

# Tools and Technologies for Coastal Regional Sediment Management

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**American Shore and Beach  
Preservation Association Conference**  
25-27 October 2017  
Fort Lauderdale, FL



**ERDC**  
Engineer Research and  
Development Center





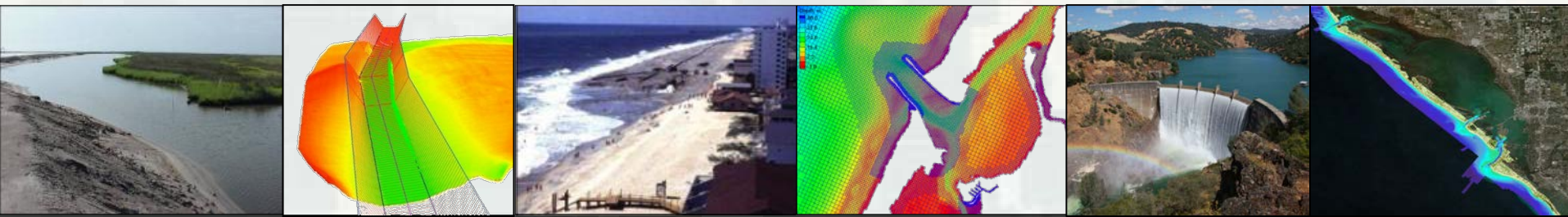
# Regional Sediment Management...

## Est 1999, CERB Charge



A systems approach to deliberately manage sediments in a manner that maximizes natural and economic efficiencies to contribute to sustainable water resource projects, environments, and communities = Healthy Systems

- Navigation, Flood Risk Mgmt, Ecosystem, Emergency Mgmt:
  - Short and long-term sustainable, resilient solutions
  - Coastal and Inland
- Recognizes sediment as a valuable regional resource
- Work across multiple projects, authorities, business lines
- Tools and technologies for regional approaches
- Relationship building for decision making & implementation





# RSM Goals and \*Strategies



Reduce  
Upland/CDF  
Disposal



Bypass  
Backpass  
Sediments



Reduce  
Erosion



Save  
Capacity



- Keep sediments in the system
- Mimic natural sediment processes
- Reduce unwanted sedimentation
- Environmental enhancement
- Maintain & protect infrastructure



Stabilize  
Structures



Reduce  
Channel  
Shoaling



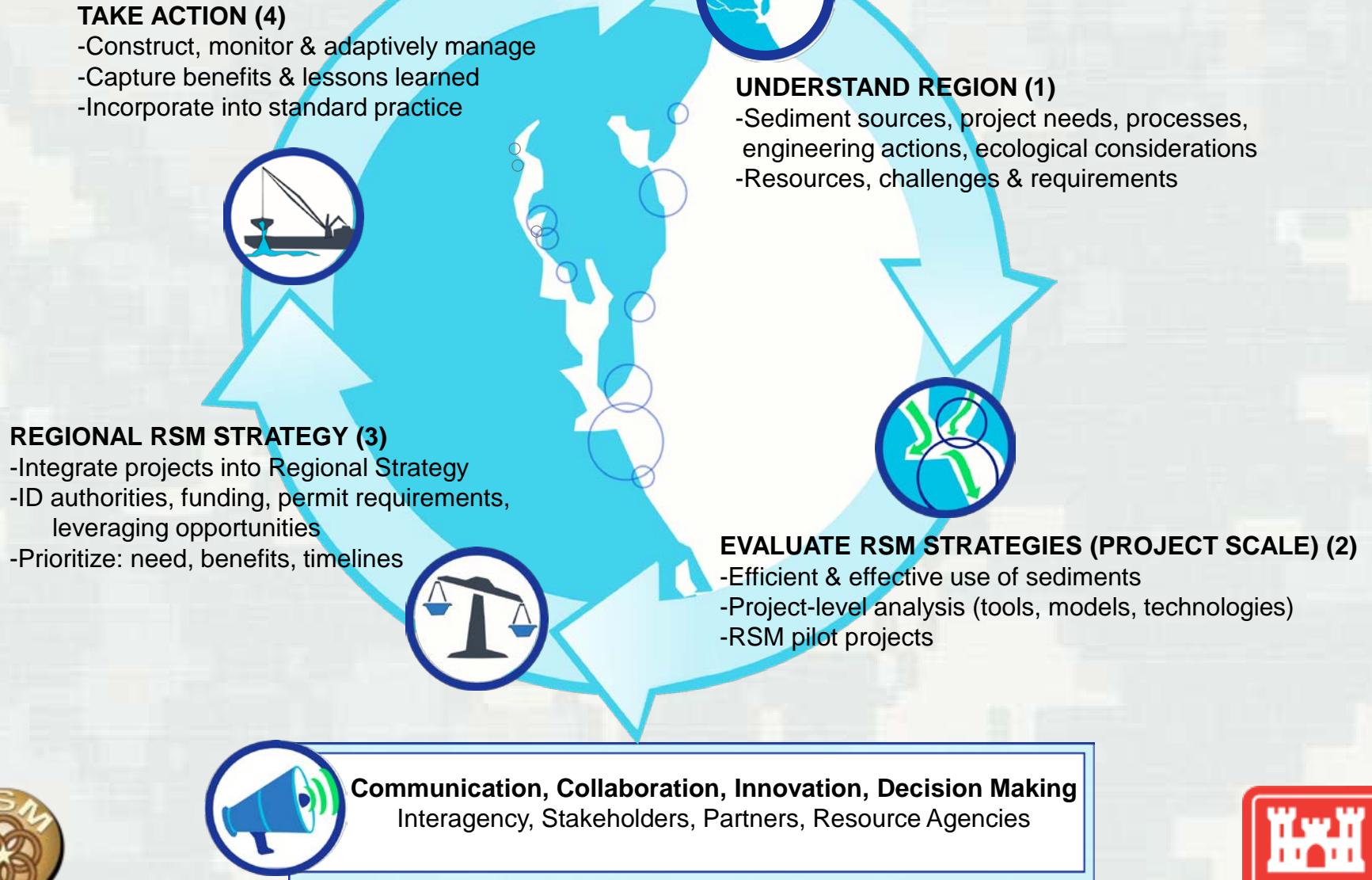
Reduce  
Runoff



Ecosystem  
Habitat  
Restoration



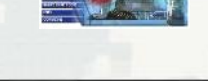
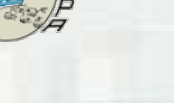
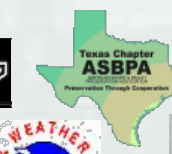
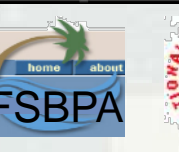
# RSM Process





# National RSM Program Participation (2000-2018)

## Collaboration



## Tools & Technologies

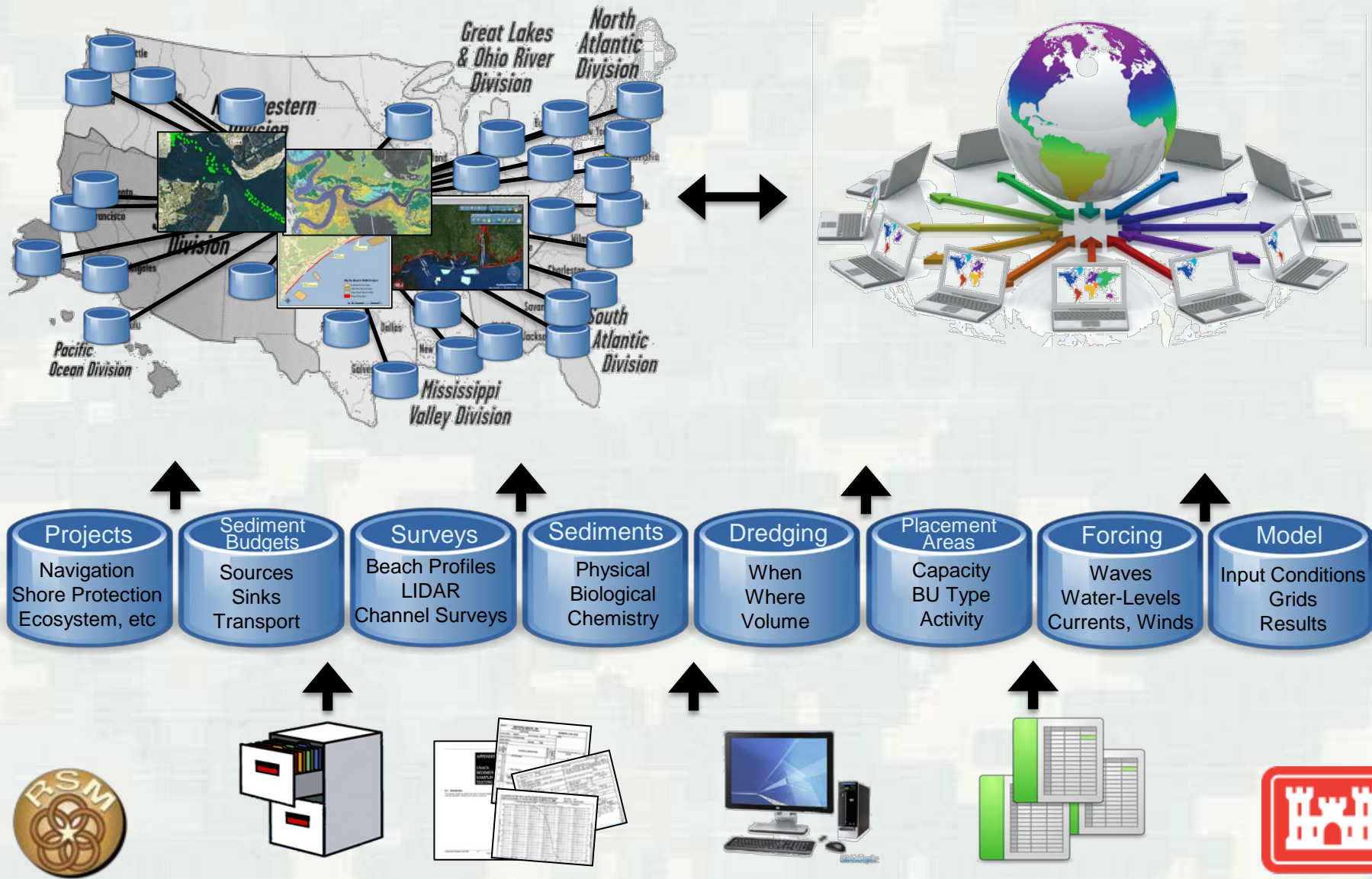
**Where is the data? What format? When collected?  
How do I get it?**






# USACE Navigation Data Integration Framework (NDIF)

## *Data Management & Integrated Tools*



<http://navigation.usace.army.mil>



ABOUT  
EXPLORE  
NAVIGATION  
RESOURCE  
DISCOVERY

HOME  
CONTACT  
LOGIN

## USACE Navigation Portal

Note: To view additional information in each of the following categories, click the Login button.

### Dredging

Maintenance of inland, intracoastal, and coastal waterways, channels, ports, and harbors

### Surveying & Mapping

Hydrographic Surveying, National Channel Framework (NCF), and Inland Electronic Navigational Charts (IENC)

### Marine Transportation System

Performance measures, including economic benefits, safety & security, environmental stewardship, system performance, capacity & reliability, and resilience

### e-Navigation

Coming Soon

Harmonized navigation information resources (including lock operations and marine safety) for US inland, intracoastal, and coastal waterways and channels

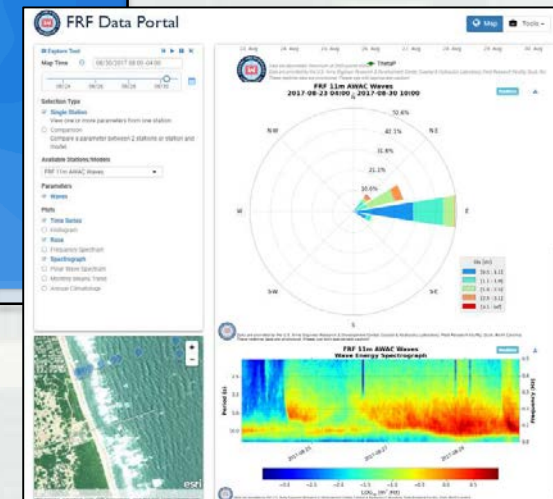
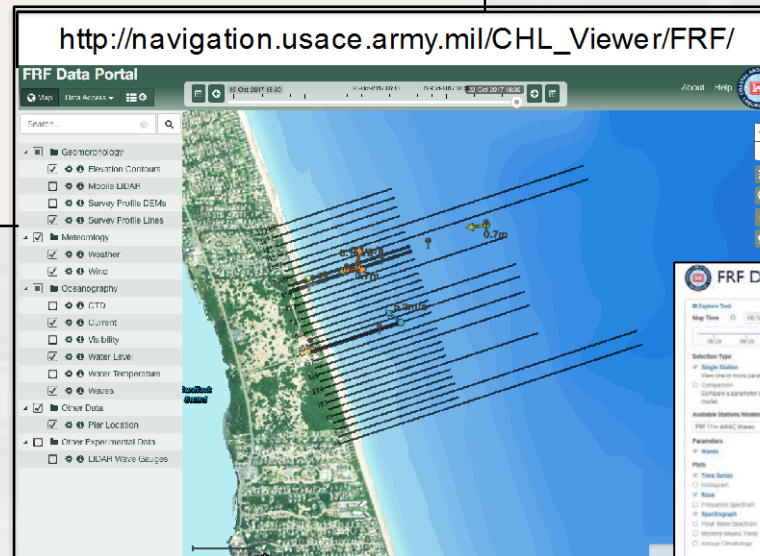
### Sediment & Ecosystem Management

Regional Sediment Management and Engineering With Nature

### Infrastructure & Asset Management

Coming Soon

Engineering, design, operation, monitoring, maintenance, and repair of coastal and inland structures





# Sediment Analysis and GeoApp (SAGA)

**Sediment Analysis (SAGA)**

<http://navigation.usace.army.mil/SEM/Analysis>

To view sediment data, from the Project List drop-down select a project or in the Search Sample Name text box type a sample name. The map zooms to the appropriate location, displaying sediment sampling events for all items selected in the Sediment Characterization Layers drop-down and the Layer Control section. To display the ID of an event, hover over its icon, to display a popup with additional data about the event, click the icon. Many popups also include links to additional data and/or reports. Sediment data is provided by the Sediment Analysis & Geo-App (SAGA) database, which is populated by USACE Districts through [Excel data templates](#) available on the USACE Geospatial Platform. To analyze a sediment sample not available in SAGA, select a tool from the Calculator Tools drop-down.

Project List ▾ Search Sample Name:

Sediment Characterization Layers ▾ Calculator Tools ▾

Layer Control:  
☒ Borehole ☒ Grab ☒ Well ☐ USGS Riverine ☐ USACE Riverine ☐ District Boundaries ☐ Navigation Channels ☐ Placement Areas

Information (1 of 2)  
 Name: DRV-25-91  
 Date: 07/16/1991  
 Type: Borehole  
 Description: Philly to the Sea, Reach E

Location Stratigraphy  
 Subsamples Sediment Characterization  
 Documents

Mapped Sites

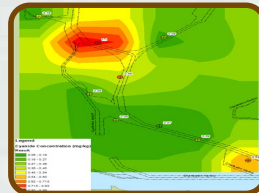
- Show distribution of sampling sites
- Filter sites based on sediment characterization testing
- View navigation channels or placements areas

Tools

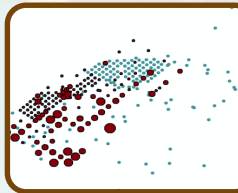
- Compute Grain Size statistics with data not yet stored in SAGA (Sieve size distribution testing)

Site Details

- Retrieve testing results
- View documents
- Access stratigraphy



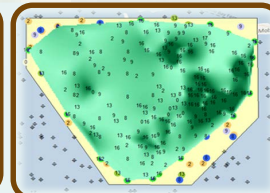
Visualize distribution of detected chemicals



Symbolize sites based on average grain size



Isolate sites based on attributes



Determine volume of material at specified depths



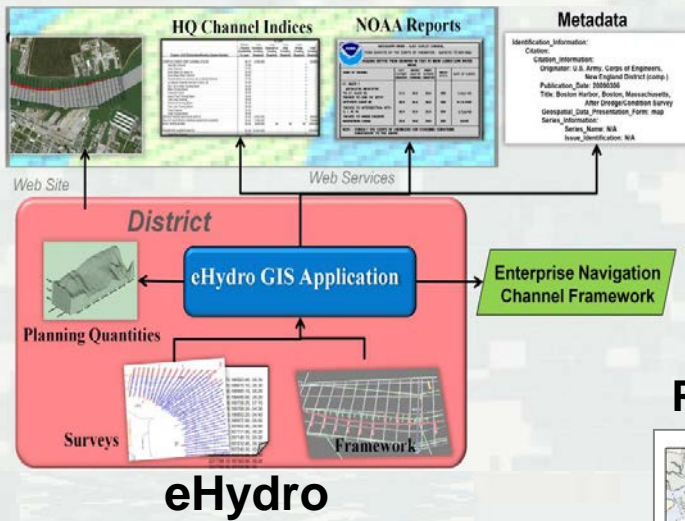
FRF



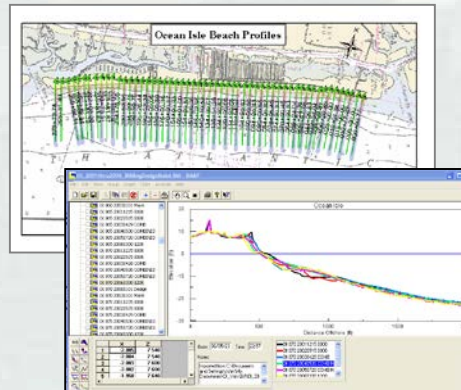
SAC, SPN  
MVD



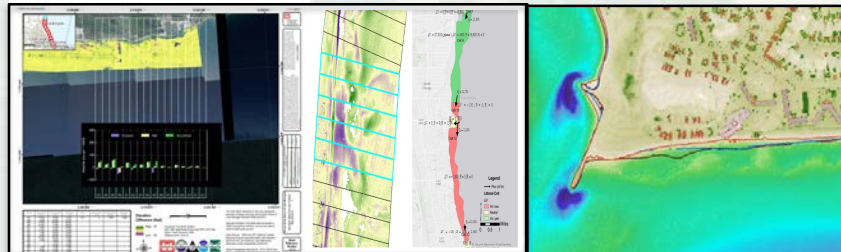
# Surveys & Analysis Tools



## Integrate Beach Profiles, Data & Tools



## Corps Shoaling & Analysis Tool (CSAT)



**JALBTCX ArcGIS Toolbox**  
elevations, volumes, shorelines, feature detection

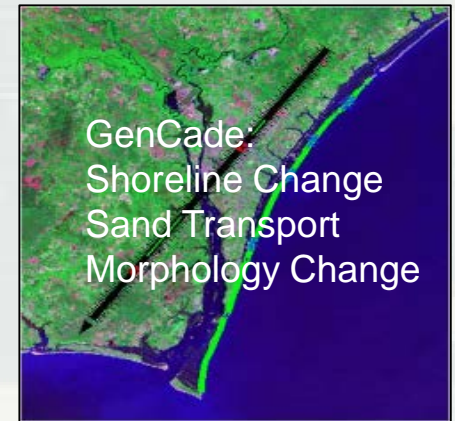
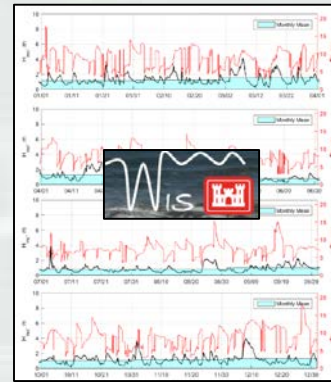
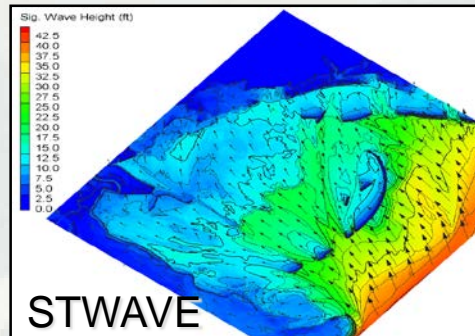
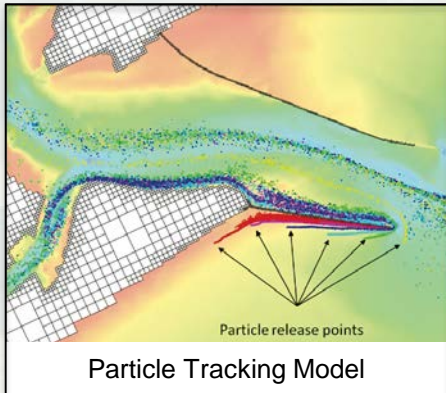
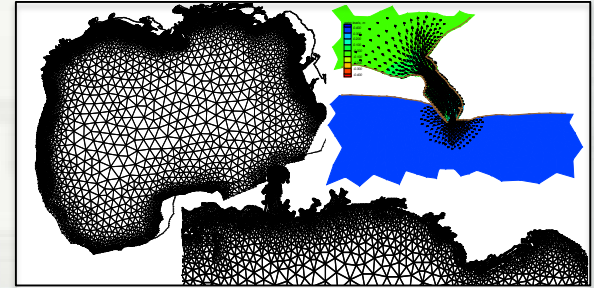




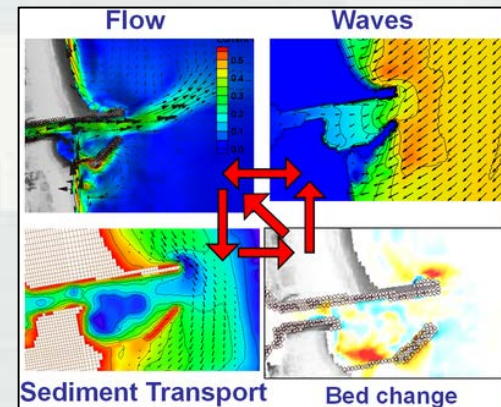
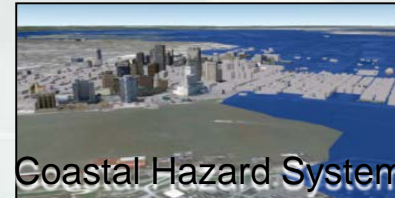
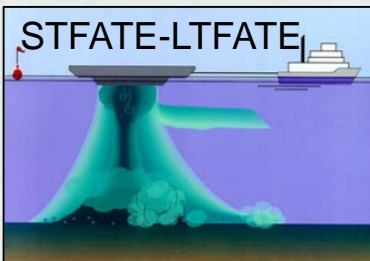
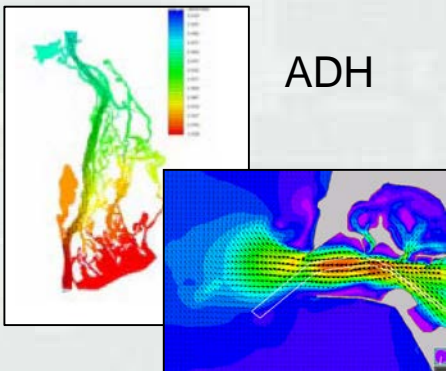
# Models for Coastal RSM

- Sediment sources and sinks
- Regional processes and trends
- Multiple interacting projects
- Connect beaches & inlets
- Connect rivers & reservoirs
- Navigation channel maintenance
- Evaluate local/regional RSM strategies

ADCIRC: Storm Surge & Circulation



Coastal Modeling System





# \*Dredging Technologies Web Interface

Selection Criteria, Model Requirements,  
Available Data, Guidance, Case Studies

**Dredging Technologies**  
A tool to identify appropriate models based on selected criteria

**1 Problem Criteria**

**Dredge Type**

- Hydraulic
  - ☐ Auger
  - ☐ Cutterhead
  - ☒ Hopper
- + Mechanical

**Location**

- Dredging Location
  - ☐ Entrance Channel
  - ☐ Estuary
  - ☒ Harbor
  - ☐ Inlet
  - ☐ River
- Placement Location/Type
  - ☐ Beach Nourishment
  - + Beneficial Use
    - ☐ Capping
    - ☐ Confined Aquatic Disposal
    - ☐ Confined Disposal Facility
    - ☒ Open Water

**Problem Type**

- ☐ Confined Disposal Facility Design
- ☐ Containment Transport
- ☒ Sediment Transport

**2 Models**

**Sediment Transport**

- LTFATE
- STFATE
- PTM →

**Hydrodynamic**

**Confined Disposal Facility**

**Contaminant Transport**

**Health Risk Assessment**

**Sediment Assessment and Management**

**Water Quality**

**3 PTM Sediment Transport**

Particle Tracking Model, a Lagrangian particle tracker numerical model to simulate particle transport processes.

**4**

**5**

Documentation and Downloads Data Sources Contact

**6 Input Parameters**

- + Computational Parameters
- + Simulation Temporal Details
- + Hydrodynamics
- + Native/Bed Sediment Characterization
  - Grid (Bathymetry)
  - Bed Porosity
  - Temperature
  - Salinity

**7 Output Parameters**

- + Mesh Data Output File (\_mesh.h5)
- + Particle Output File (\_particle.h5)

**8**

Click and drag to draw rectangle.

Model Data

- Toledo-sediment-websiteNB.avi
- Toledo-sediment-websiteSolids.avi

Cancel

Leaflet | OpenStreetMap | PTM dataset search

**Data changes (including image) based on selected model**

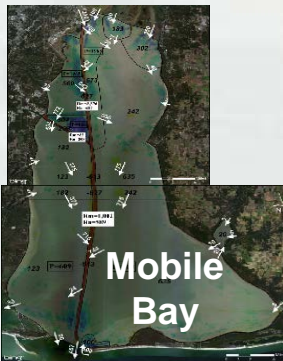
# Sediment Budget Analysis System (SBAS)



Regional Scale



Texas Coast



Mobile Bay

North Atlantic Coast Comprehensive Study



Fire Island Inlet to Montauk Point, NY



MS/AL Coast and Barrier Islands

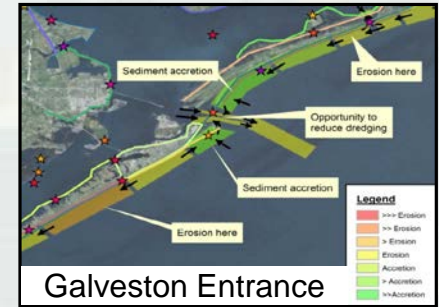
Sediment Budget Portal & Tools



Sediment Budget Database



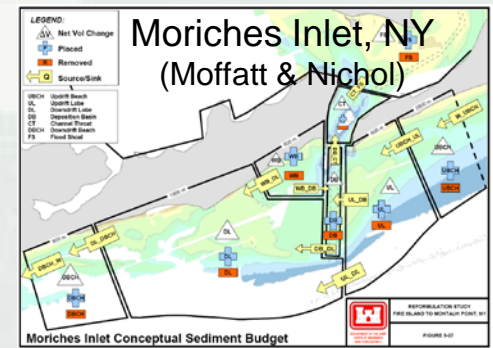
Project Scale



Galveston Entrance



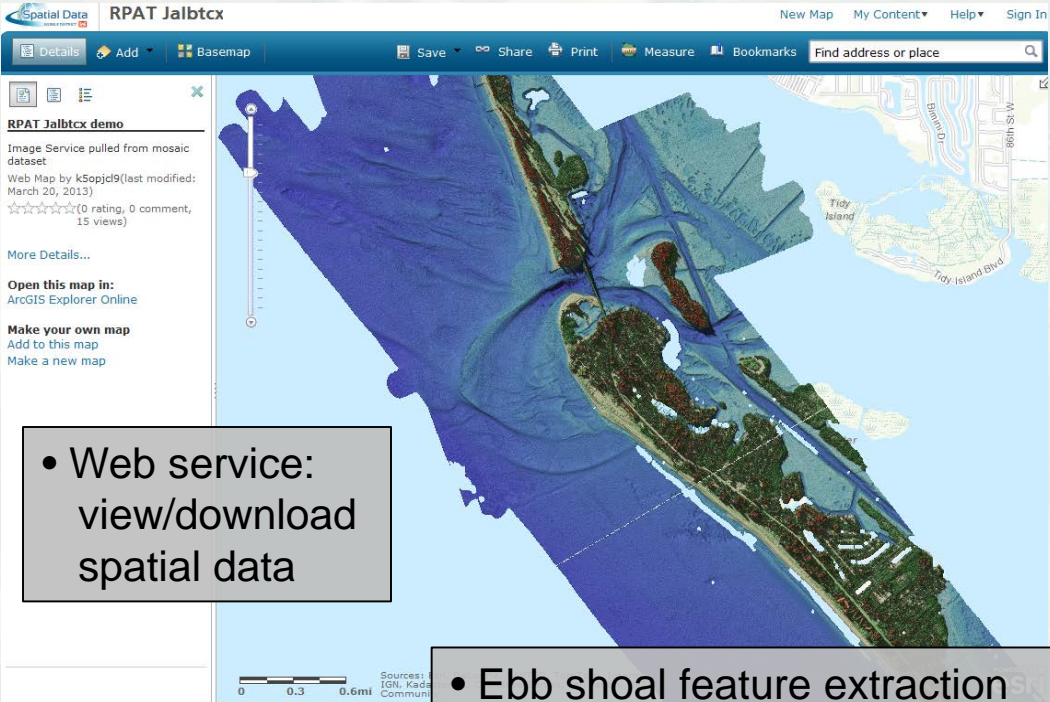
East Pass, FL



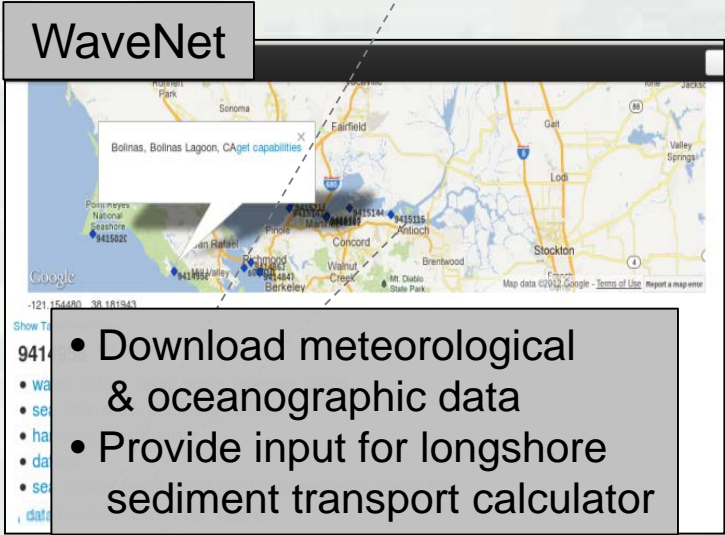
Moriches Inlet, NY (Moffatt & Nichol)



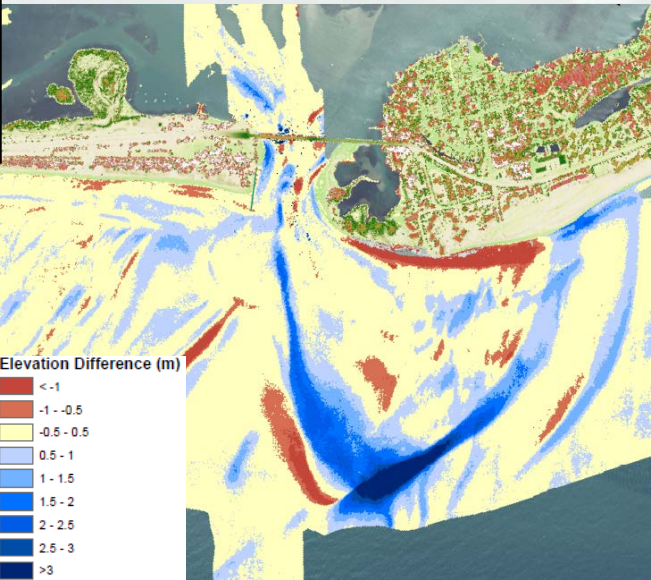
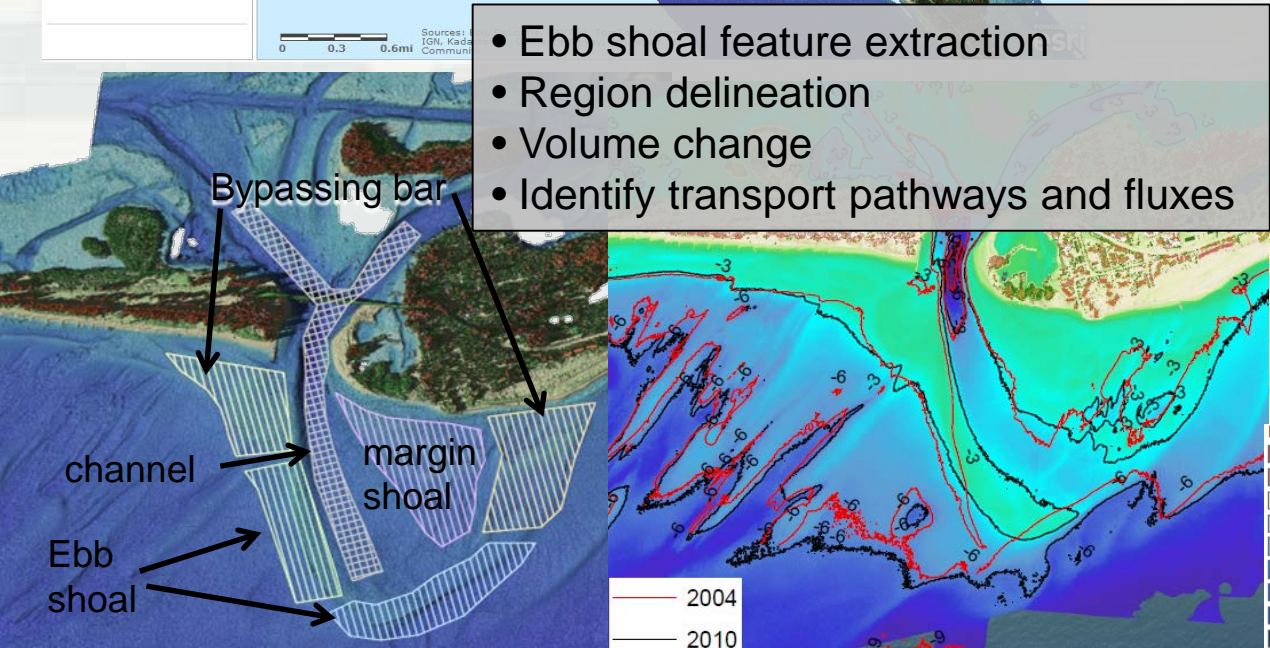
# Regional Process and Analysis Tool (RPAT)



- Web service: view/download spatial data



- Download meteorological & oceanographic data
- Provide input for longshore sediment transport calculator





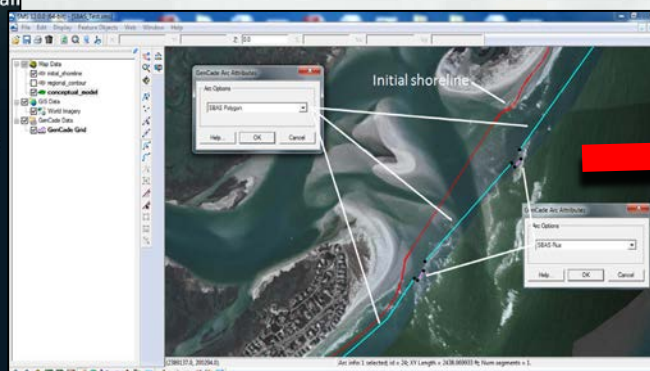
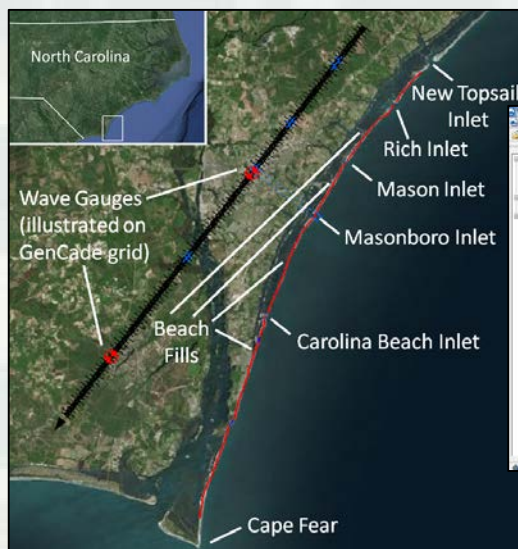
# GenCade & SBAS Integration



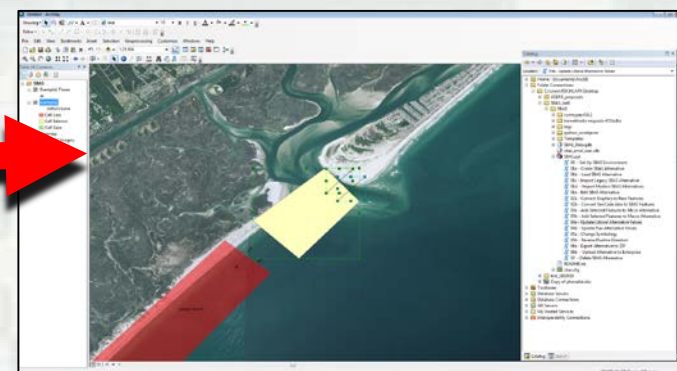
## GenCade

- Regional shoreline change, sand transport, inlet-sand sharing model
- Connects multiple beaches & inlets
- Multiple sources & sinks
- Regional trends
- Evaluate regional strategies

## GenCade



## SBAS



### Automate Output to SBAS

- Volume change
- Transport rates
- Dredging and beach fill volumes
- Cells and fluxes



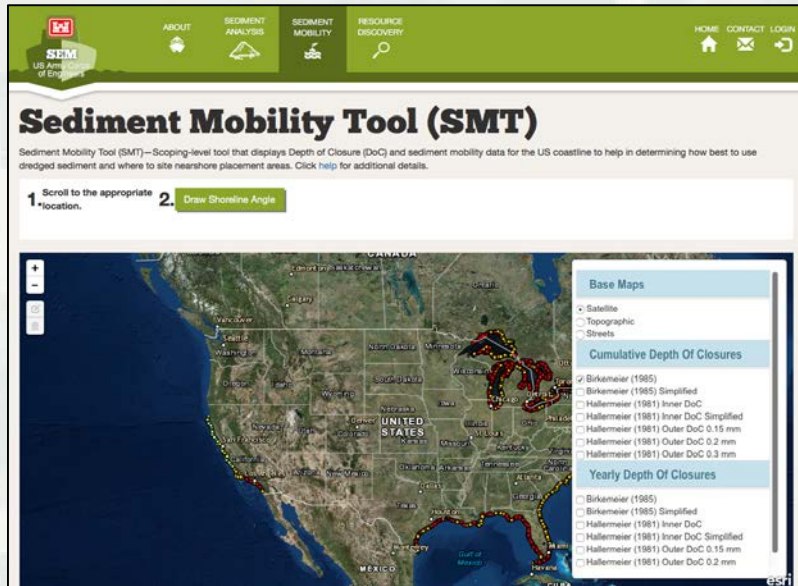
# Nearshore Berm Research, Guidance, and Tools

<http://navigation.usace.army.mil/SEM/SedimentMobility>

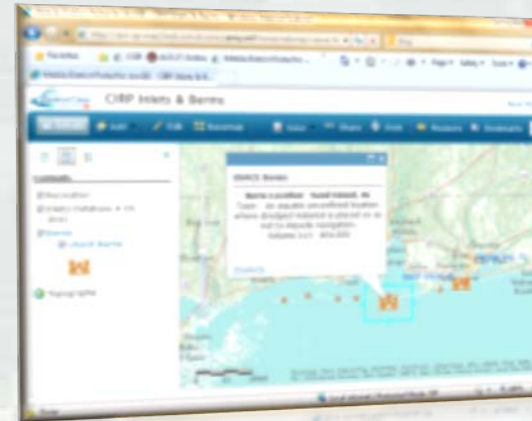
## SMT

Preliminary tool: educated decisions w/limited data  
Estimates

- Frequency of sediment mobility
- On/Offshore migration direction
- Dominant axis of wave direction to estimate alongshore migration



$d_{50}$ (mm)	Frequency of Mobilization	Predicted Sediment Migration
0.1	16 – 38%	83% Offshore
0.2	14 – 30%	60% Onshore
0.3	12 – 26%	84% Onshore



Berm Database



Assateague  
Island, MD



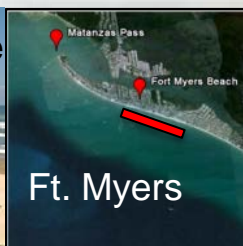
Pensacola



Vilano



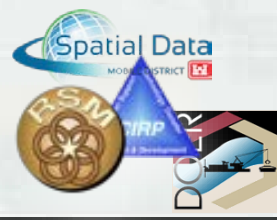
Egmont



Ft. Myers



South Padre  
Island





# Thin Layer Placement of Dredged Sediments - Wetlands



Predict response of coastal wetlands to dredged sediment placement

- consolidation
- settlement
- biomass
- sediment organic content
- carbon sequestration

Better design TLP projects

- achieve design marsh elevations

Advance state of practice

- reducing costs
- maximizing benefits

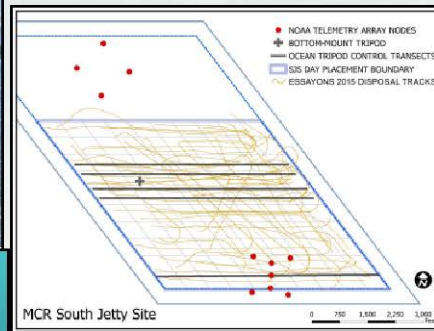
Provide Guidance





# Thin Layer Placement of Dredged Sediments

## Open Water Placement



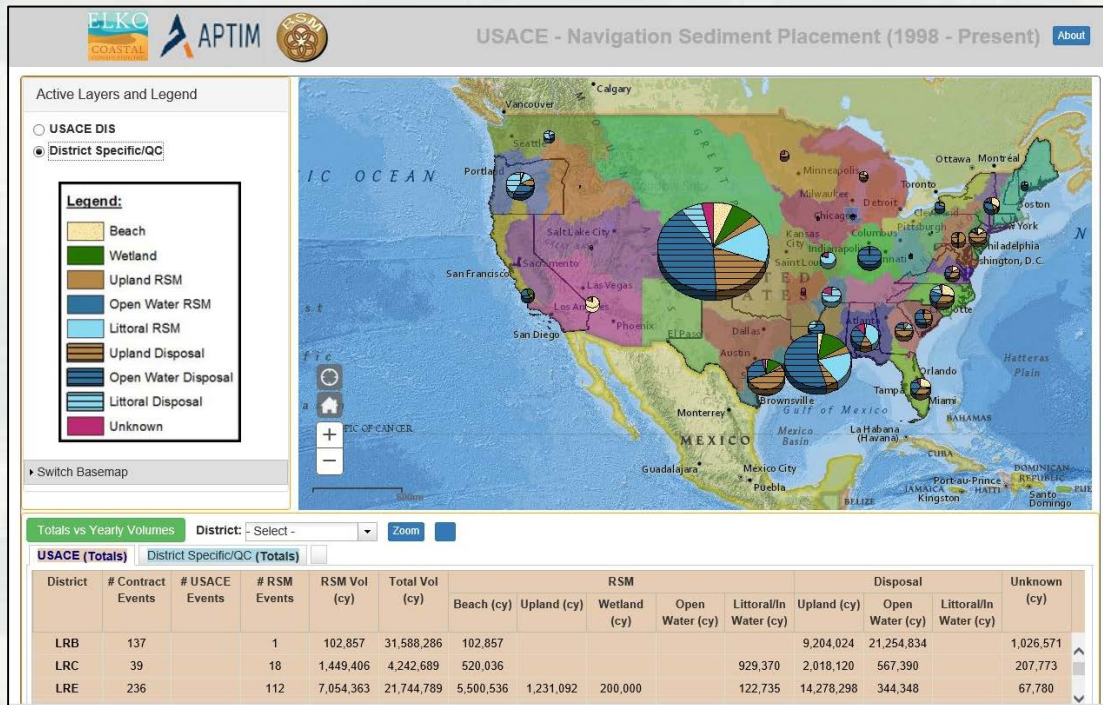
Mouth of the Columbia River  
*(Lower Columbia River Solutions Group)*    *(Interagency Working Group)*

Understand Behavior - Mobilization, Transport, Consolidation  
 Benthic Habitat - Reduce Impacts & Enhance  
 Shallow Emergent Tidal Marsh Habitat  
 Dredge Hole filling - Recover Hypoxic & Anoxic Zones

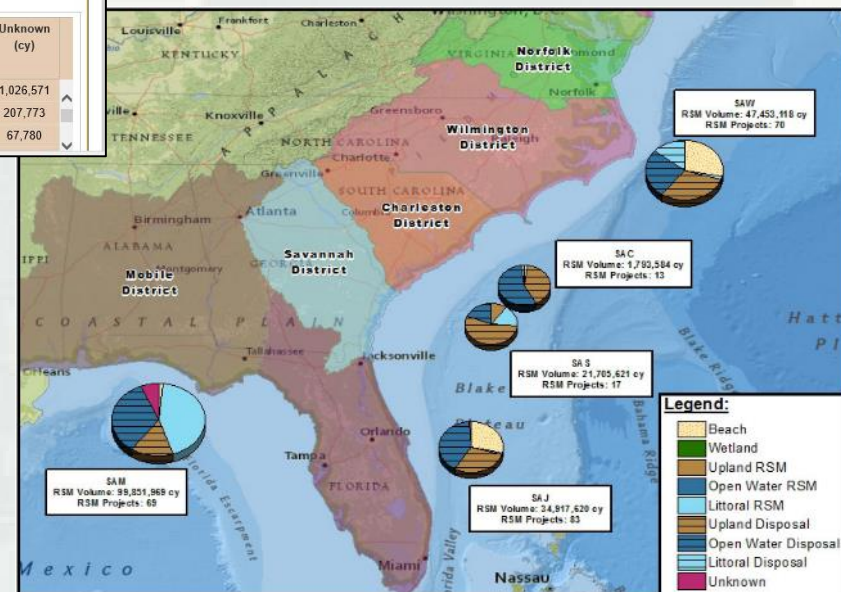


# RSM/Beneficial Placement of \*Coastal Navigation Sediments

Where, when, volume? Where can we improve?



- 1998 to Present
- 200 - 300 Mcy/yr USACE
- 175 Mcy/yr Coastal Navigation
- 33% or 57.6 Mcy/yr Placed Beneficially



\*Inland Navigation 2017/2018



# National Beach Nourishment Database

asbpa



APTIM

National Beach Nourishment Database [About](#)

Search and Zoom to Features

Zoom to State

NJ

Zoom

Legend:

National Nourishment Volume (cy)



Nourishment Volume By State (cy)

<1,000,000

1,500,000 to <15,000,000

15,000,000 to <50,000,000

50,000,000 to <100,000,000

100,000,000 to <700,000,000

Nourishment Project Locations

Nourishment Volume By Project (cy)

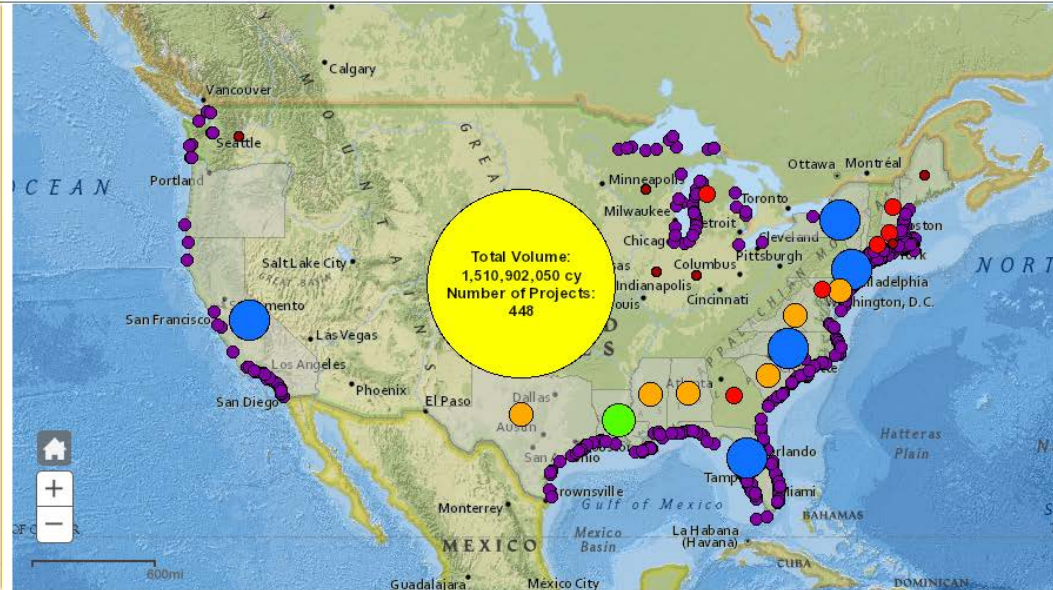
Known Total Volume (cy)

Known Federal Volume (cy)

Known RSM Volume (cy)

Known Other Volume (cy)

Turn On/Off Map Layers



State	Number of Projects	Number of Nourishment Events	Oldest Event	Newest Event	Known Total Cost	Total Volume (cy)	Known Length (Miles)
AK	2	7	2010	2016	\$9,871,702	331,271	
AL	5	15	1986	2016	\$60,757,977	17,675,692	16.7
CA	42	435	1927	2016	\$75,028,778	394,107,701	13.7
CT	28	40	1955	2014	\$15,161,135	6,234,672	13.9
DE	16	199	1953	2017	\$180,798,329	35,255,203	19.7
Totals	448	2901			\$5,770,351,757	1,510,902,050	789.2

- 449 projects placed >1.5 Bcy sand US beaches since 1920's
- Federal coastal storm damage reduction projects
- Beneficial placement of navigation sediment on beaches
- State/Local/Private beach nourishment projects

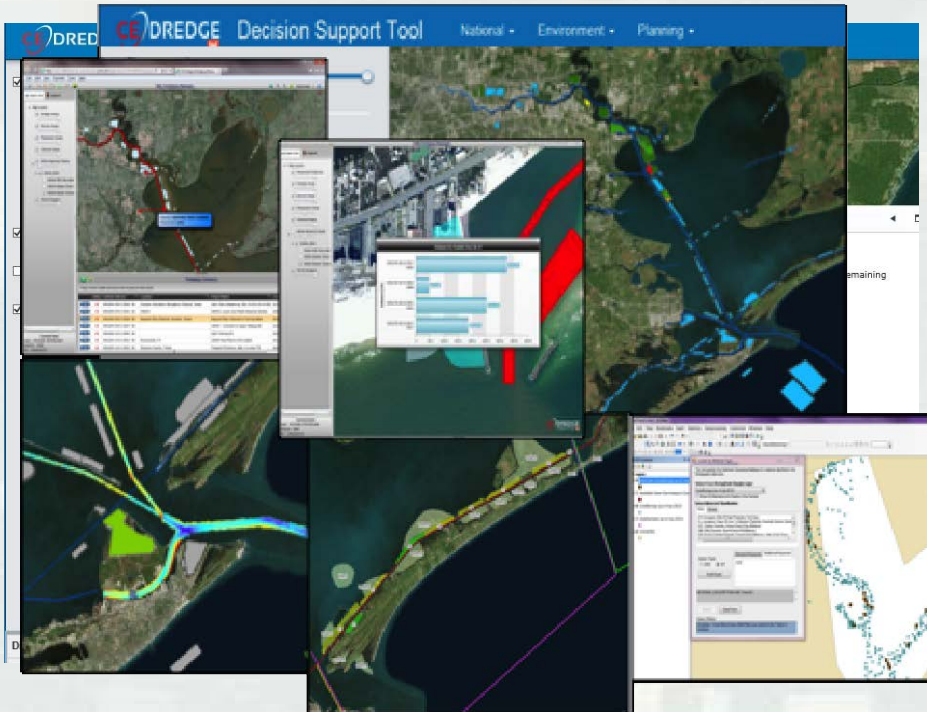




# Communication, Collaboration, Decision Making



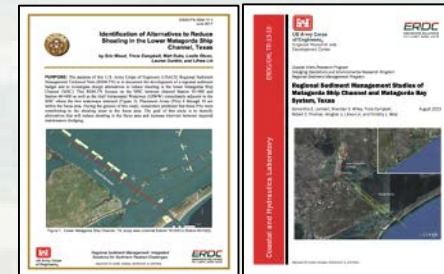
## Web-Based Decision Support Tools



## RSM-University Workshops & Training

- Thin-Layer Placement 2017
- Reservoir Sediment Mgmt 2017/18
- Sediment Budgets 2018
- Sediment Tracers 2018
- Interagency Meetings

## Lessoned Learned





# Regional Sediment Management = Resilient Healthy Systems



Regional Sediment Budgets  
Local Actions=Regional Benefits



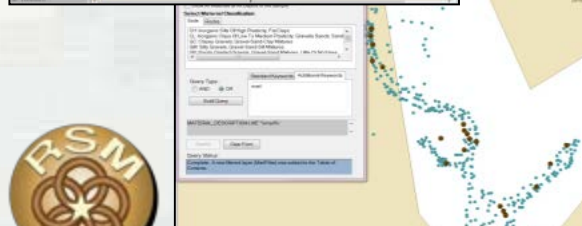
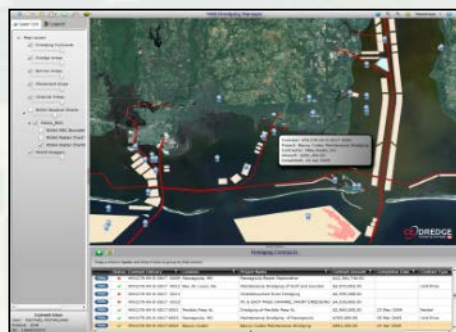
Regional Strategies



Nearshore Placement



Thin-Layer Placement



Data Management and Access



Improved Relationships



Riverine & Reservoir Mgmt



Fine Sediment Losses



Ecosystem Restoration



