An Update on Coastal Engineering Applications

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JALBTCX Workshop

US Army Corps of Engineers
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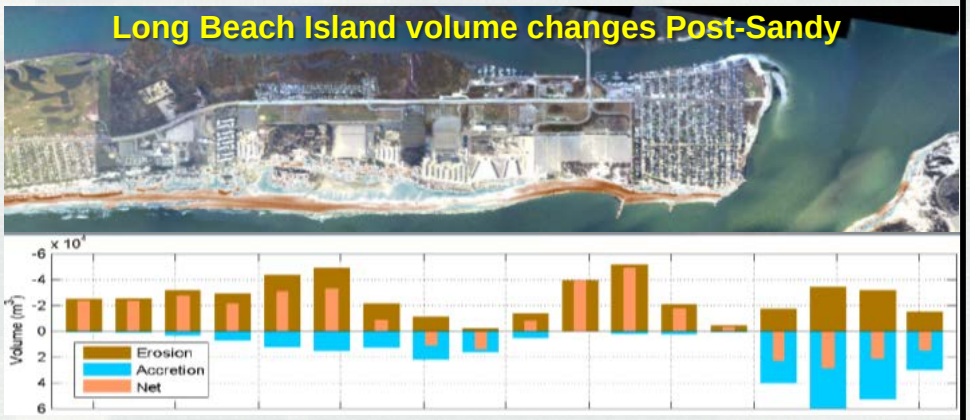
Coastal Engineering Applications

Coastal Resiliency – extract resiliency metrics

- Metrics (narrow beach width, low dune line)
- Identify areas resilient to storm impacts and quantify pre- and post-storm changes

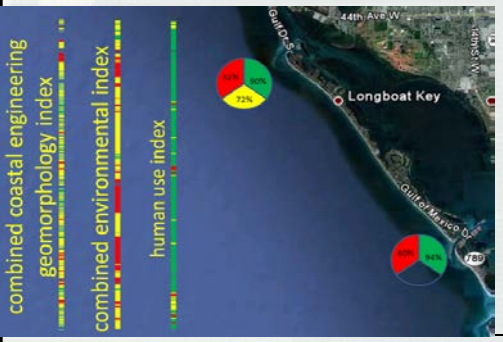


Critical Habitat– assess the relative suitability of critical habitat sites for loggerhead turtles by developing a spatially-explicit ecological model

- Support tool utilizing geomorphic and environmental parameters
- Inform and address integrated resource management concepts

Regions

- Delineate regions to meet specific project or temporal objectives
- Using the coastal engineering indicies



Shoaling analysis– determine shoaling rates for navigation projects

- Project future dredging requirements
- Relate metrics of economic significance to shoaling conditions and dredging

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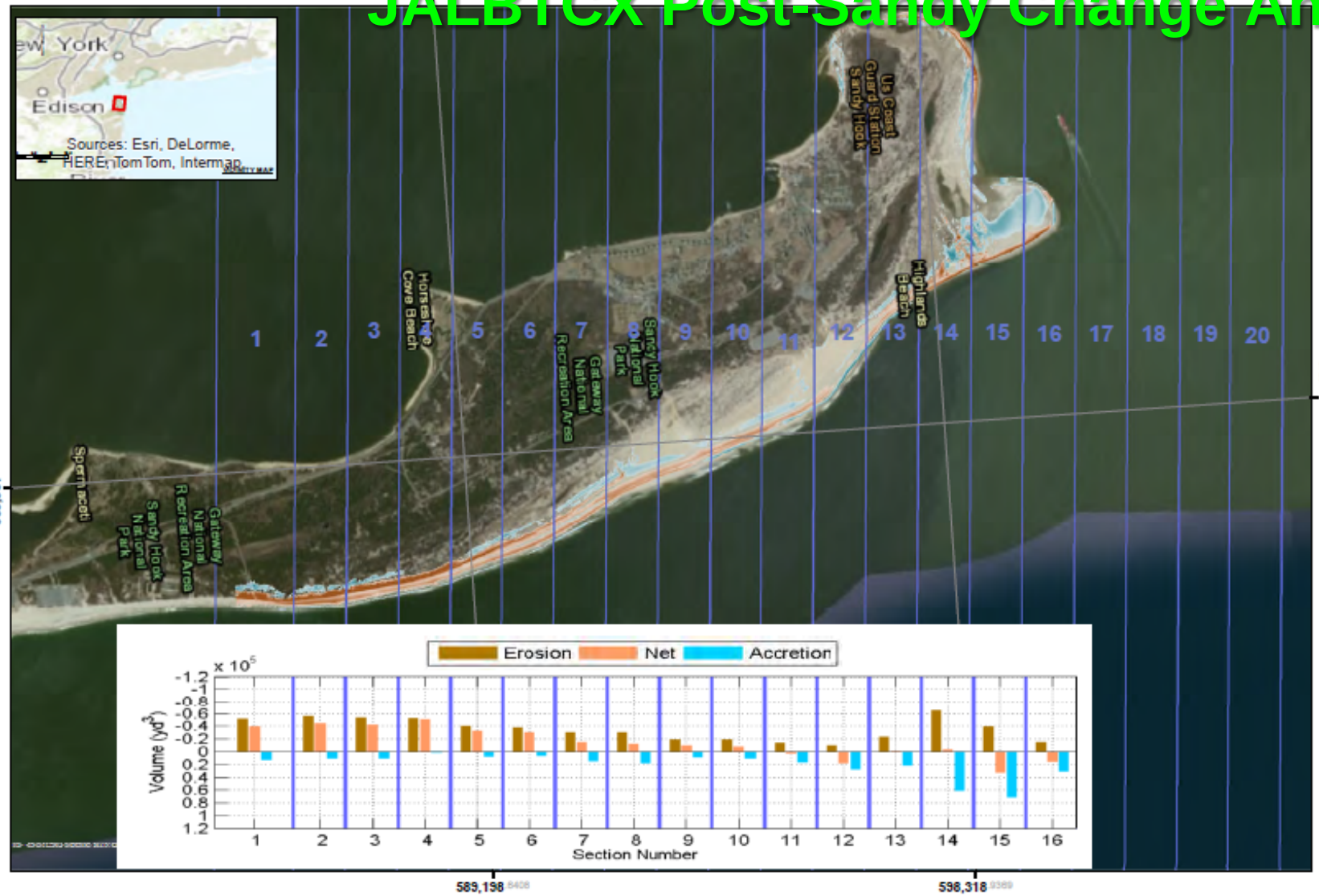
Post-Sandy activities

- Change analysis
  - Elevation/volume/shoreline change
  - Automated map product
  - Assist w/ response/recovery effort
- Resiliency work
  - Extract parameters from spatial data

JALBTCX Post-Sandy Change Analysis

CORPS OF ENGINEERS

U.S. ARMY



Section	Net (yd³)	Erosion (yd³)	Accretion (yd³)	Section	Net (yd³)	Erosion (yd³)	Accretion (yd³)
1	-39000	-52000	13000	10	-8000	-19000	11000
2	-45000	-56000	11000	11	3000	-14000	17000
3	-45000	-54000	11000	12	18000	-10000	28000
4	-51000	-53000	2000	13	-1000	-23000	22000
5	-32000	-40000	8000	14	-3000	-65000	62000
6	-30000	-37000	7000	15	33000	-39000	72000
7	-15000	-30000	15000	16	16000	-15000	31000
8	-12000	-30000	18000				
9	-10000	-19000	9000				

Elevation Difference (yd)

High : 2

Low : -2

Miles

0 0.5 1

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Horizontal Coordinate System:
NAD 1983 StatePlane New Jersey FIPS 2900 Feet

Datum: North American 1983

Distance Units: Foot US

The information depicted on this map represents volume change between 2010 and 2012.

Data Sources: Volumes were derived using the JALBTCX 2010 LIDAR and the JALBTCX 2012 Post-Sandy LIDAR.

Aerial Photography data source: ESRI Basemaps

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NEW YORK DISTRICT

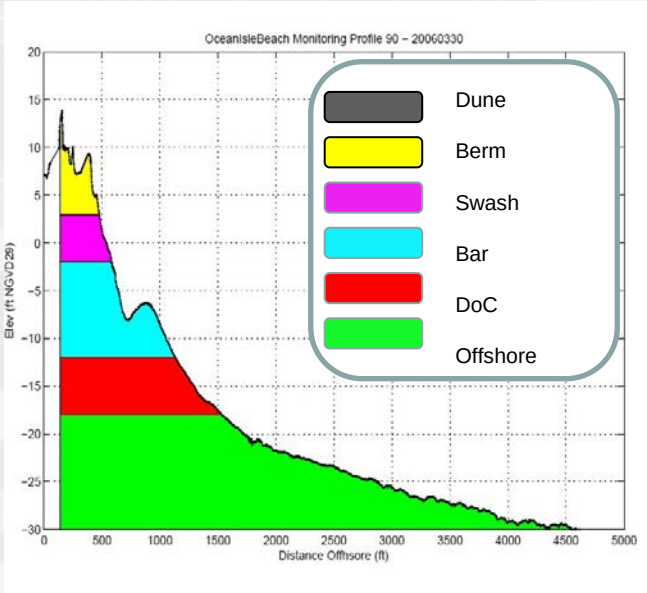
National Coastal Mapping Program
Post-Superstorm Sandy
Elevation Differences and Volumes
New Jersey 04: 000238, 000239

Sheet Reference Number 1 of 1

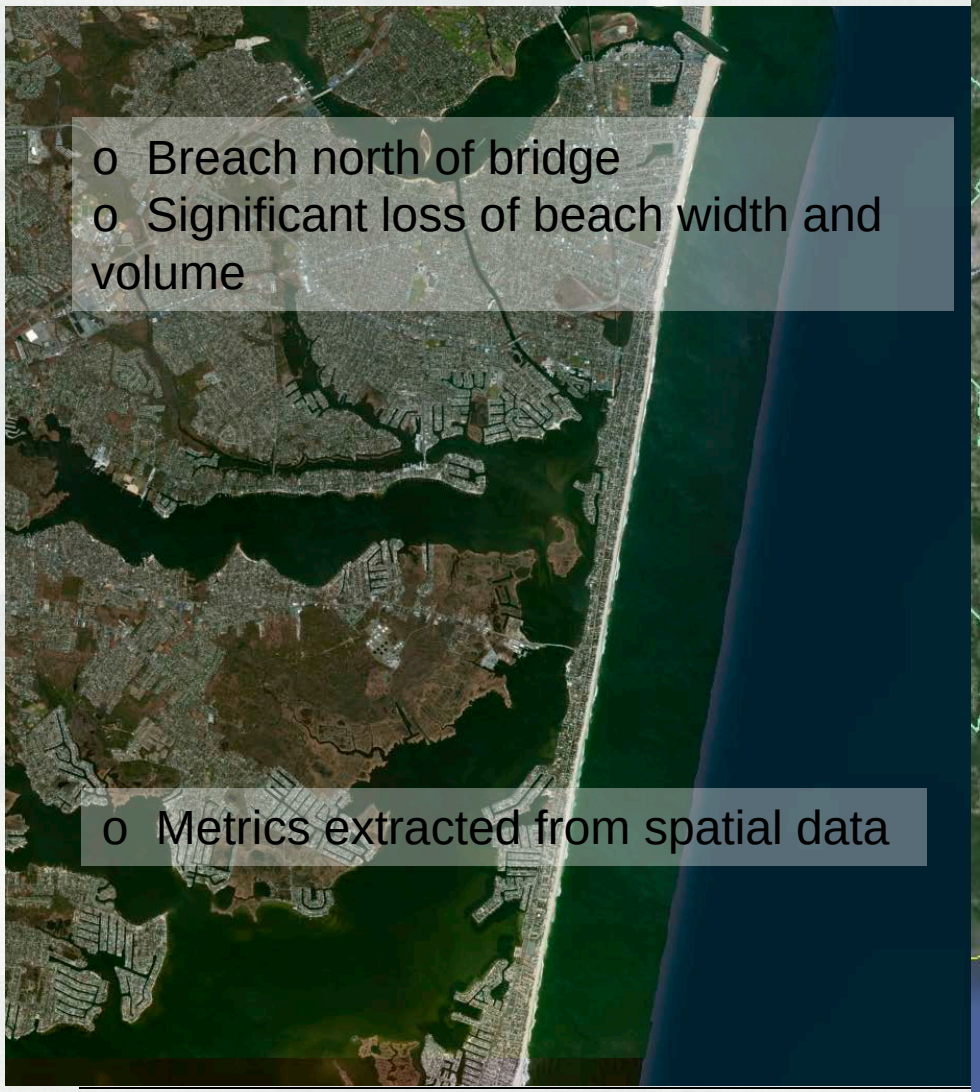
JALBTCX Post-Sandy Change Analysis

Resiliency Work

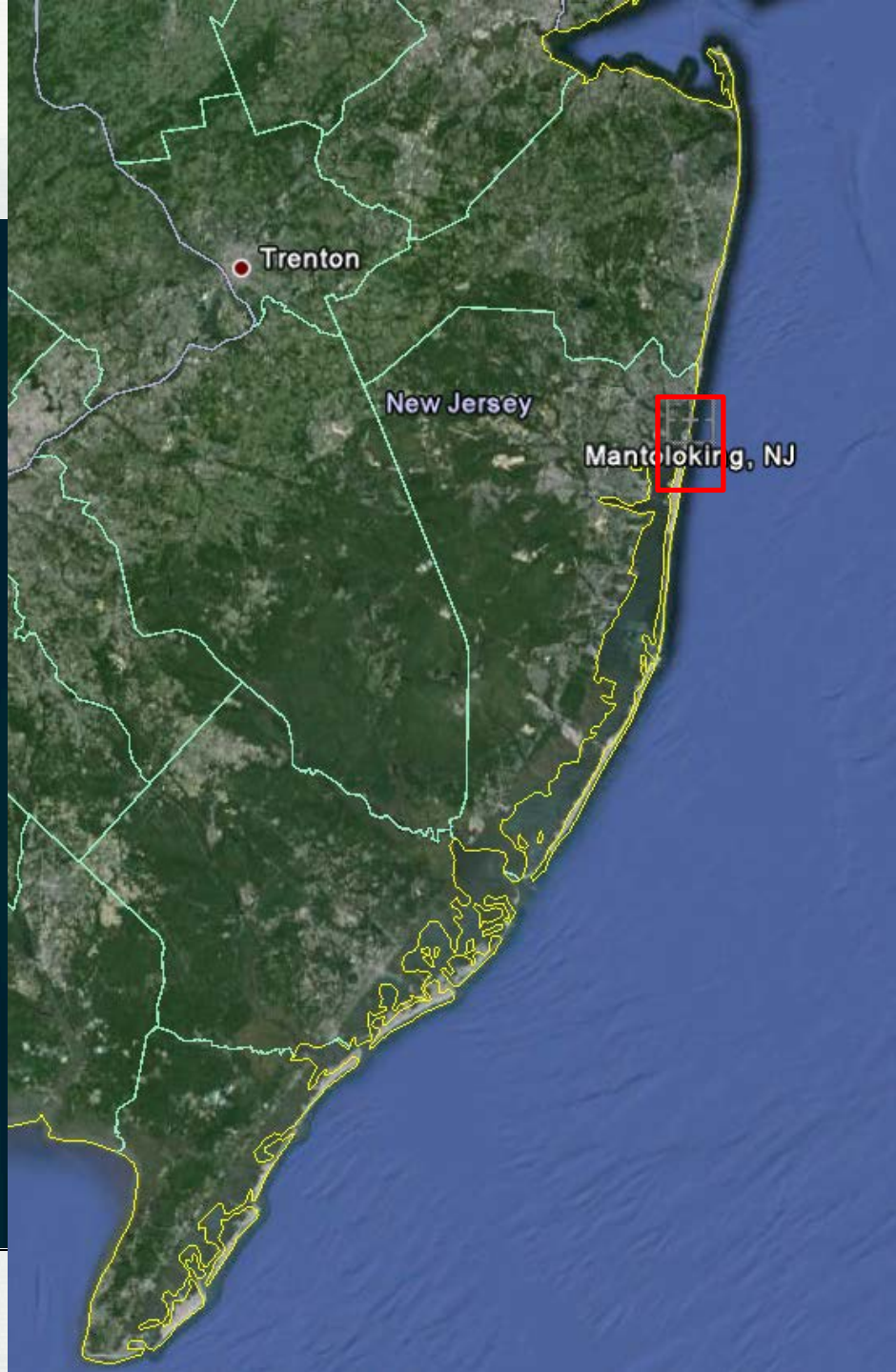
- ***Resilience is the ability of a system to maintain or recover functional performance – or adapt to a new functional state – under the stress of adverse events.***
- Extract parameters from spatial data to use as indicator of resilient systems
  - Dune
    - Crest and toe
  - Beach Width
    - Zero contour to dune toe
  - Dune field volume
  - Beach slope



Mantoloking, NJ

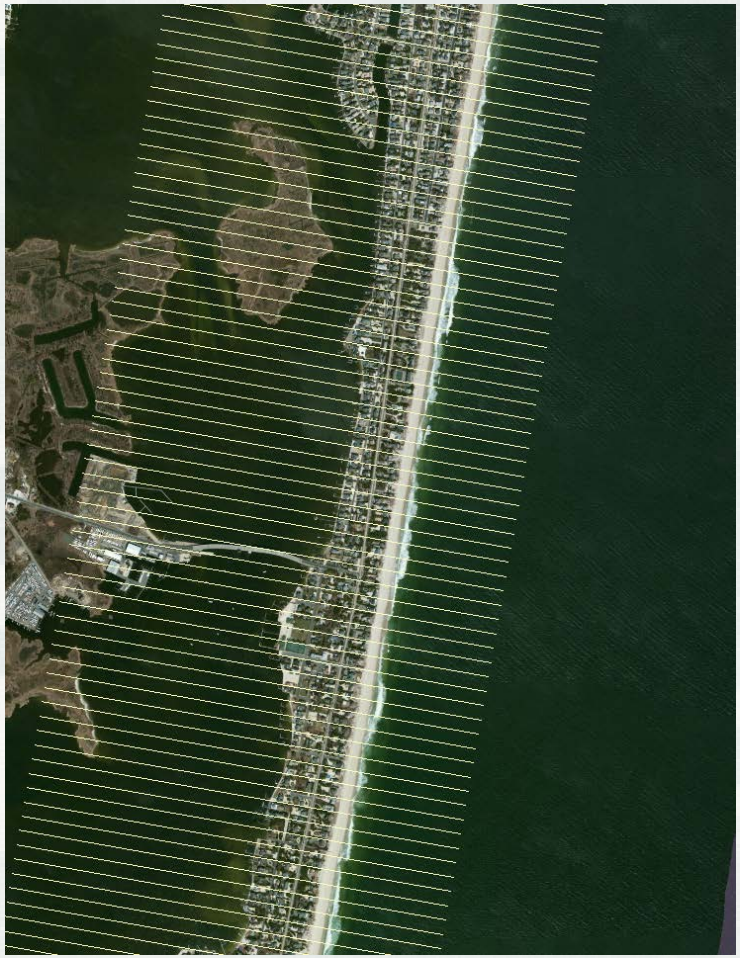


- o Breach north of bridge
- o Significant loss of beach width and volume
- o Metrics extracted from spatial data



Elevation Difference

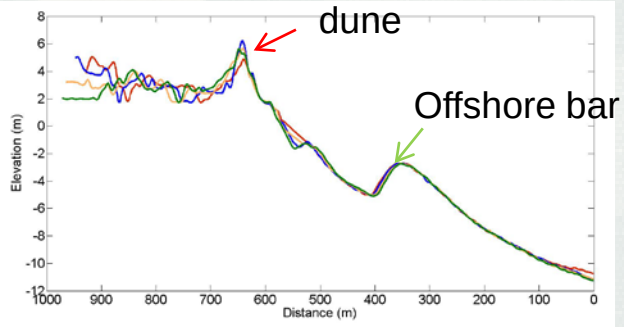
Transects

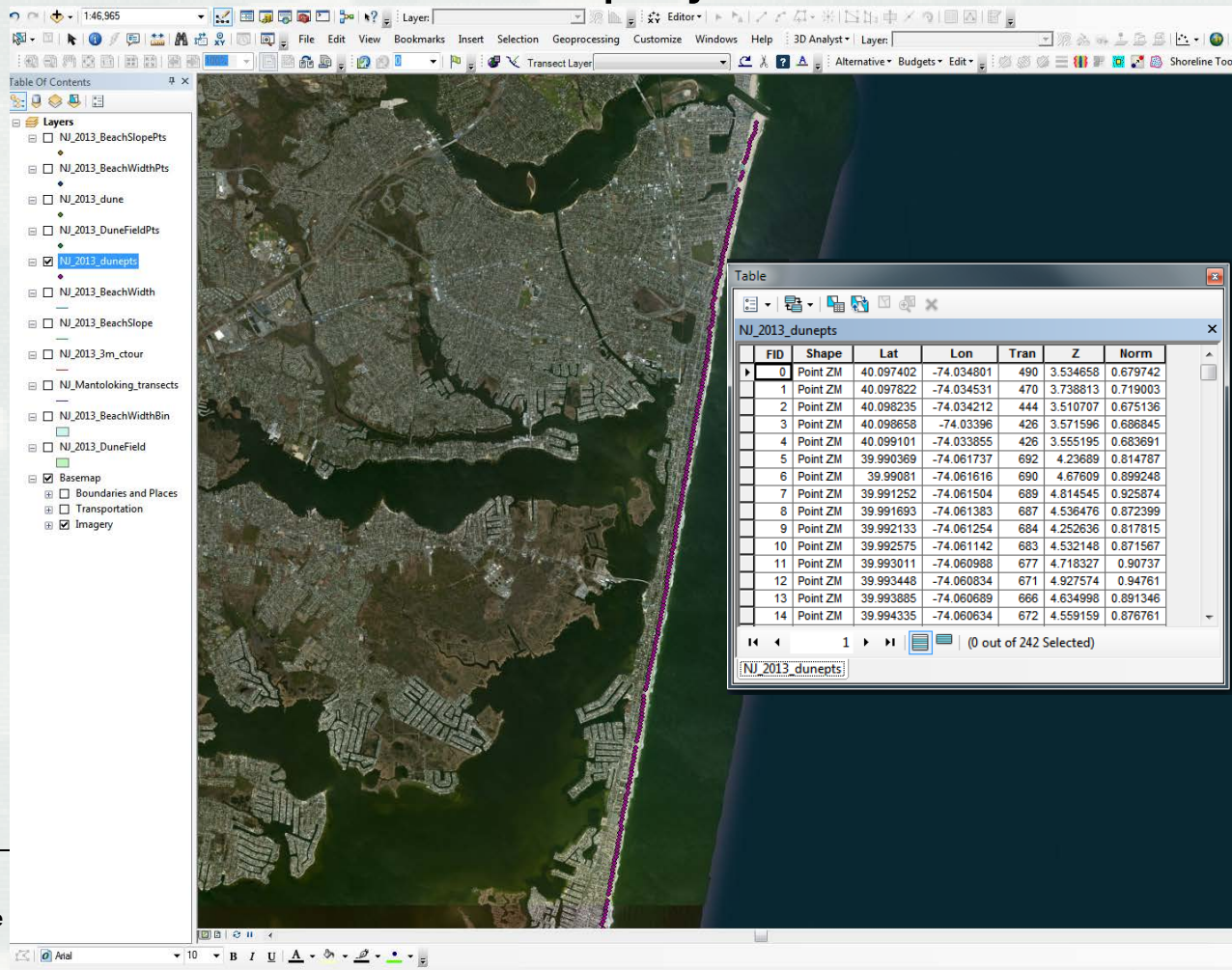


2010 Pre-Storm dataset
2013 Post-Storm dataset

Dune

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





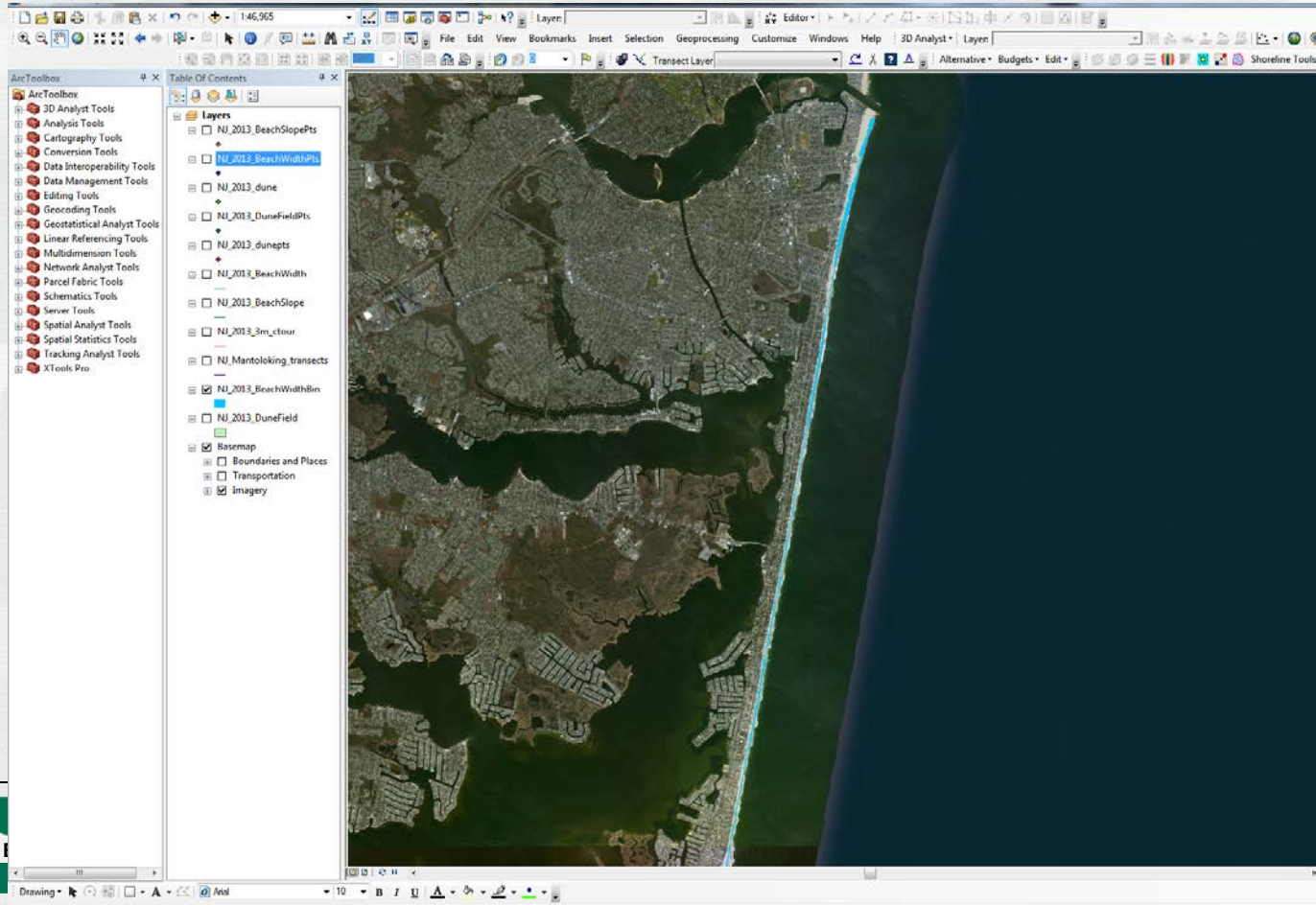
FID	Shape	Lat	Lon	Tran	Z	Norm
0	Point ZM	40.097402	-74.034801	490	3.534658	0.679742
1	Point ZM	40.097822	-74.034531	470	3.738813	0.719003
2	Point ZM	40.098235	-74.034212	444	3.510707	0.675136
3	Point ZM	40.098658	-74.03396	426	3.571596	0.686845
4	Point ZM	40.099101	-74.033855	426	3.555195	0.683691
5	Point ZM	39.990369	-74.061737	692	4.23689	0.814787
6	Point ZM	39.99081	-74.061616	690	4.67609	0.899248
7	Point ZM	39.991252	-74.061504	689	4.814545	0.925874
8	Point ZM	39.991693	-74.061383	687	4.536476	0.872399
9	Point ZM	39.992133	-74.061254	684	4.252636	0.817815
10	Point ZM	39.992575	-74.061142	683	4.532148	0.871567
11	Point ZM	39.993011	-74.060988	677	4.718327	0.90737
12	Point ZM	39.993448	-74.060834	671	4.927574	0.94761
13	Point ZM	39.993885	-74.060689	666	4.634998	0.891346
14	Point ZM	39.994335	-74.060634	672	4.559159	0.876761

- Dune crest extracted from intersection of transect and DEM

Beach Width

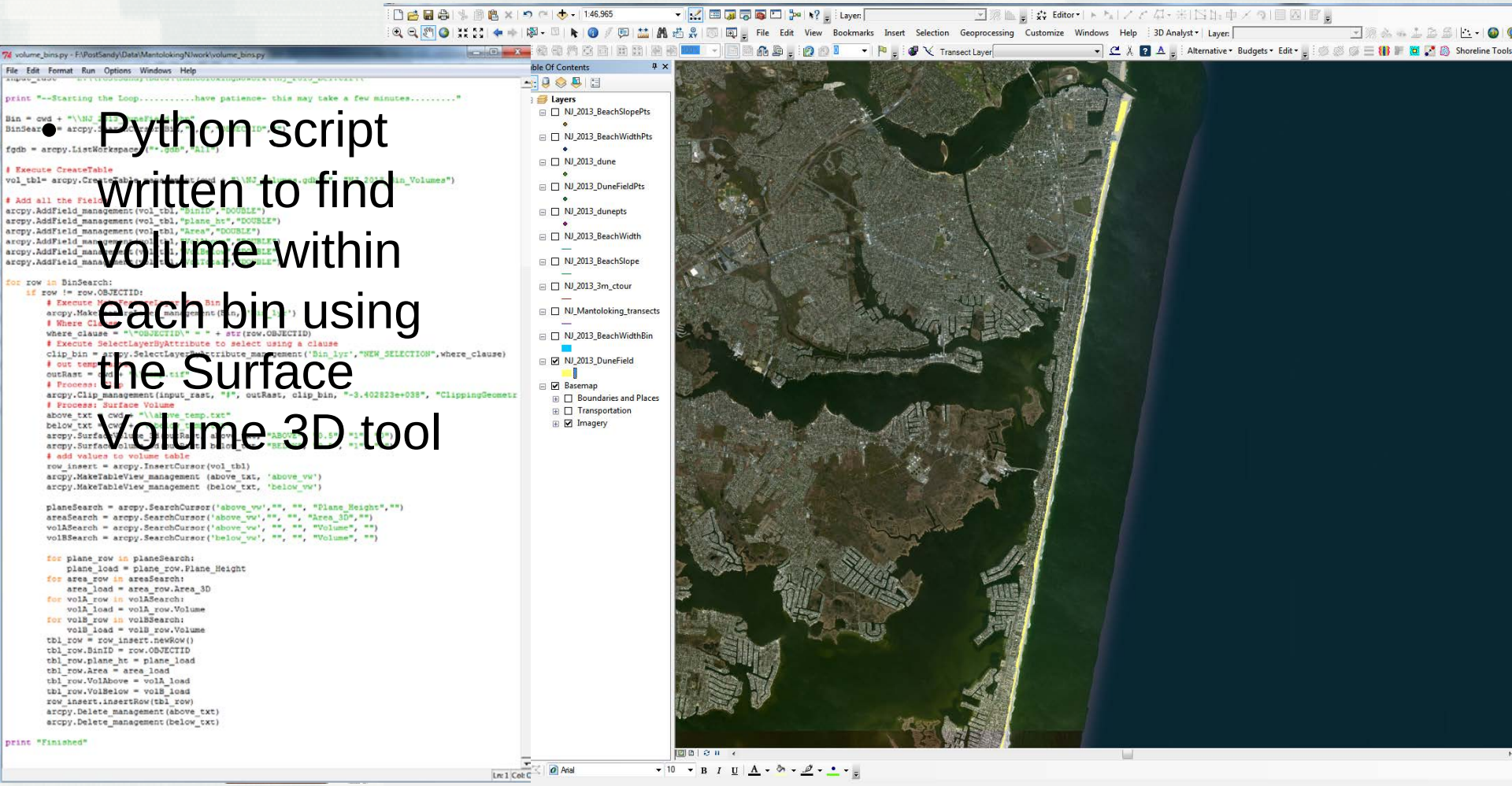
- Beach width provides buffer before the dune as well as recreational benefits
  - Defined as the distance between the zero contour and the dune toe
  - Active portion of the beach

- Bins created using transects and dune toe and shoreline contours



Dune Field Volume

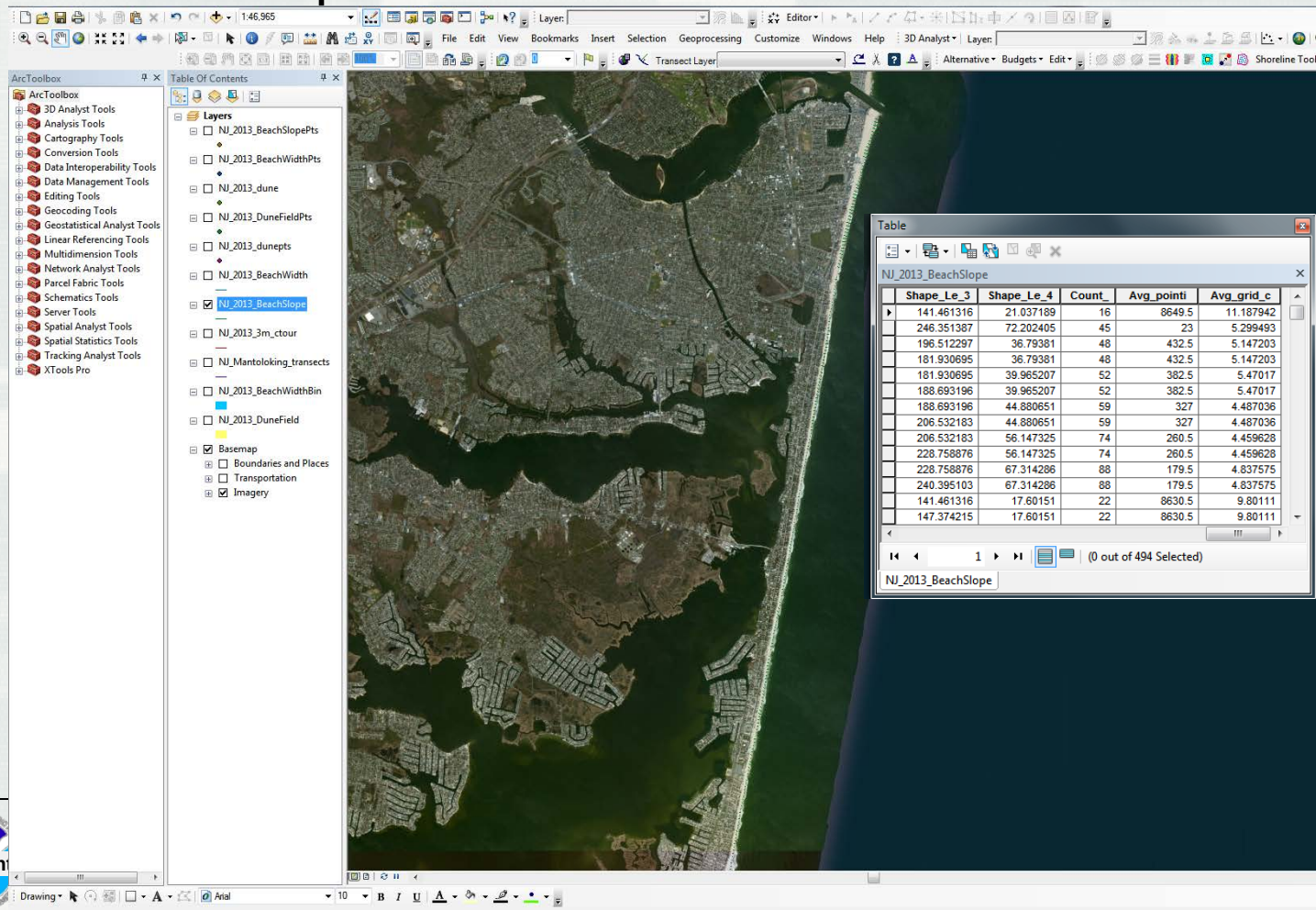
- Volume of sediment available in the system
- Bins created from dune backline, dune toe, and transects



- Python script written to find volume within each bin using the Surface Volume 3D tool

Beach Slope

- DEM is clipped to the extent of the beach width bin
- Percent rise slope for the clipped DEM
- Extract percent rise slope for each bin

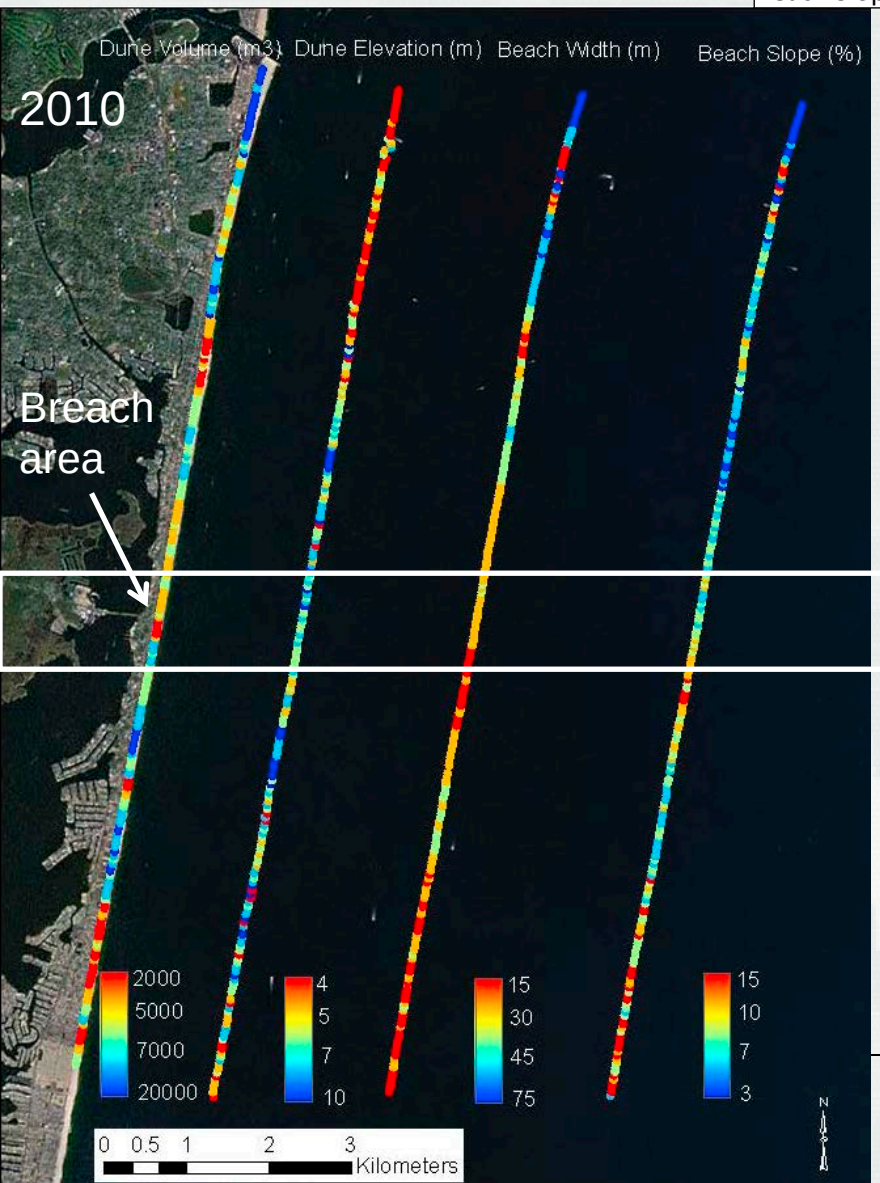


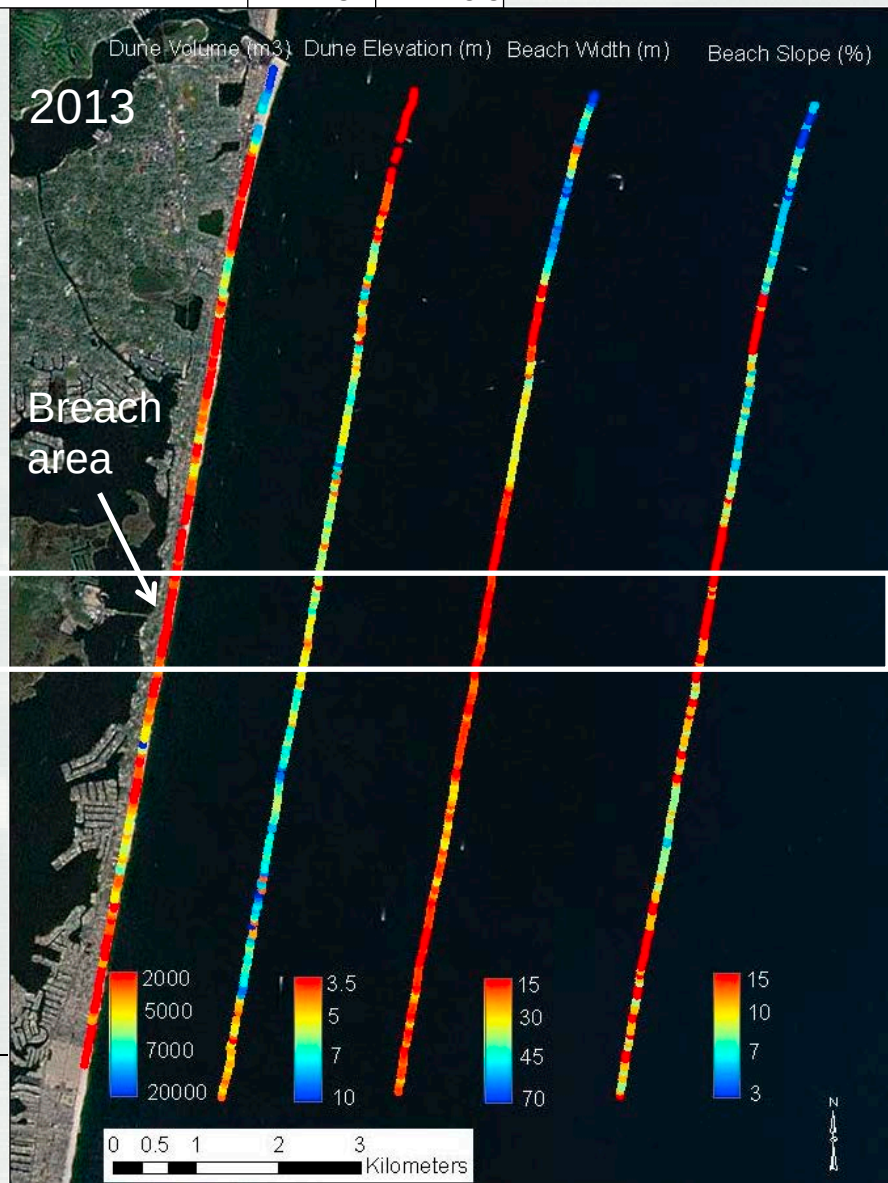
Shape_Le_3	Shape_Le_4	Count_	Avg_pointi	Avg_grid_c
141.461316	21.037189	16	8649.5	11.187942
246.351387	72.202405	45	23	5.299493
196.512297	36.79381	48	432.5	5.147203
181.930695	36.79381	48	432.5	5.147203
181.930695	39.965207	52	382.5	5.47017
188.693196	39.965207	52	382.5	5.47017
188.693196	44.880651	59	327	4.487036
206.532183	44.880651	59	327	4.487036
206.532183	56.147325	74	260.5	4.459628
228.758876	56.147325	74	260.5	4.459628
228.758876	67.314286	88	179.5	4.837575
240.395103	67.314286	88	179.5	4.837575
141.461316	17.60151	22	8630.5	9.80111
147.374215	17.60151	22	8630.5	9.80111

- Slope is important for natural recovery of the beach
- Indicator of sediment grain size

2010 vs 2013

	2010	2013
Average Dune Elevation (m)	5.8	5.2
Average Dune Field Volume (m3)	6688	5680
Average Dune Field Area (m2)	1648	1643
Beach Width (m)	32.8	26.7
Beach Slope (%)	8.4	9.8





Average Comparison

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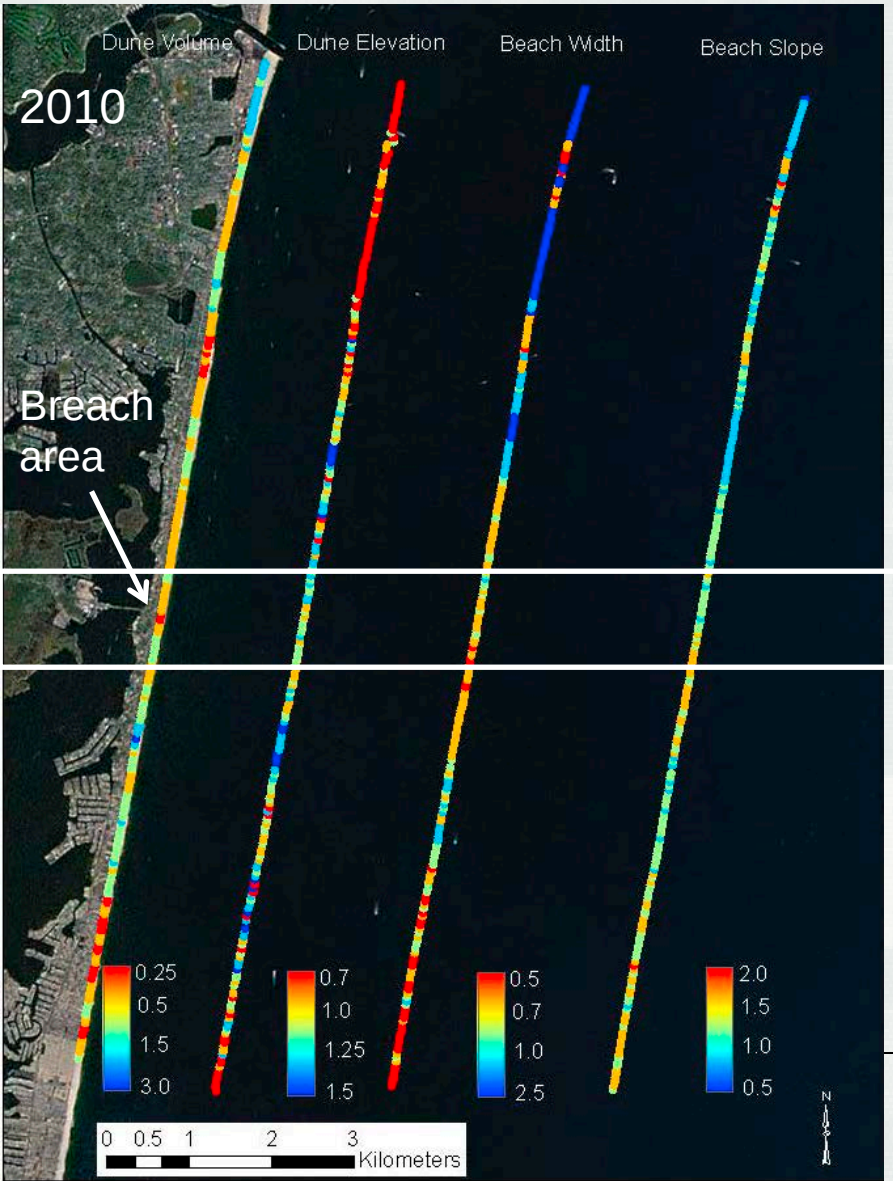
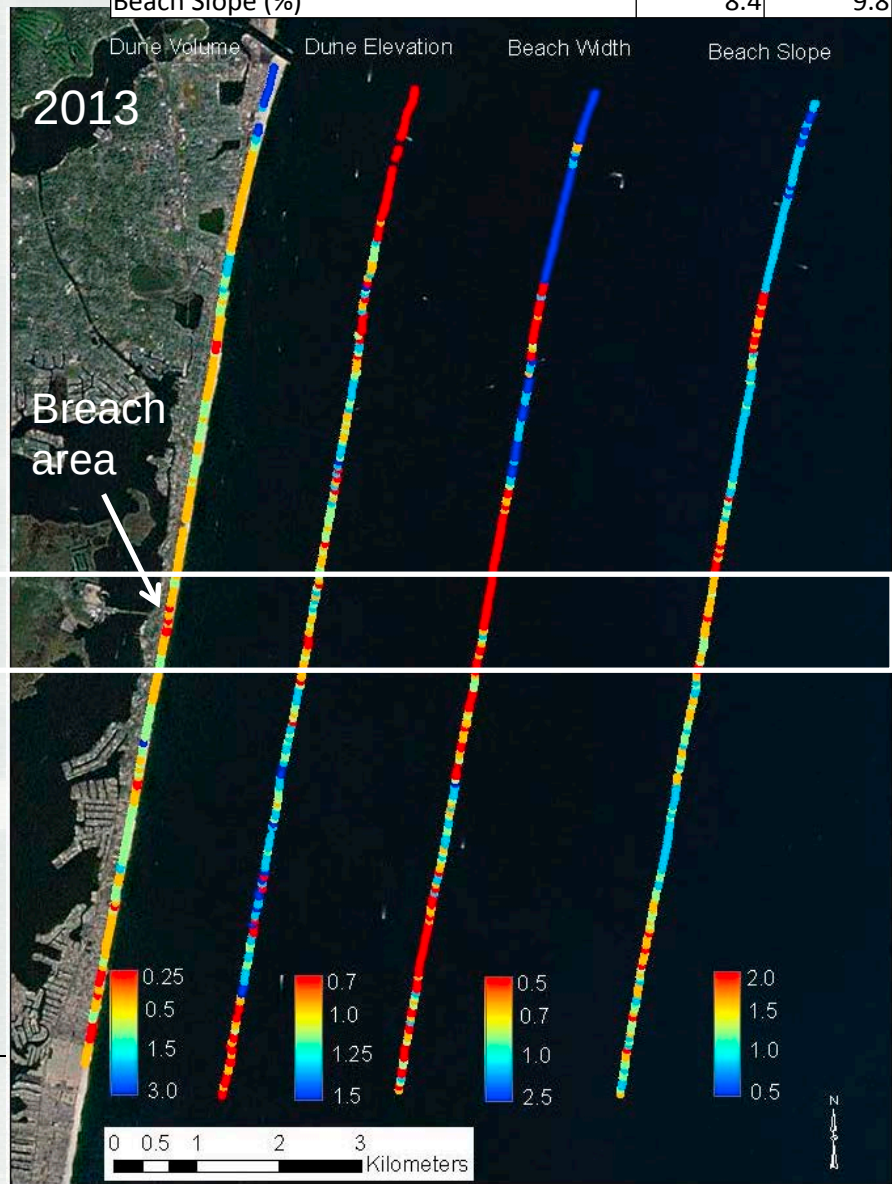
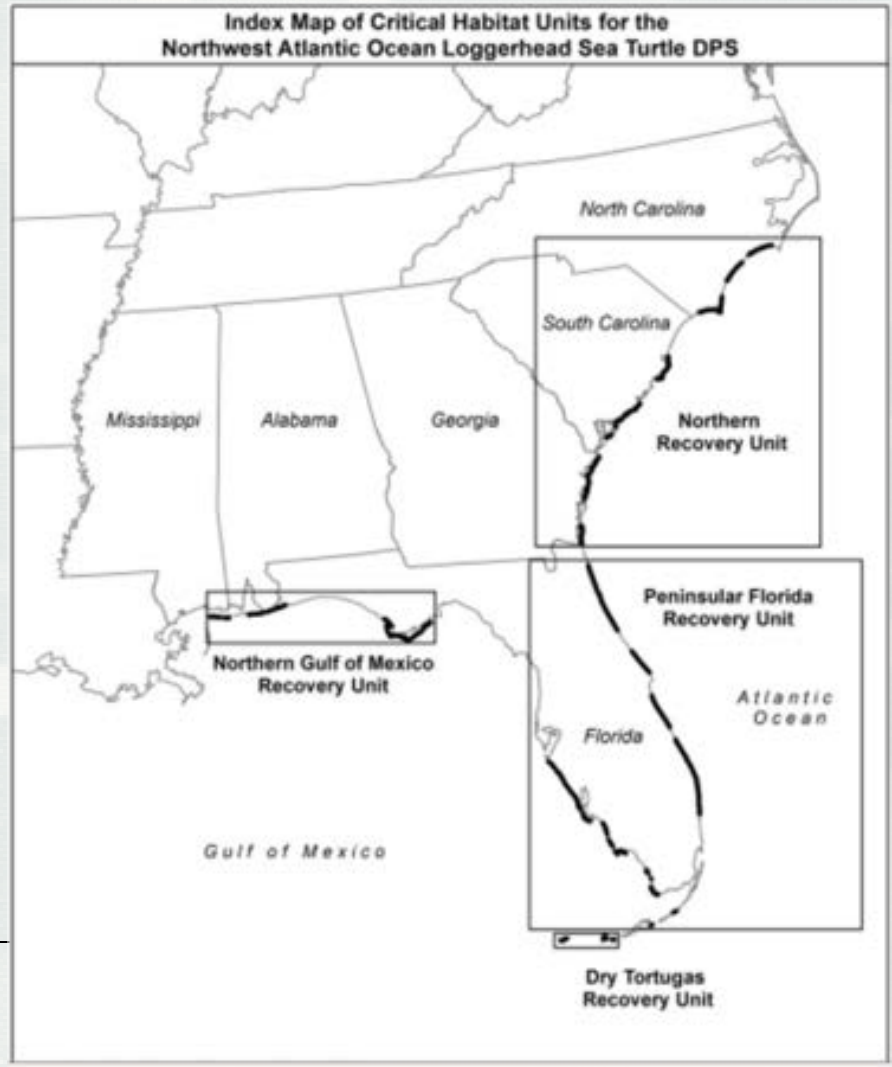




Critical Habitat

- Atlantic and Gulf of Mexico coastlines are being proposed for designation as critical habitat for loggerhead sea turtle conservation.
- Some areas overlap or are adjacent to areas that have USACE Navigation or Costal Storm Damage Reduction projects.



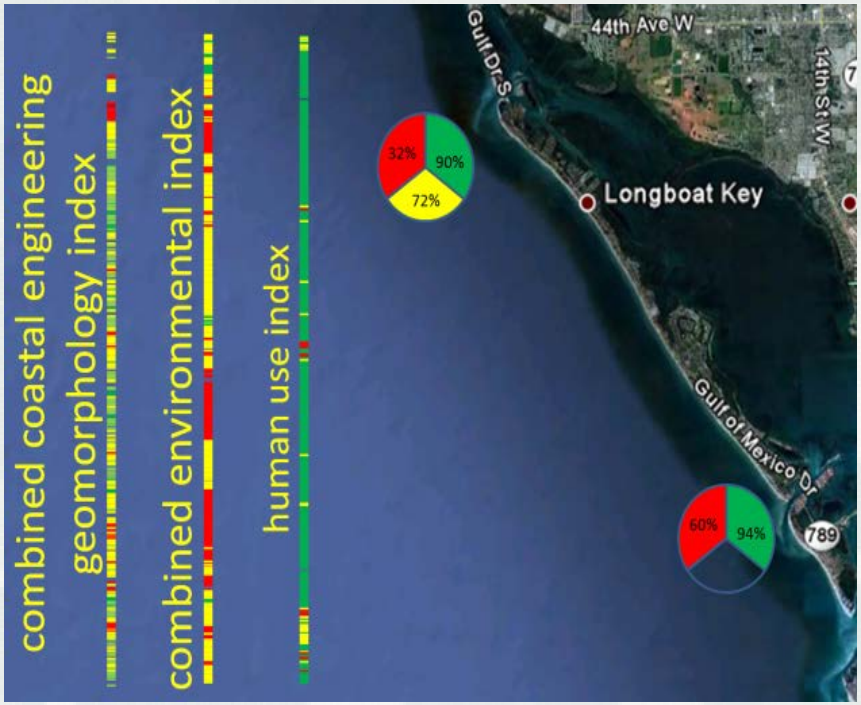
Critical Habitat

- Extract geomorphic and environmental parameters
  - Remote sensing mappable parameters; higher level view
- Assess the relative suitability of sites
- Develop a spatially-explicit ecological model for select study areas

- Benefit to USACE :
  - Determine the value of using remote sensing data to extract geomorphic and environmental parameters to improve model capabilities supporting USACE planning/managing objectives
  - Beneficially manage sediment and identify opportunities to design ‘turtle friendly’ beach profiles

Regions

- Coastal Engineering Indices: engineering and environmental parameters
- Standard method of delineating regions that can be scaled to incorporate different temporal and/or project objectives



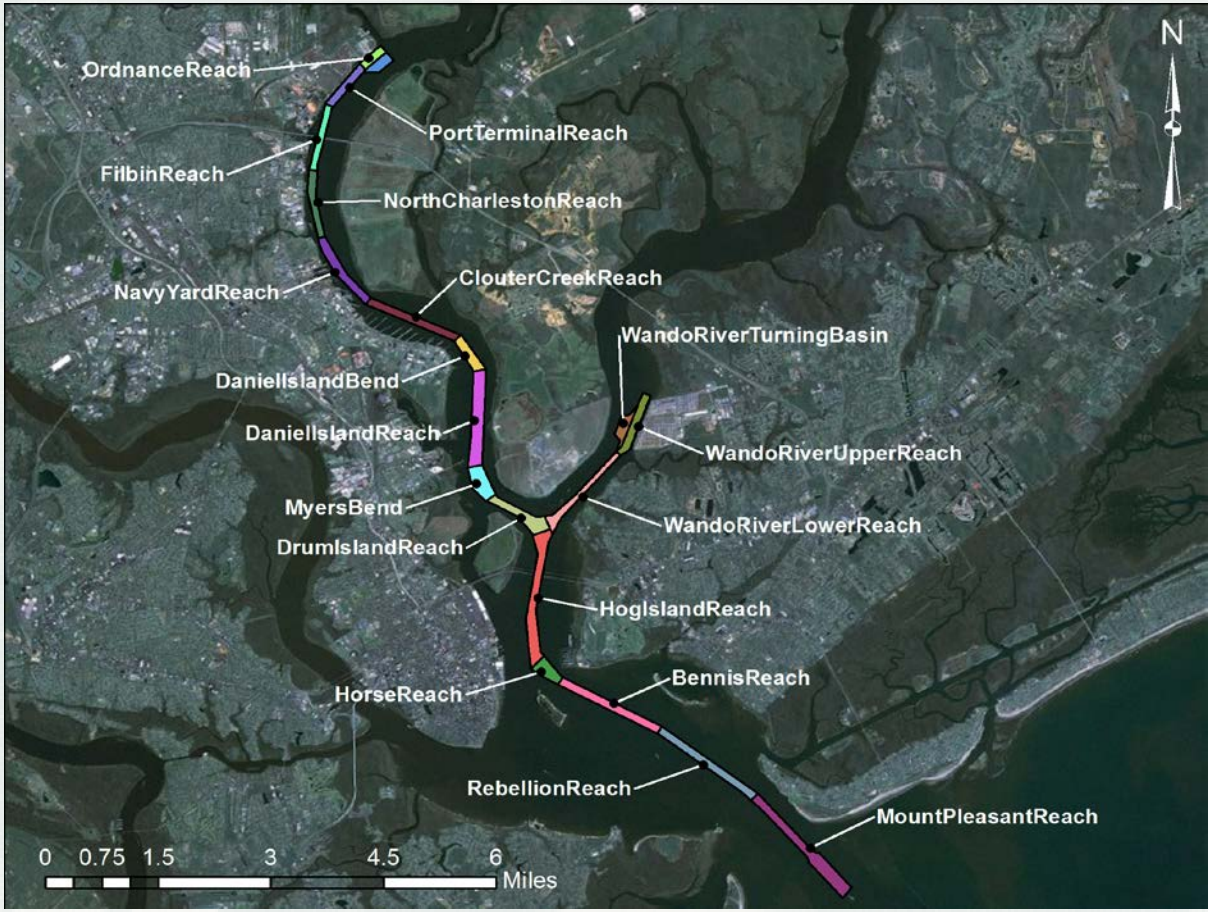
- Benefit to USACE :
  - Asses change from storm events or for restoration efforts,
  - Identify resilient coastal systems, and
  - Provide planners with a programmatic method for defining boundaries used for project planning

USACE Shoaling Analysis

- Relate metrics of economic significance to shoaling conditions and dredging requirements
- Quantify the value of maintaining Navigation channels as a function of cost, depth
  - Automatically ingest USACE survey data
  - Calculate shoaling rates in 3d
  - Plan dredging needs and impacts over a 2 year budget cycle
  - Improve dredging communication and coordination

Shoaling Analysis

- Channel Framework
  - Navigation channels defined by quarters
- Historical Surveys
  - single beam, multi-beam, lidar



Shoaling Analysis

- Analysis on 10’ x 10’ grid
  - Elevations
  - Avg/max/min shoaling rates

Shoaling Analysis

		Quantity (CY) at different future times to reach specified depth						
Target Elev, ft (MLLW)	Dredge Cut ft (MLLW)	Now	6 mos.	12 mos.	18 mos.	24 mos.	30 mos.	36 mos.
-45	-47	171,608	423,772	790,205	1,207,360	1,625,518	1,999,915	2,230,219
-43	-45	65,202	221,973	502,672	850,467	1,203,905	1,517,865	1,697,573
-41	-43	30,921	111,591	313,894	606,834	915,851	1,195,519	1,353,134
-39	-41	14,615	52,706	184,026	421,057	691,288	939,472	1,080,938
-37	-39	5,801	26,432	102,175	275,375	509,354	730,962	858,071
-35	-37	1,107	12,820	52,997	169,619	358,176	556,497	672,752
-33	-35	0	5,187	27,232	99,895	236,771	407,405	515,969
-31	-33	0	905	13,695	54,885	146,987	282,359	381,179
-29	-31	0	13	5,812	29,086	85,495	182,608	266,129
-27	-29	0	2	1,271	15,452	45,198	107,254	172,888
-25	-27	0	0	172	7,243	21,502	56,055	99,746
-23	-25	0	0	48	2,312	9,467	24,086	46,945
-21	-23	0	0	7	528	3,256	6,834	15,480
-19	-21	0	0	0	39	317	621	1,630
-17	-19	0	0	0	0	0	0	0

eHydro does this

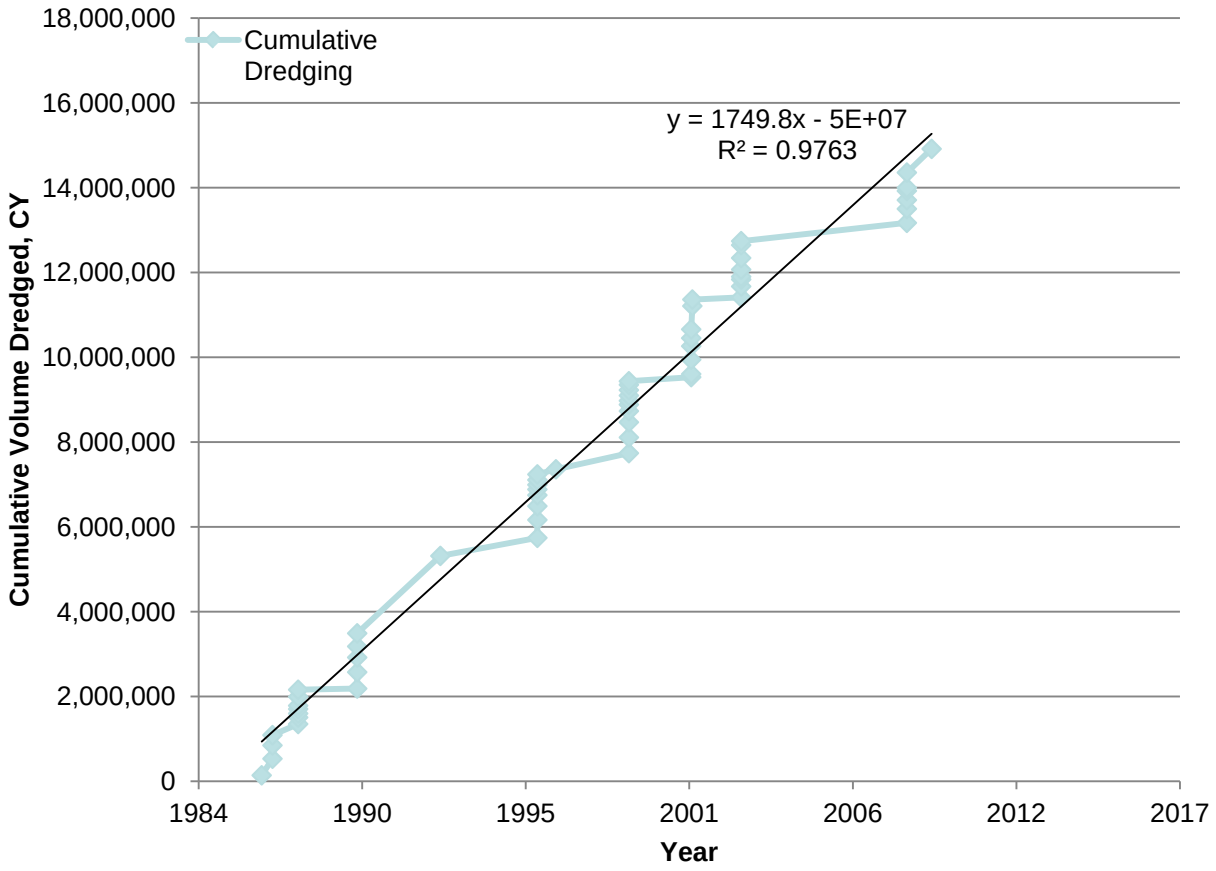
Shoaling Analysis

Shoaling Analysis

- Compare survey shoaling rates with dredging history
  - Cumulative dredging
  - Multiple surveys per year for each reach

Texas City Dredging History Analysis from 1986-2009	
Mean dredging rate, CY/year	639,114

CSAT shoaling rate from 2012 to 2013	
Mean dredging rate, CY/year	648,677



Questions?

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