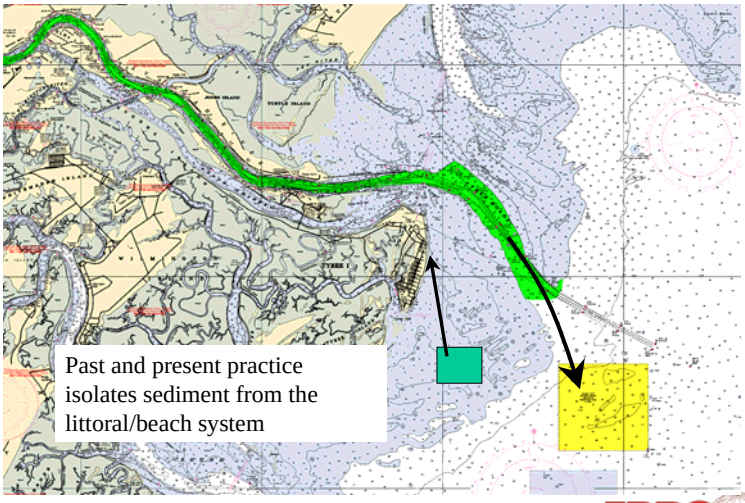
Savannah Harbor Beneficial Use Study

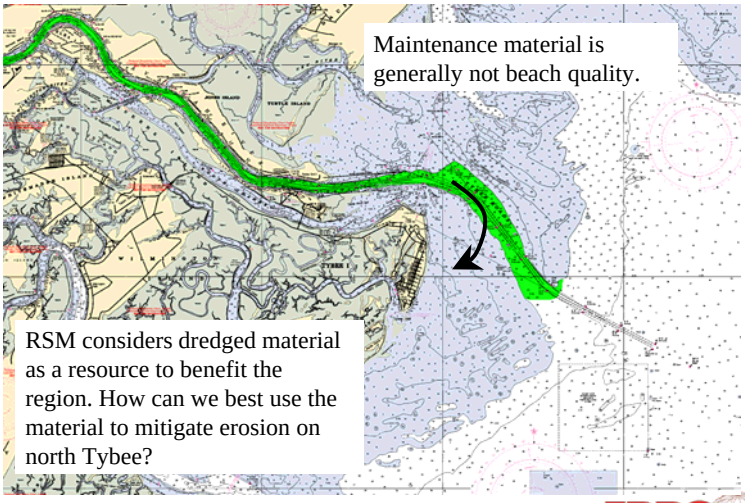
Joseph Gailani, Jarrell Smith
Bruce Ebersole, Carl Miller, Layla Raad

U.S. Army Corps of Engineers
Engineer Research and Development Center

Project Specific Sediment Management



Regional Sediment Management



U.S. Army Corps of Engineers
Engineer Research and Development Center

Savannah Nearshore Placement Study Issues:

- **Benefits to Tybee Island littoral system?**
- **Negative impacts to Tybee Island shoreline?**
- **Minimize sediment rehandling**
- **Nearshore turbidity**
- **Identify optimal placement locations and orientation for nearshore placement.**

U.S. Army Corps of Engineers
Engineer Research and Development Center

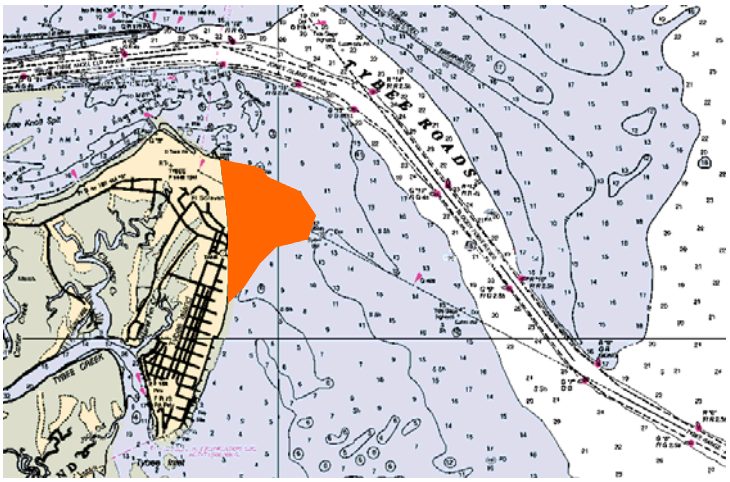
Savannah Nearshore Placement Study Methods:

- Collect appropriate data at Savannah
- Model hydrodynamics, waves and sediment transport at Savannah
- Improve and increase confidence in Savannah predictions by validating methods and models at Brunswick.
  - Collect nearshore mound migration data
  - Model same processes at Brunswick

U.S. Army Corps of Engineers
Engineer Research and Development Center

ERDC

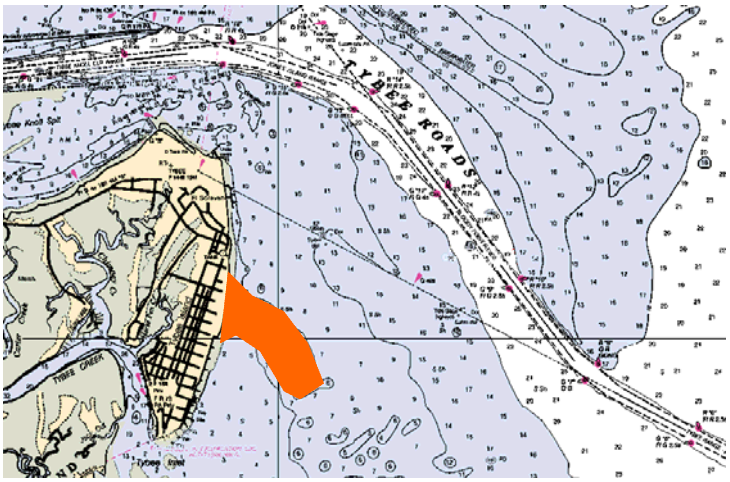
Attachment Bar 1854



U.S. Army Corps of Engineers
Engineer Research and Development Center

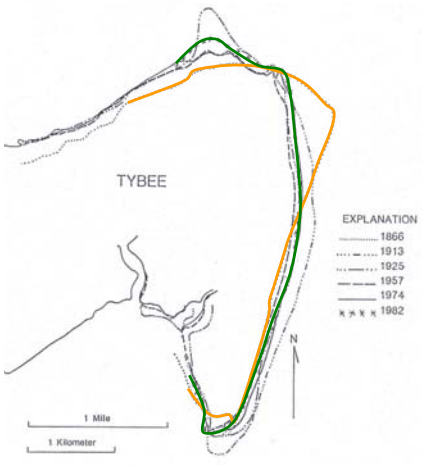
ERDC

Attachment Bar 2002



U.S. Army Corps of Engineers
Engineer Research and Development Center

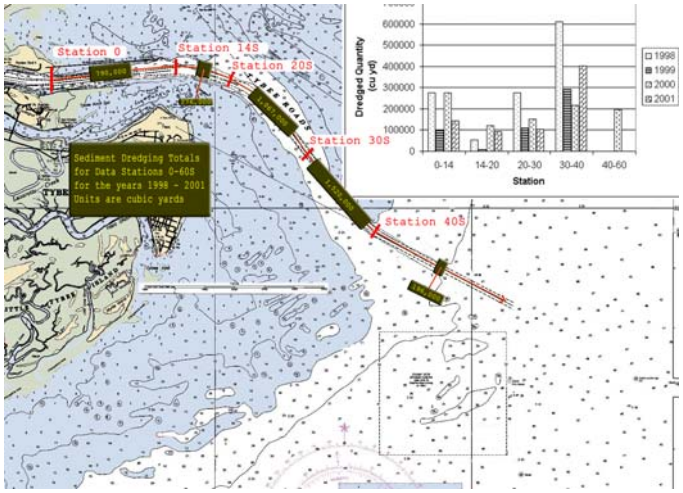
History of Tybee Island Shoreline



1866
1982

U.S. Army Corps of Engineers
Engineer Research and Development Center

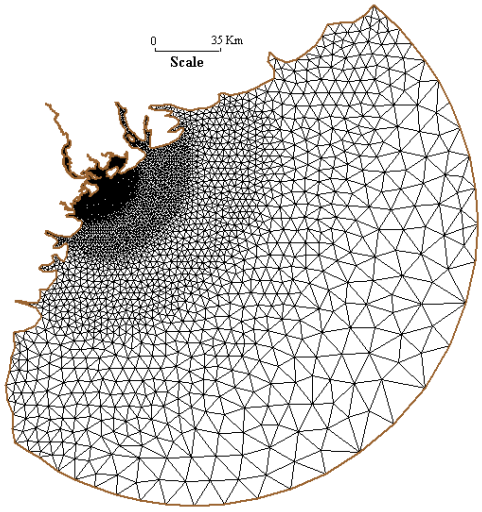
Present Trends in Dredging



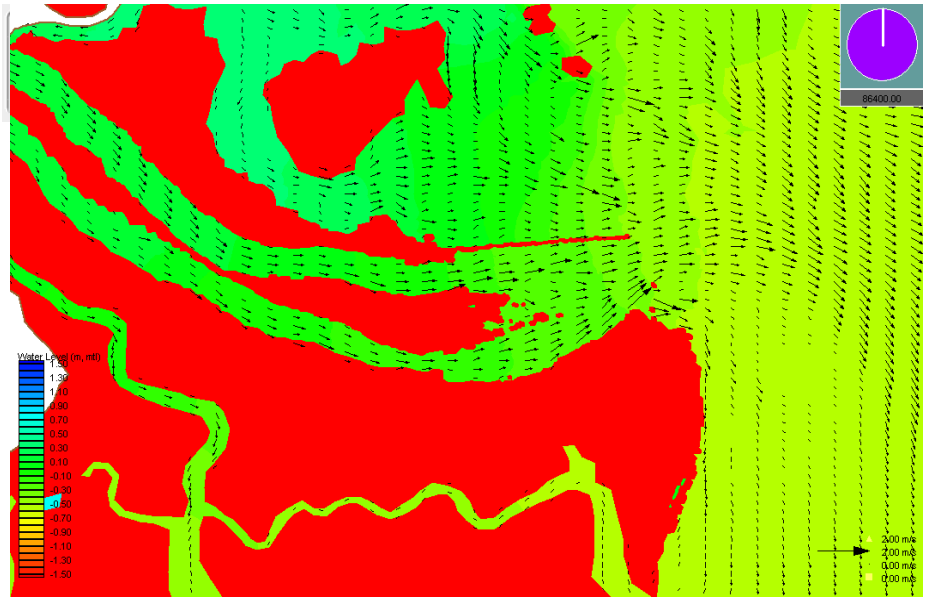
Understanding Transport of Mixed Dredged Material:

- Savannah dredged material will be more resistant to erosion than pure sand due to cohesive forces
- Site-specific erosion tests on dredged material
- Incorporate critical shear stress for erosion and erosion rates into GTRAN

ADCIRC Circulation Modeling



U.S. Army Corps of Engineers
Engineer Research and Development Center

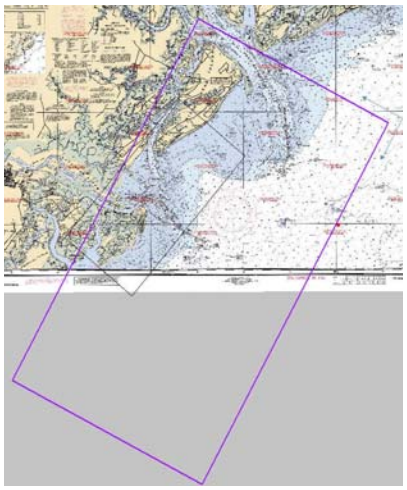


U.S. Army Corps of Engineers
Engineer Research and Development Center

Wave Model Grids

Parent Grid
36 km x 67 km
dx: 200 m

Nested Grid
15 km x 30 km
dx: 50 m

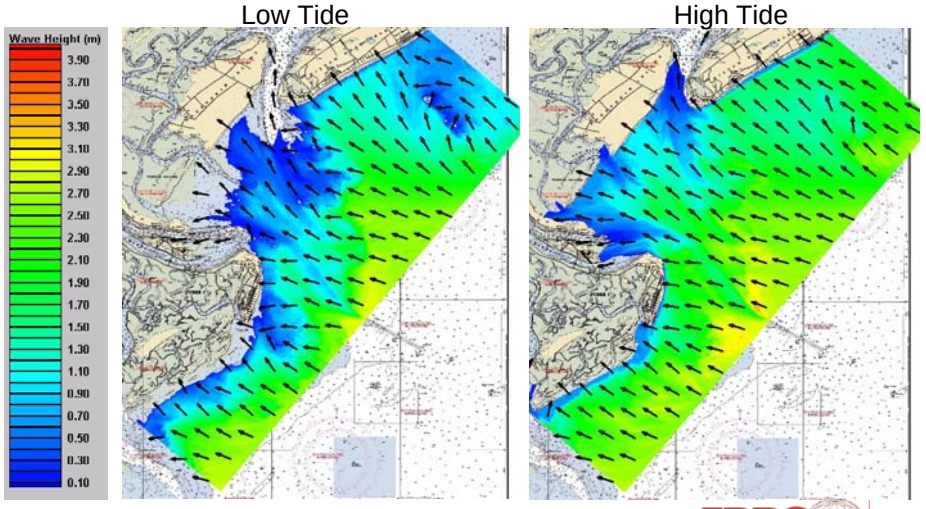


U.S. Army Corps of Engineers
Engineer Research and Development Center

Water Level Influence on Wave Transformation

Low Tide

High Tide

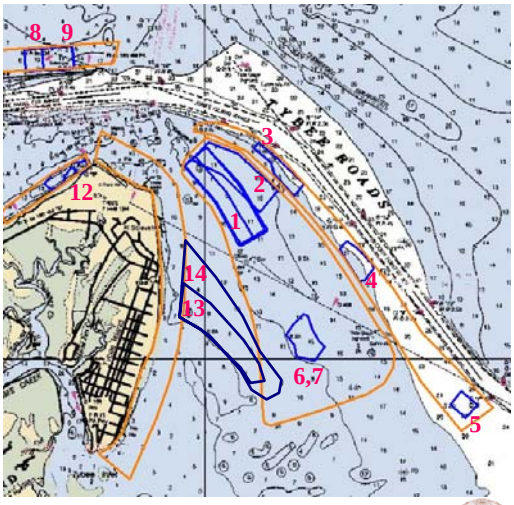


U.S. Army Corps of Engineers
Engineer Research and Development Center

Nearshore Placement Scenarios

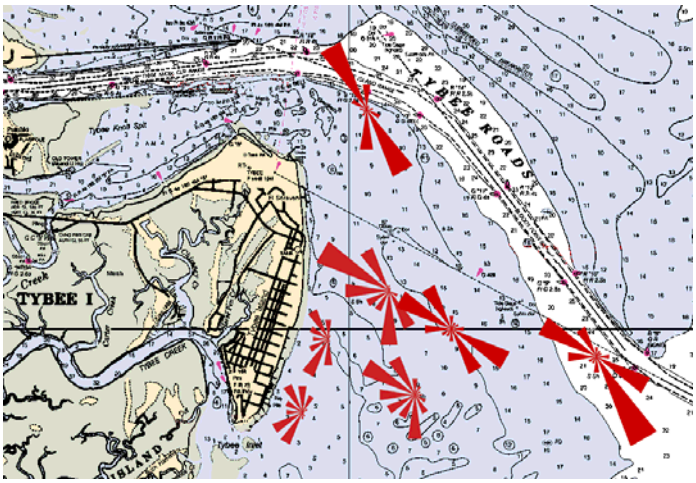
Crest Elevation

Berm 01: 2.1 m
Berm 02: 2.1 m
Berm 03: 3.0 m
Berm 04: 4.0 m
Berm 05: 4.0 m
Berm 06: 3.5 m
Berm 07: 2.5 m
Berm 08: 1.5 m
Berm 09: 2.5 m
Berm 12: 3.0 m
Berm 13: 2.0 m
Berm 14: 2.0 m



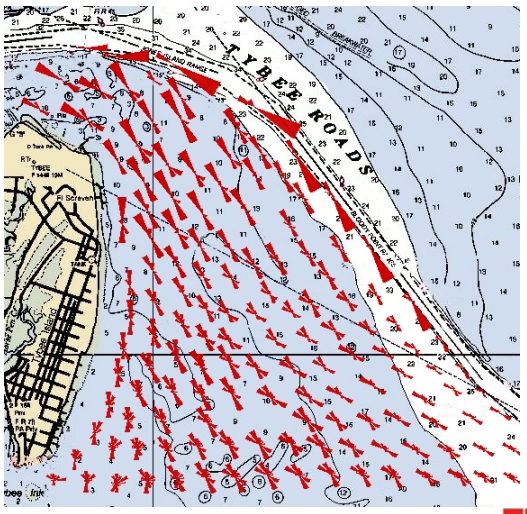
U.S. Army Corps of Engineers
Engineer Research and Development Center

Transport direction and magnitude



U.S. Army Corps of Engineers
Engineer Research and Development Center

Transport direction and magnitude

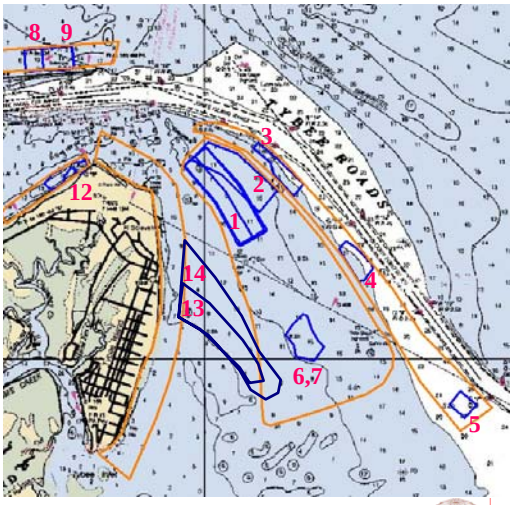


U.S. Army Corps of Engineers
Engineer Research and Development Center

ERDC

Effect of Nearshore Placement on Waves and Longshore Transport

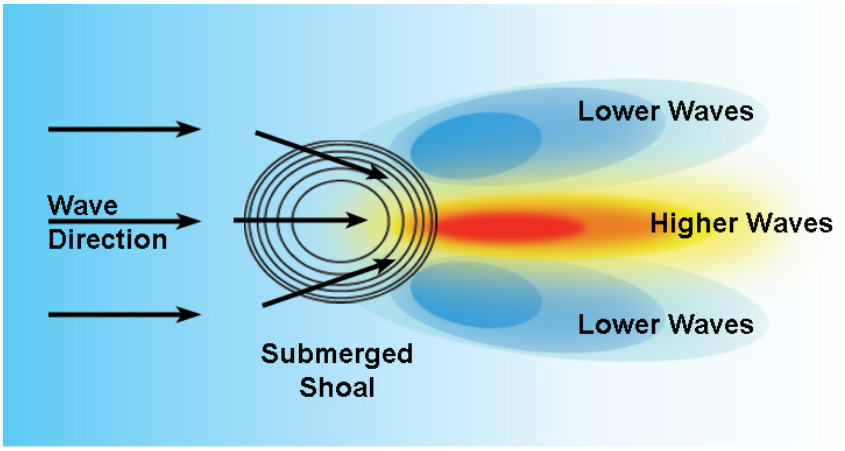
- Nearshore bathymetric relief influences wave transformation
- Changes in transformation influence longshore transport
- Longshore transport affects shoreline change



U.S. Army Corps of Engineers
Engineer Research and Development Center

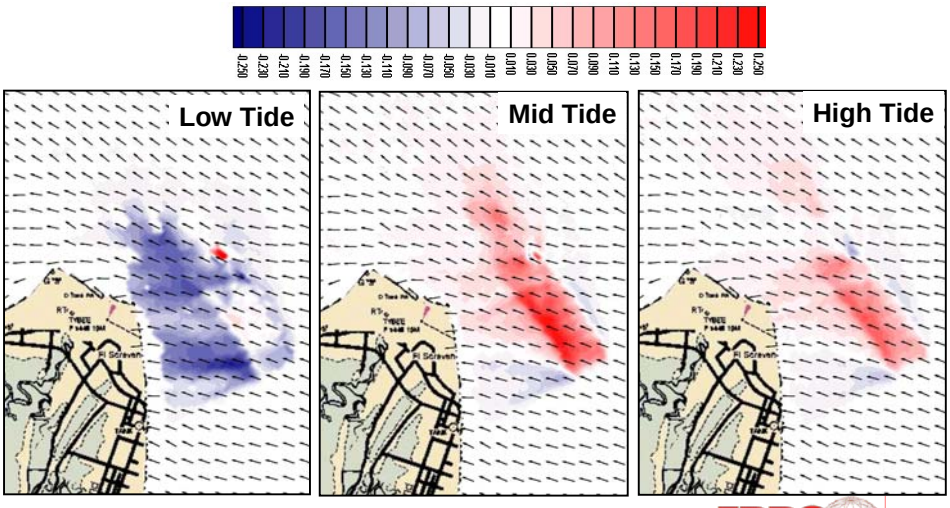
ERDC

Wave Focusing by Nearshore Berms



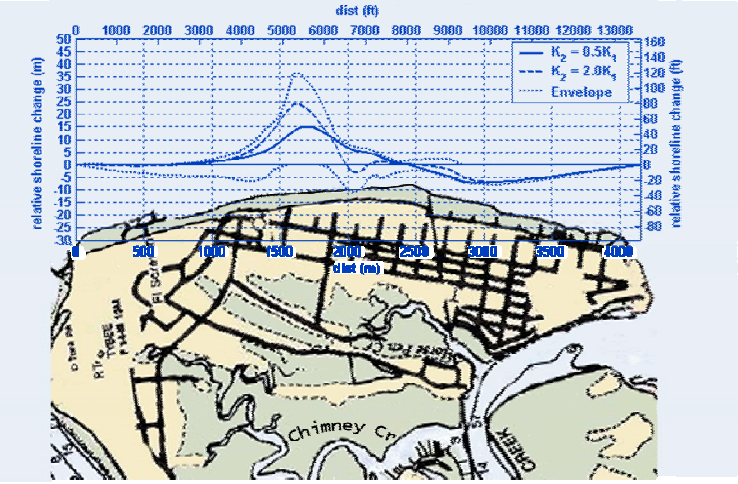
U.S. Army Corps of Engineers
Engineer Research and Development Center

Wave Focusing at Nearshore Berm 01



U.S. Army Corps of Engineers
Engineer Research and Development Center

Relative Shoreline Change Over 20 years, Berm 13 (Genesis Model)



U.S. Army Corps of Engineers
Engineer Research and Development Center

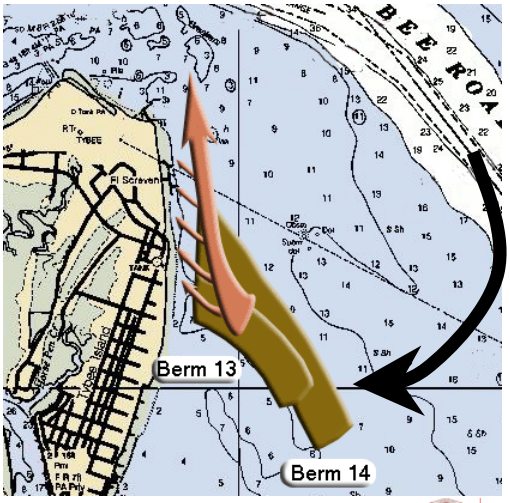
Conclusions

- Offshore or channel adjacent placement will not benefit Tybee shoreline
- Berms placed closer to shore more likely to provide sand to Tybee shoreline and nearshore platform
- Nearshore berm location is critical in maximizing nourishment and minimizing rehandling
- Transport patterns remove sediment from north Tybee nearshore platform

U.S. Army Corps of Engineers
Engineer Research and Development Center

Recommendations

- Move mixed material from channel to Berm 13/14
- Allow natural winnowing to remove fine content
- Longshore transport patterns will move sediment into sand-starved north Tybee littoral zone



Validation

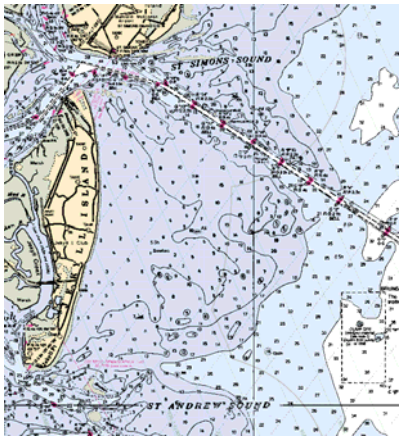
• New models developed from verified theories applied to nearshore berm placement at Savannah

• Opportunity to validate and improve new models applied at Savannah by monitoring ongoing nearshore placement at Brunswick

• Model validation is critical to improve and increase confidence in the Savannah nearshore placement results

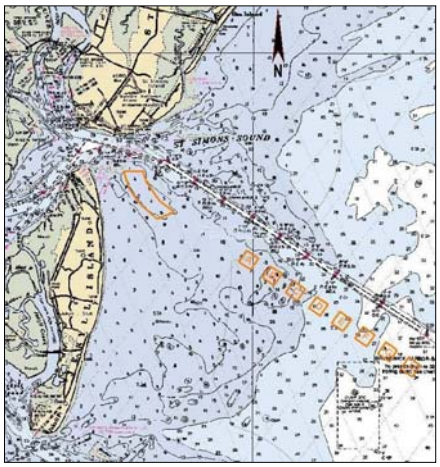
Nearshore Placement at Brunswick
Main Issues

- Rate and direction of mound migration
- Does sand-sized material re-enter the littoral system or the channel?
- Do fines deposit in the nearshore area?
- Do numerical models of dredging process and sediment transport models accurately represent nature?



Nearshore Placement at Brunswick
Main Issues

- Rate and direction of mound migration
- Does sand-sized material re-enter the littoral system or the channel?
- Do fines deposit in the nearshore area?
- Do numerical models of dredging process and sediment transport models accurately represent nature?



U.S. Army Corps of Engineers
Engineer Research and Development Center

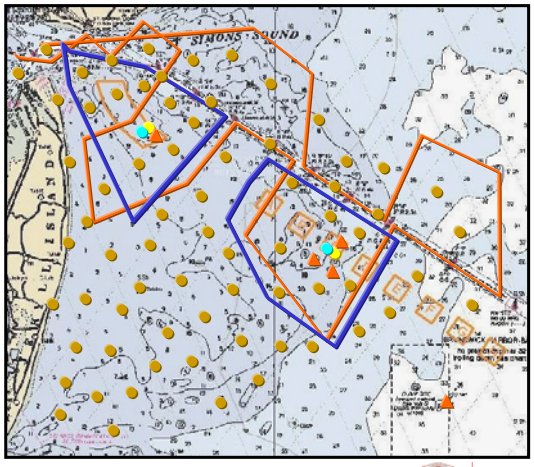
Fate of Sediment
Field Techniques

Sediment Tracer
(Feb – Aug 2003)
- Sand
- Fines (Silt and Clay)

Instrumentation
(Nov 2002 – Aug 2003)
- Currents
- Roving Survey
- Waves
- Suspended Sediment

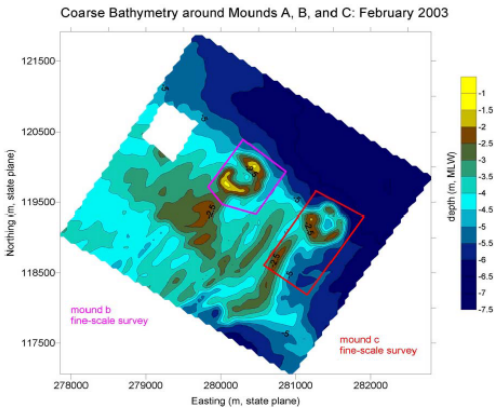
Bathymetric Surveys
(Feb, Apr, Jul 2003)
- Survey Bounds

Sediment Sampling
(Feb, Apr, Jul 2003)
- Grab and Core Samples

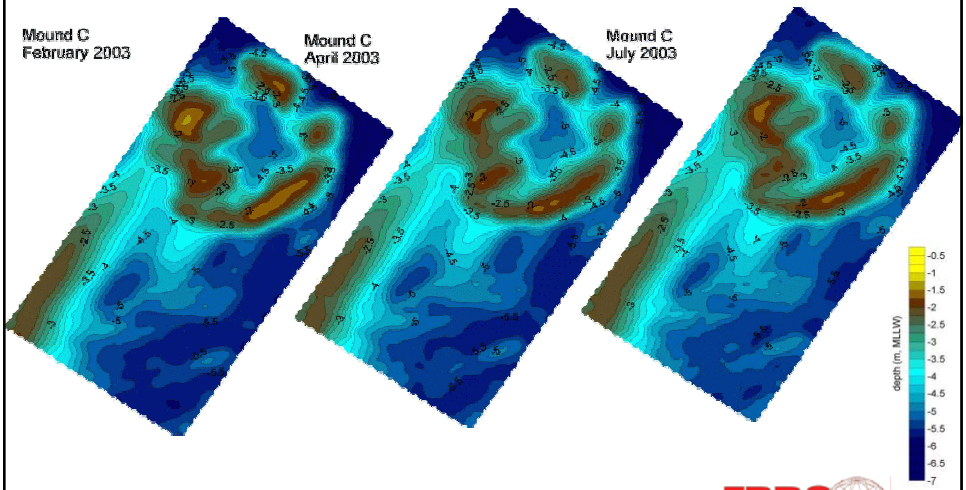


Mounds B & C

- Disposal method results in annular (donut-shaped) mounds
- Analysis
  - Mound relief at similar scale as natural (?) features
  - Mound evolution (Feb-July)
  - Mound evolution consistent with tracer movements
  - Backscatter (sediment sorting)

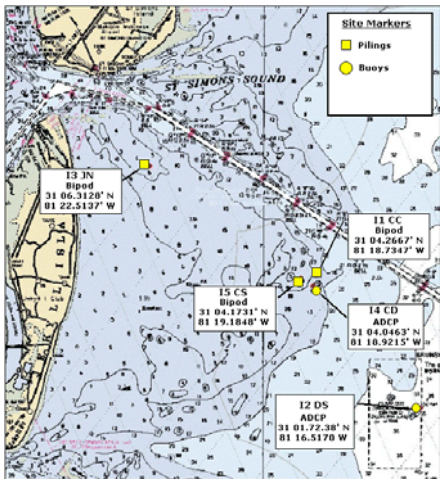


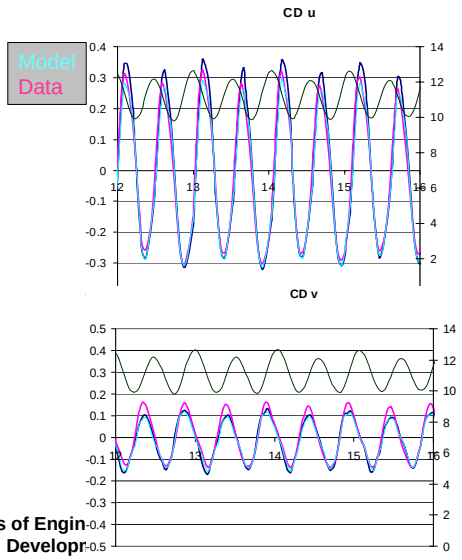
Morphology of Mound C



U.S. Army Corps of Engineers
Engineer Research and Development Center

ADCIRC: Calibration to currents





U.S. Army Corps of Engin
Engineer Research and Developr

Results of ADCP current profile analysis behind Mound C

Present BL Approach

Tidal Currents

With BL Separation

Tidal Currents

U.S. Army Corps of Engineers
Engineer Research and Development Center

Potential Effect of Vertical Structure on Mound Evolution

Present BL Approach

Tidal Currents

Near-bed currents in the lee of the mound tend to transport sediments away. Result is a more dispersive mound.

With BL Separation

Tidal Currents

Near-bed currents in the lee of the mound are toward the mound crest. Result is a less dispersive mound.

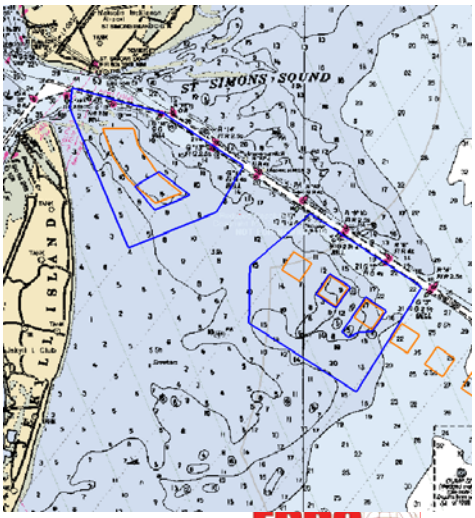
U.S. Army Corps of Engineers
Engineer Research and Development Center

Summary: Current profiles

- Significant structure exists in the vertical current profiles near the navigation channel and dredged material mounds.
- Spatial variance exists in the profiles and appears to be associated with gradients in the bathymetry.
- Three-dimensional structure of currents may be important in the evolution and dispersion of the mounds.

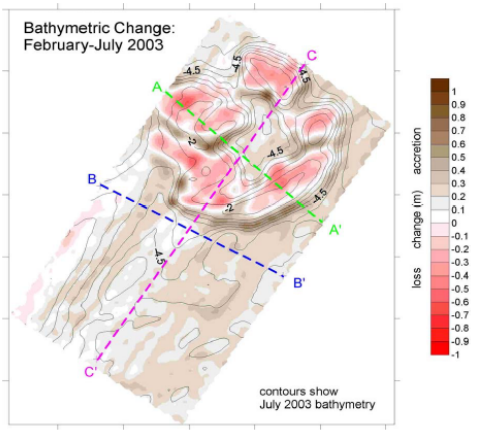
High-Resolution Bathymetry

- 3 sets of high-resolution bathymetry covering large area (27 km², 10 mi², or 6600 acres)
- Analysis and Data Use
  - Provides best available bathymetry for numerical models
  - Accurate enough for detailed volume-change analysis
  - Supplementary data for tracer analysis

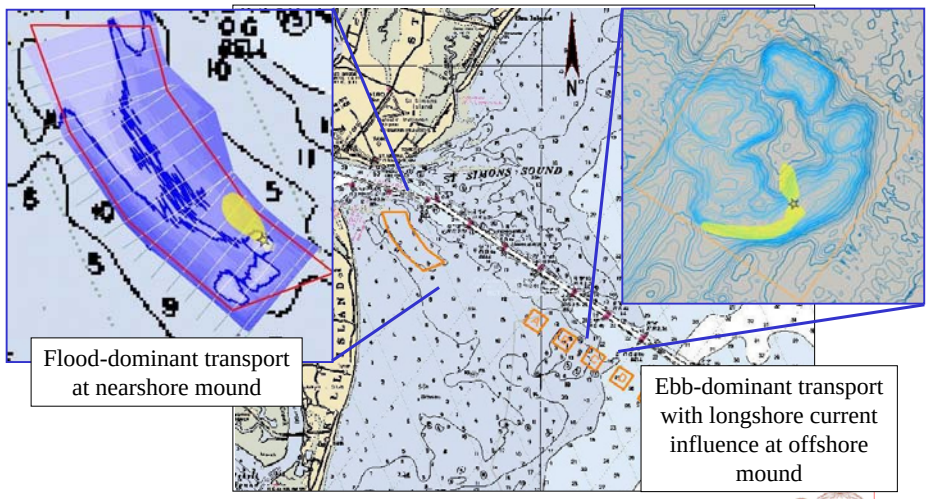


Summary: Preliminary analysis of survey and tracer data

- Surveys and tracer movement indicate net migration of mound to the SSW.
- Acoustic backscatter and cores suggest winnowing of sediments.



Sand Tracer Movement (Feb – June 2003)



Other Tracer Study Observations

- Silt tracer
  - disperses rapidly.
  - Small amount temporarily found in nearshore
  - At end of study, majority of silt tracer unaccounted for (deep burial or transport outside study area)
- Sand tracer
  - Transported rapidly from mound crest
  - Majority of sand tracer mass buried in migrating mound
  - Tracer movement consistent with bathymetric surveys

Modeling at Brunswick

- Modeling is ongoing
- Hydrodynamic and wave model results compare well to field data
- Hydrodynamics is very similar to Savannah
- Preliminary sediment transport modeling results are consistent with field data
- BL separation has a significant impact on transport at Mound C