Engineering with Nature and Wetland Restoration: How the Corps is Approaching Navigational Beneficial Reuse Projects

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US Army Corps of Engineers
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What is Engineering with Nature?

- USACE navigation program introduced EWN initiative in 2010
- Attempt to understand and deliberately work with natural processes to accomplish engineering goals
- Expands environmental, social, & economic benefits from USACE projects
- Focuses on collaboration and communication with a variety of stakeholders throughout the life of a project
- http://el.erdc.usace.army.mil/ewn/

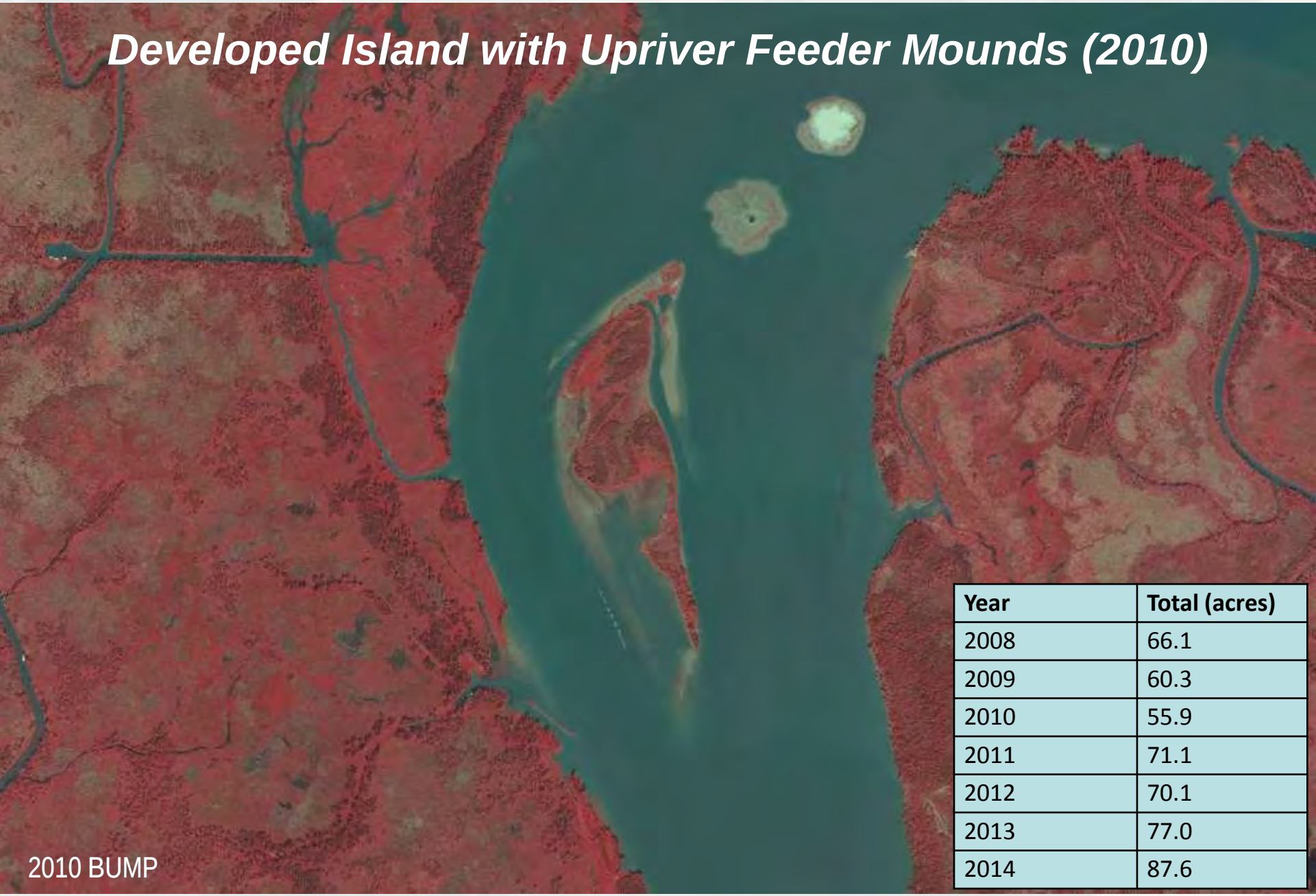
USACE Case Studies

- Atchafalaya River, LA: Federal Navigation Channel: multiple benefits derived from a novel dredged material placement practice
- Wax Lake Delta, LA: Strategic placement of sediment for coastal protection and resilience
- San Francisco Bay, CA: Use of sediment from a navigation project to restore degraded salt marsh and mudflat ecosystems

USACE Case Study

Atchafalaya River
Federal Navigation
Channel

Developed Island with Upriver Feeder Mounds (2010)



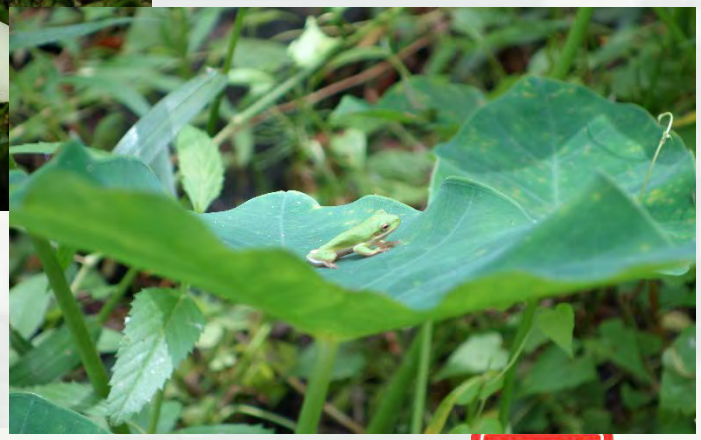
Year	Total (acres)
2008	66.1
2009	60.3
2010	55.9
2011	71.1
2012	70.1
2013	77.0
2014	87.6

2010 BUMP

Environmental Benefits

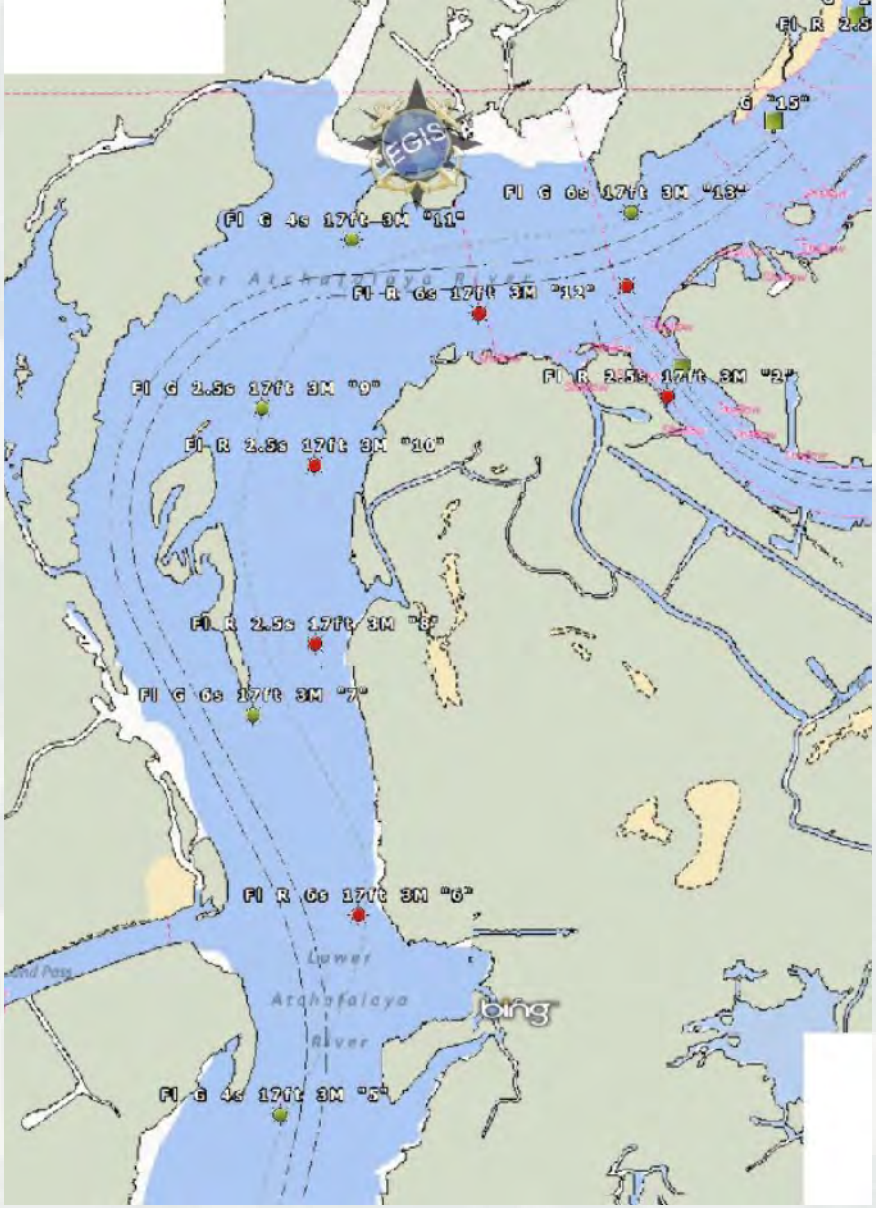
Created island supports:

- 35 ha habitat
- Four distinct habitat types
- 80 + plant species
- 20 + animal species
- Large wading bird rookery



Geomorphology and Nutrient Cycling

- Formation of dark, organic rich surface soils
- Resultant chemical reduction
  - Carbon sequestration
  - Nutrient cycling
  - De-nitrification



US Coast Guard Ship Channel Realignment

Navigation and Climate Benefits

- Island formation reduced dredging requirements
- Natural channel formed east of the island due to self-scouring
- US Coast Guard realigned channel (red circles, left)
  - channel length reduced
  - sharp bends eliminated
  - improved navigation safety
- Reduction in long-term dredging requirements
- Resultant carbon savings and reduced air pollution

USACE Case Study

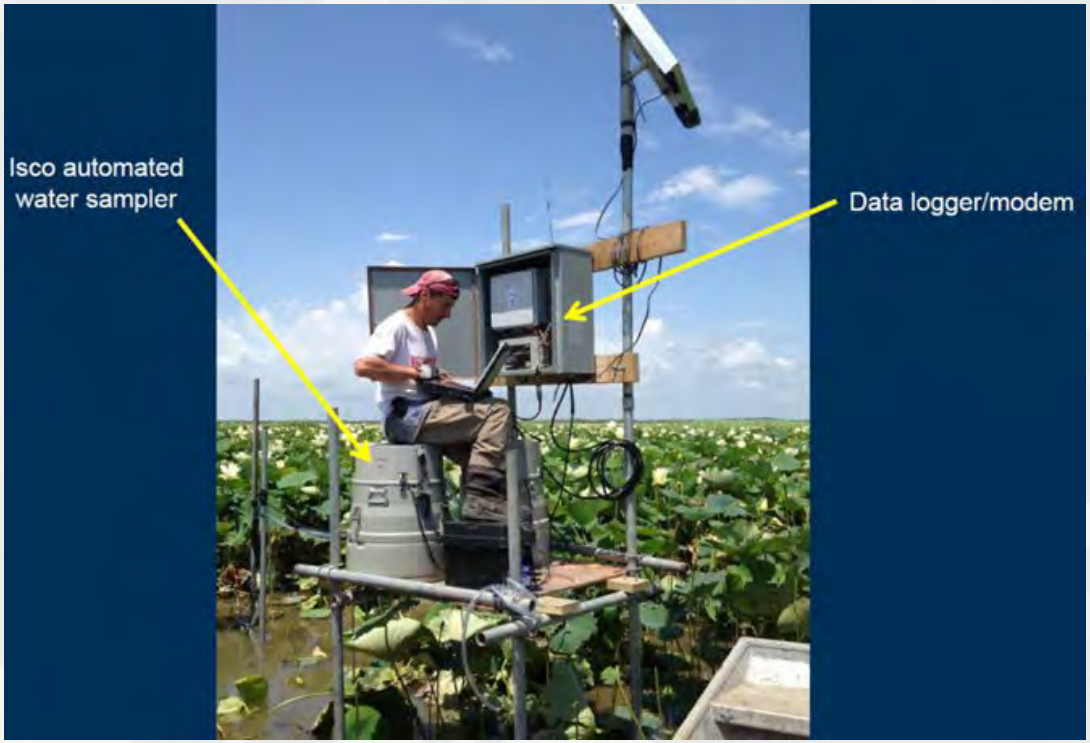
Wax Lake Delta, LA

Project Overview

- USACE charged with protecting coastal wetlands, critical habitats for a wide variety of organisms
- River diversions introduce new sediment to coastal wetlands and have been proposed as viable engineering alternatives to promote land building and further storm protection efforts
- The degree and rate of land loss in terms of sediment supply versus submergence
- Understanding wetland geomorphological processes provides the context for developing restoration alternatives and best practice strategies that can be applied across other USACE projects
- Studying such natural coastal features and processes provide insights into the design of dredged material placement areas and early identification of opportunities to coordinate navigation dredging and ecosystem restoration

Project Objective

Describe the hydrodynamic and sediment transport processes active within a delta island to better understand the mechanisms controlling sediment delivery and associated land building

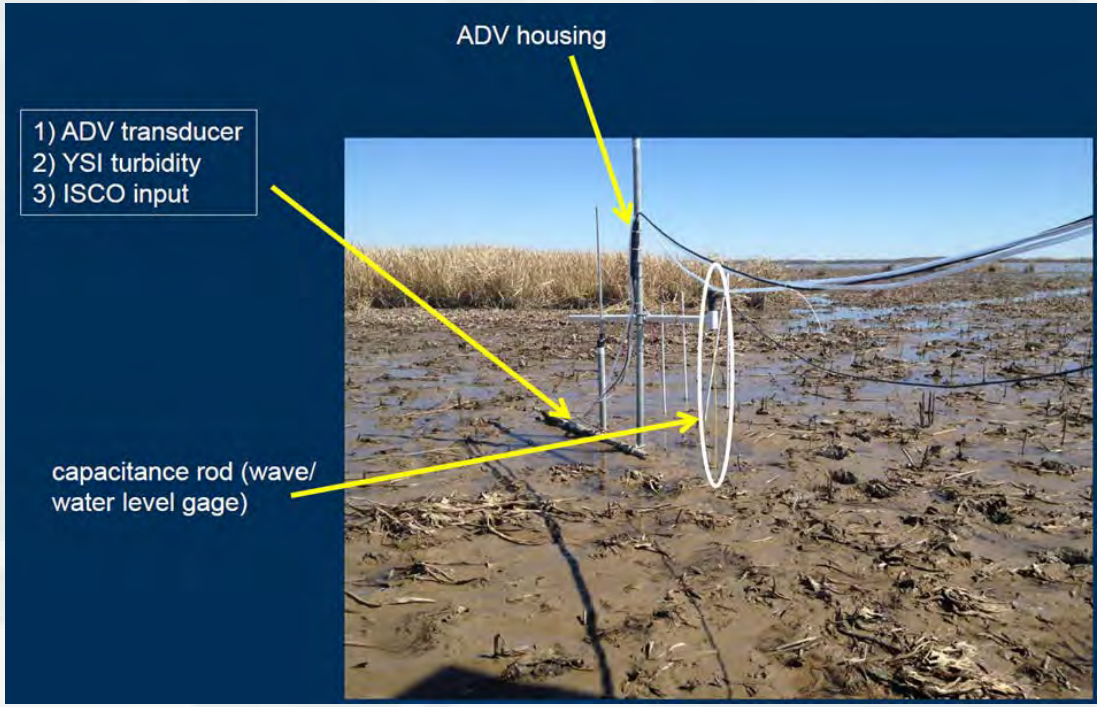


Focus on hydrodynamic measurements, which imply multiple regimes of sediment delivery based on seasonal differences in climate and biological activity

Field Data Collection

Approach

- Multiple field sites monitored to assess range of conditions necessary to achieve project objectives
- Multiple time scales
  - ► Hours/days/weeks for quantifying exposure
  - ► Days/weeks for quantifying effects on species
  - ► Days/months/year for quantifying morphologic evolution, species growth, and habitat evolution



Seasonal Differences

- **Winter:** Vegetation is absent and the primary flow is driven by tides
- **Spring:** Increased river discharge inundates the island producing lateral flows that supply large quantities of terrestrial sediments to interior regions
- **Late spring:** Persistent southeasterly winds cause setup along the coast and higher water levels over the island allowing waves to more easily penetrate the island interior
- **Summer:** Emergence of American lotus forms dense canopy over the island reducing wind and wave energy and the potential for sediment resuspension

Winter / Summer

Absent of vegetation (left); covered with the native American lotus (*Nelumbo lutea*; right).

The results reveal new insight into sediment pathways and accretion that will produce tools to inform coastal wetland management strategies in the context of global sea level rise

USACE Case Study

San Francisco Bay, CA

Levee Breached at Hamilton Airfield (KPIX)

Project Objective

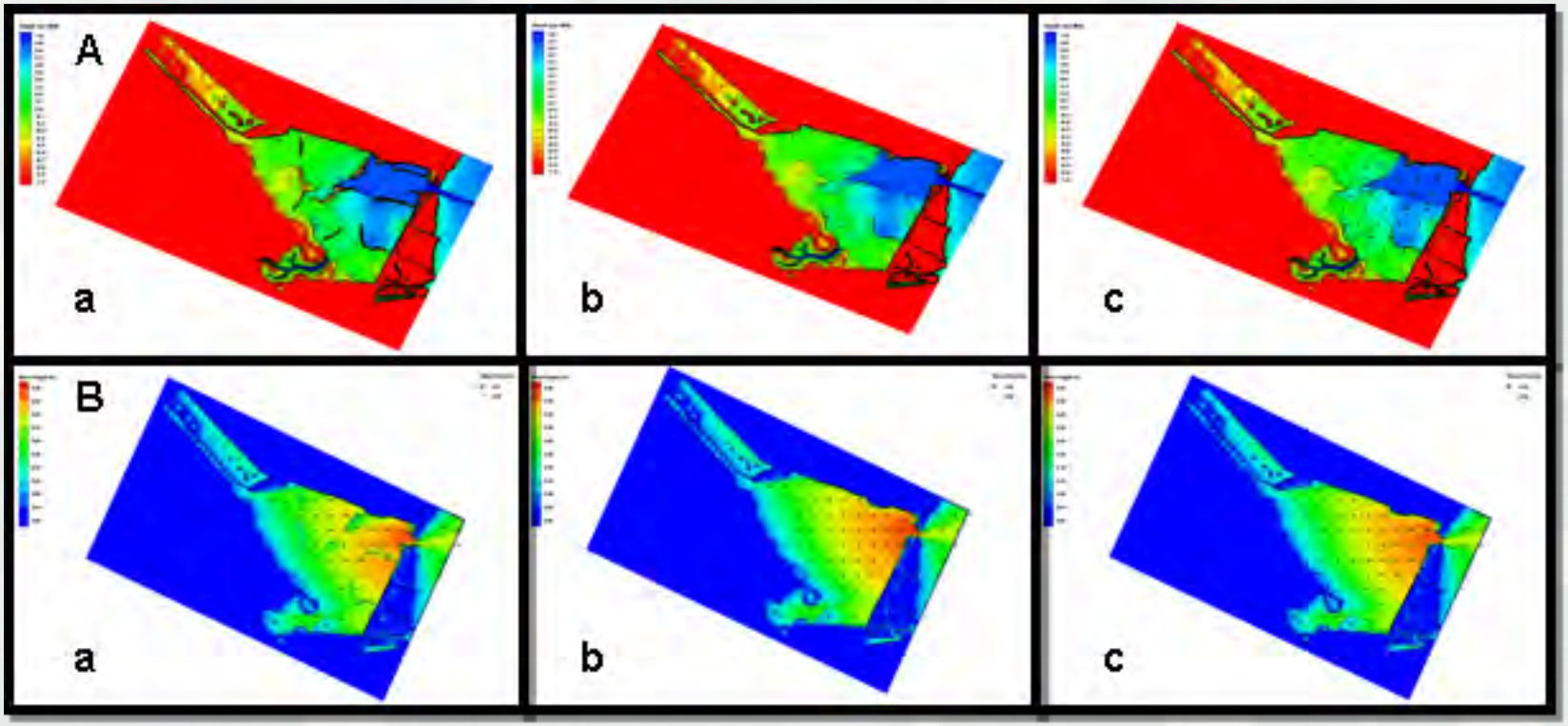
Sediment Retention Engineering to Facilitate Wetland Development

- Evaluate efficacy of linear versus round berms for decreasing fetch across a restoration site, thereby promoting accretion
- Restoration sites in San Francisco Bay:
  - Hamilton Wetlands Restoration Project, employing long, linear berms
  - Sears Point, utilizing array of round to oblong berm-like mounds
- Data lacking to evaluate and analyze outcomes and establish best practices for beneficial use of dredged material for managing sediment regionally

Approach

- Literature review
- Field data collection
- Modeling
- Scenario testing
- Bathymetry
- Topography
- Supplementary data (e.g., aerials, winds, wave height, wave energy, currents, temperature)

Some Initial Results



Example modeling results showing bathymetry (A), and wave energy results (B) for linear berms (a), flat bottom control (b) and an array of round mounds (c). Simulations showed linear berms were more effective at decreasing wave energy in various scenarios (from Smith et al. 2015).

Take Away Points

- Multiple wetland restoration benefits being realized through implementation and documentation of field demonstrations of EWN
- EWN projects fostering collaboration and implementing new practices within USACE
- Examples applying EWN related to restoration of wetlands and implementing new practices:
  - Strategic placement of sediments
  - Incorporating natural features reducing navigation channel infilling
  - Using wetlands and other features for coastal protection and resilience