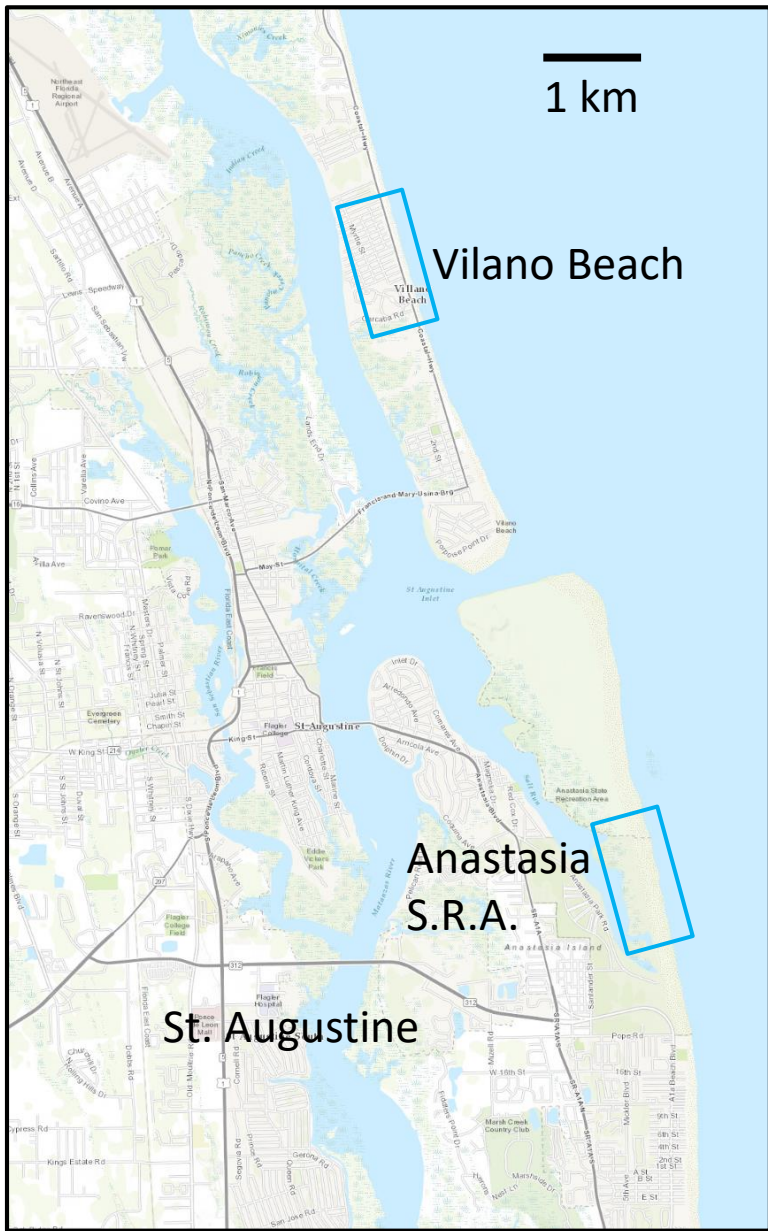
USGS collaboration on dune extraction methodology



# Data Access

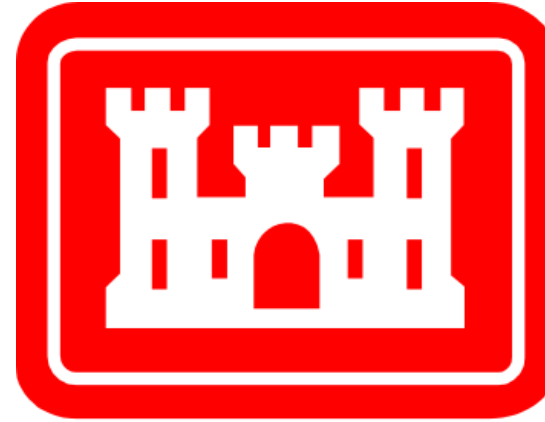
## JALBTCX Volume Change Web Map – Geomorphic Metrics







**ERDC**  
INNOVATIVE SOLUTIONS  
for a safer, better world



**US Army Corps  
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