Overview of USACE Nearshore/Aquatic Placement Tools and Models

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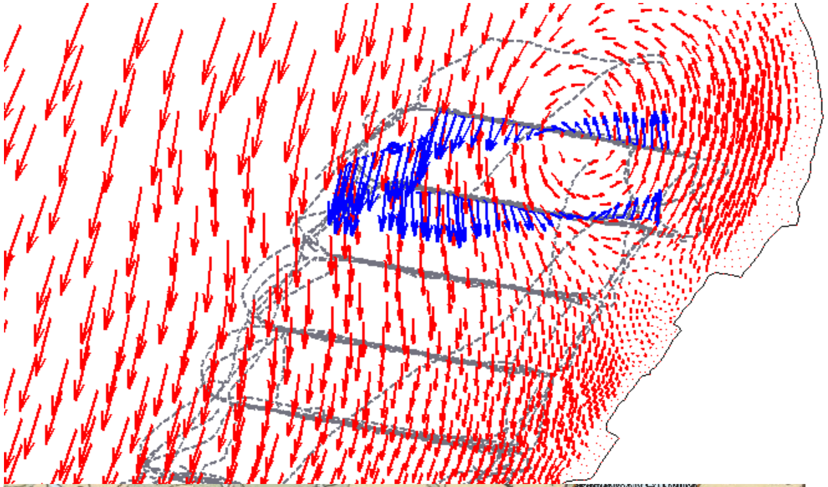
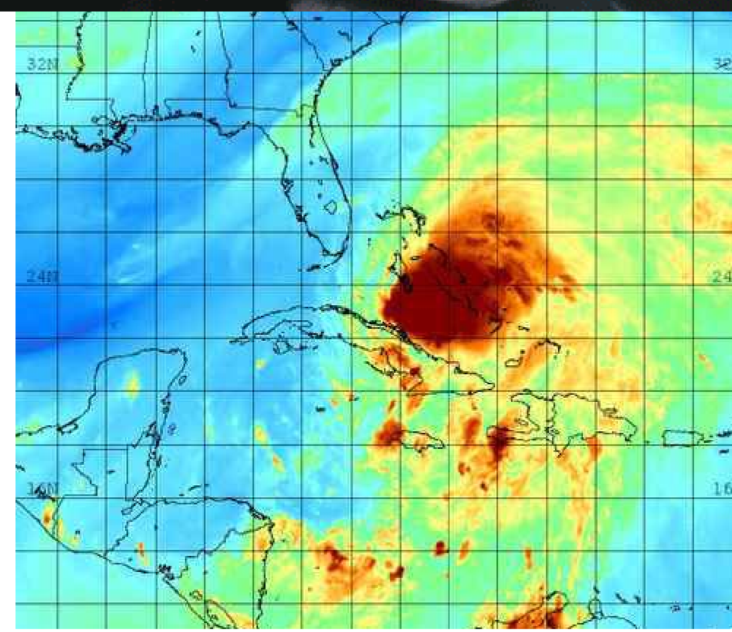
OUTLINE

- Motivation for modeling system
- Objectives of modeling system
- Near field Models
  - DREDGE
  - PDFATE
  - STFATE
  - MDFATE/MPFATE
- Far field Models
  - GTRAN
  - PTM
  - LTFATE
- Summary



MOTIVATION

- Data related to dredged material fate for mgmt purposes are limited
- Models and tools permit user to extrapolate to conditions for which data are not available
- Provide framework within which to quantify fate, assess options and compare alternatives



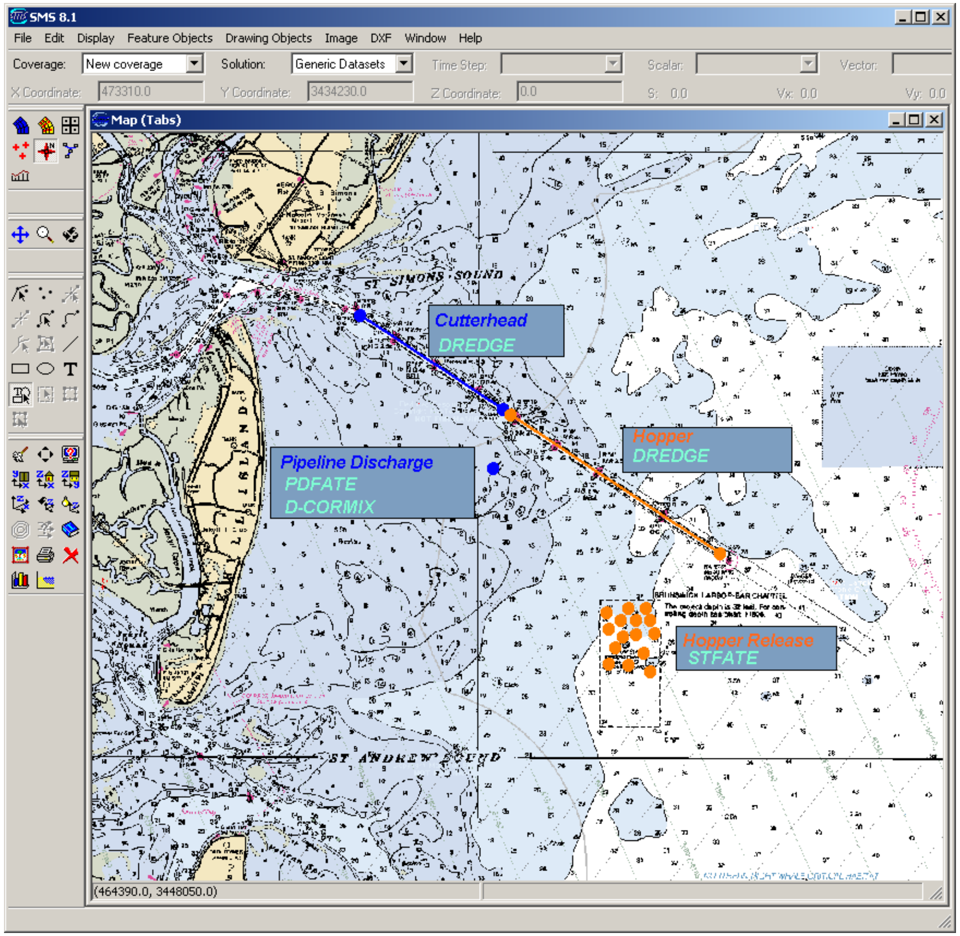
MOTIVATION

- Increasingly complex issues related to dredged material fate
  - Regulatory compliance
  - Environmental Resources/Risk Assessment
  - Site/lifecycle management
  - Dredged material as a resource
  - Regional or multiple project management
- Models are one of several tools used to address these issues (line/lines of evidence)
- Modeling capabilities must be improved to address these issues
- Users need a suite of modeling tools
  - Various levels of model (screening to detailed)
  - Address specific processes
- Models and databases must be interconnected to provide efficient use and maximize benefit

OBJECTIVES

- Develop/maintain a suite of tools, models and databases to address Corps issues related to dredged material fate and management
  - Develop needed process descriptions for improved accuracy and range of applicability
  - Increased interaction with other Corps models, databases, and tools
  - Tiered models to address appropriate level of accuracy/user needs
- Decrease time required for model setup, application and interpretation through efficient user interfaces

OBJECTIVE: Three Tiers of Models

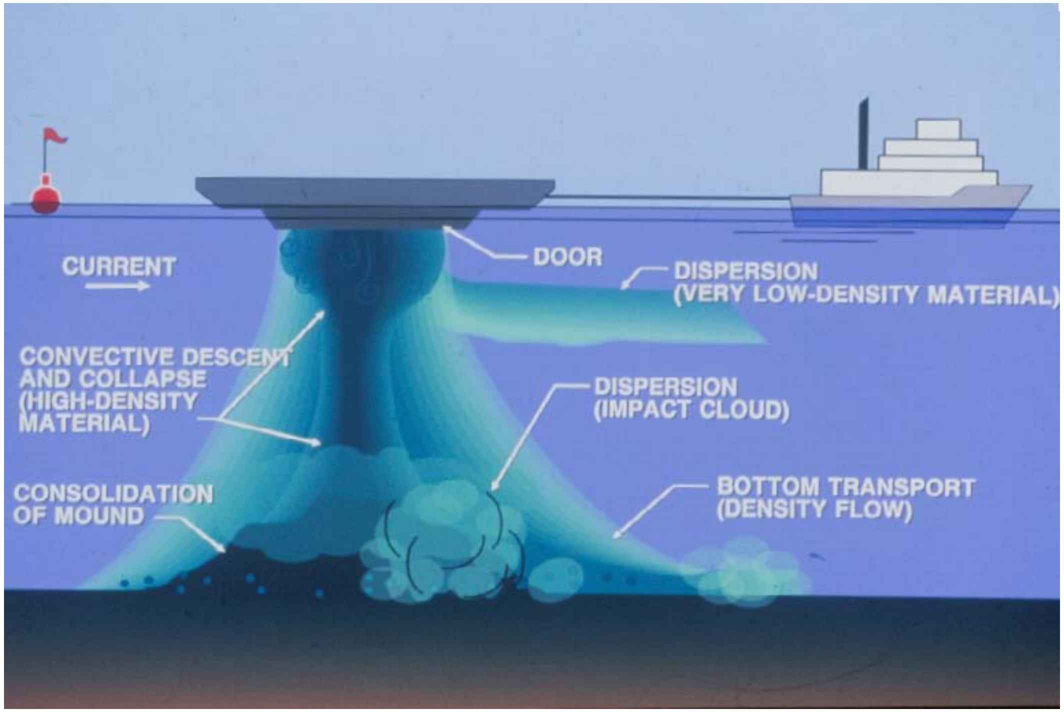


- Web-based screening level tools/models (in ADDAMS)
- Process-specific, near-field models
  - PDFATE
  - Dredge
  - STFATE
  - MPFATE
- Large domain, far-field models
  - GTRAN
  - PTM
  - 3-D LTFATE
- SMS Model/data integration

STFATE

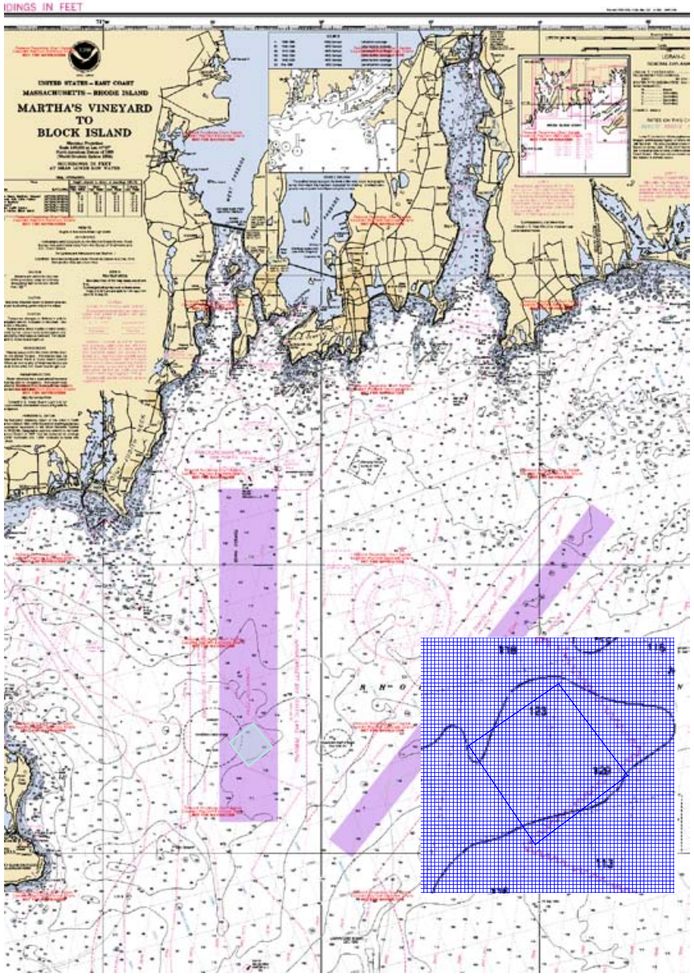
Short-Term Fate of Dredged Material

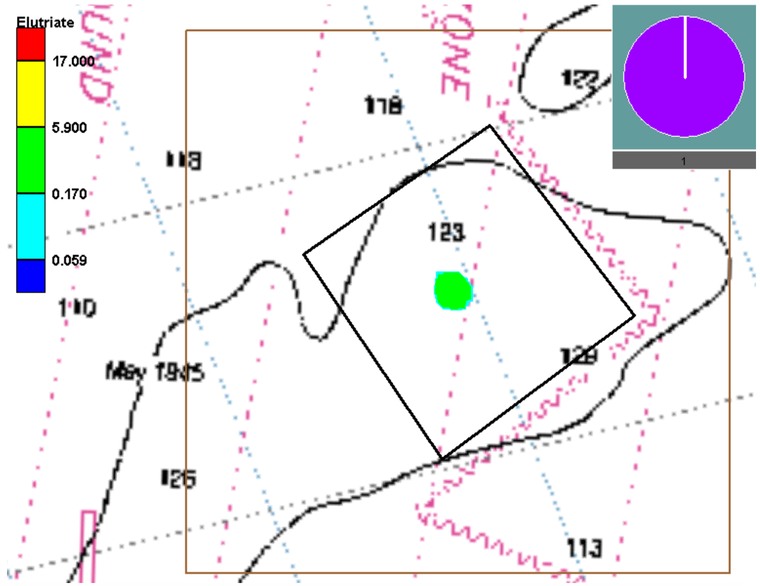
- Provide deposition pattern and resuspension from placement
- Manage placement sites
- Regulatory Compliance (water column concentration)
  - Section 103 of the MPRSA
  - Section 404 (B)(1) of the Clean Water Act
- Evaluate environmental resource issues

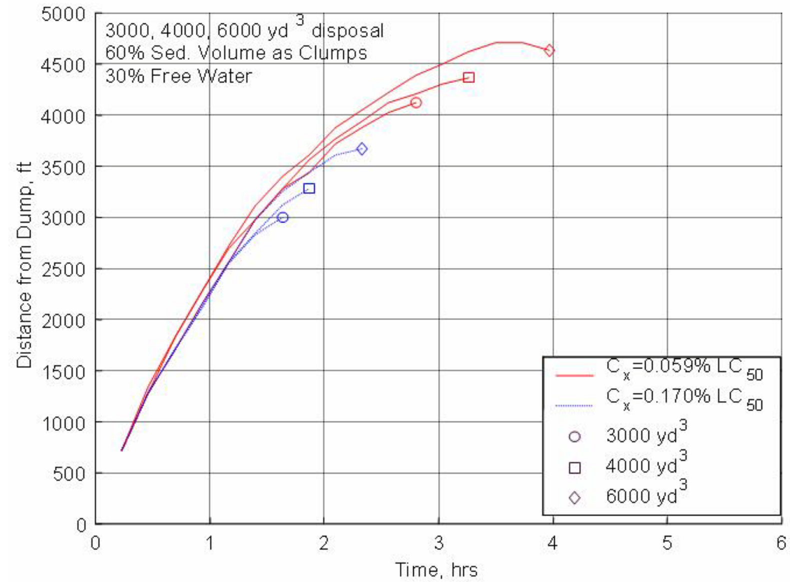


STFATE includes descent, dynamic collapse, bottom transport, and stripping phases

STFATE EXAMPLE

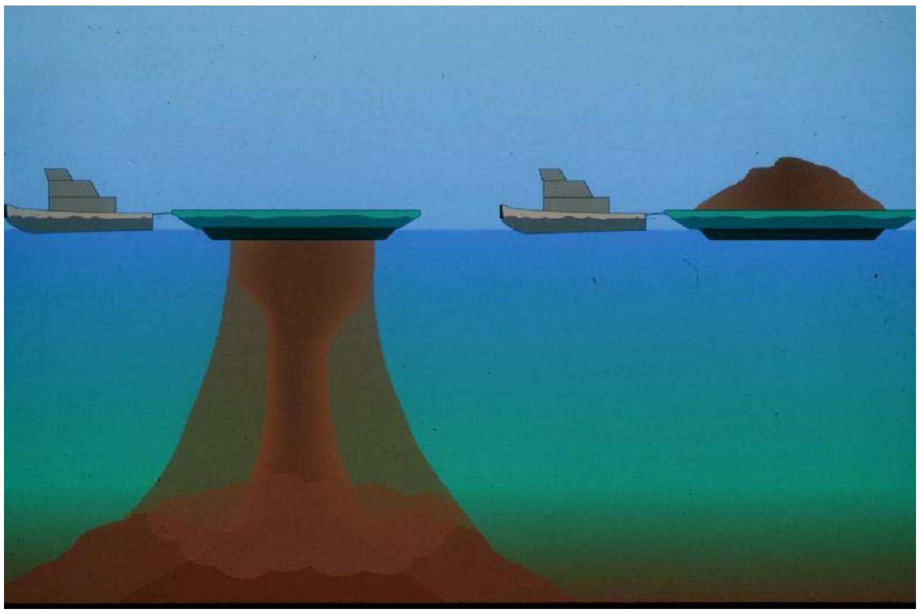






MDFATE/ MPFATE

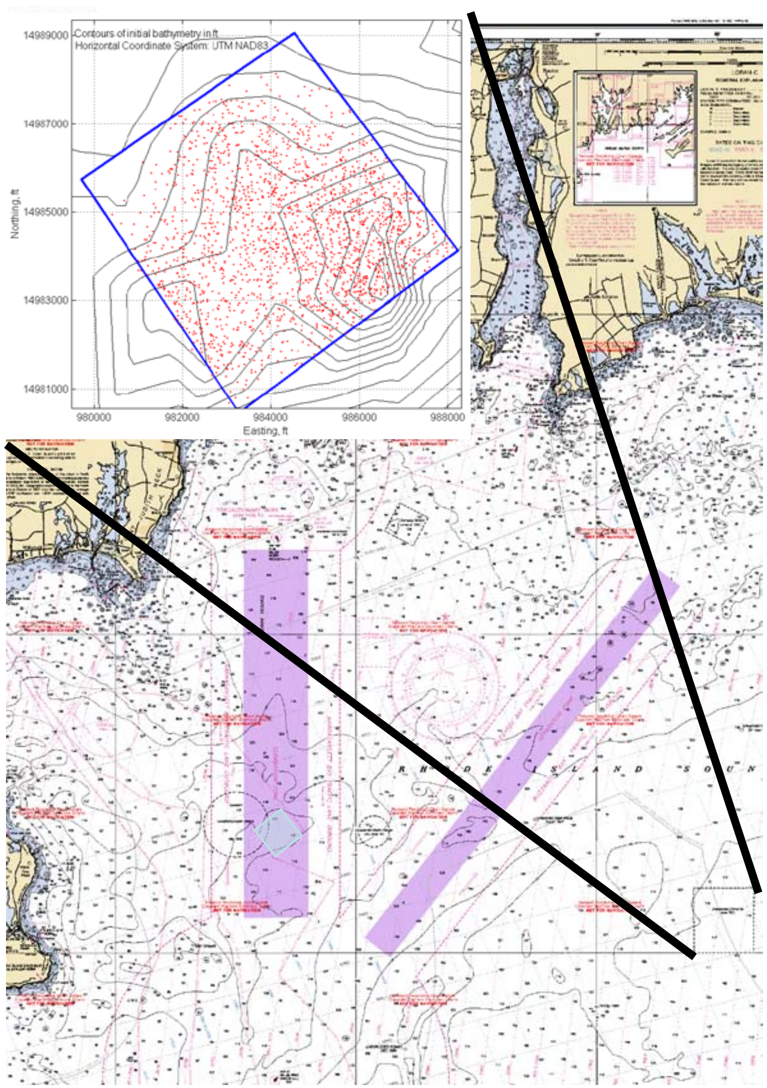
Multiple Disposal Fate of Dredged Material
Multiple Placement Fate of Dredged Material

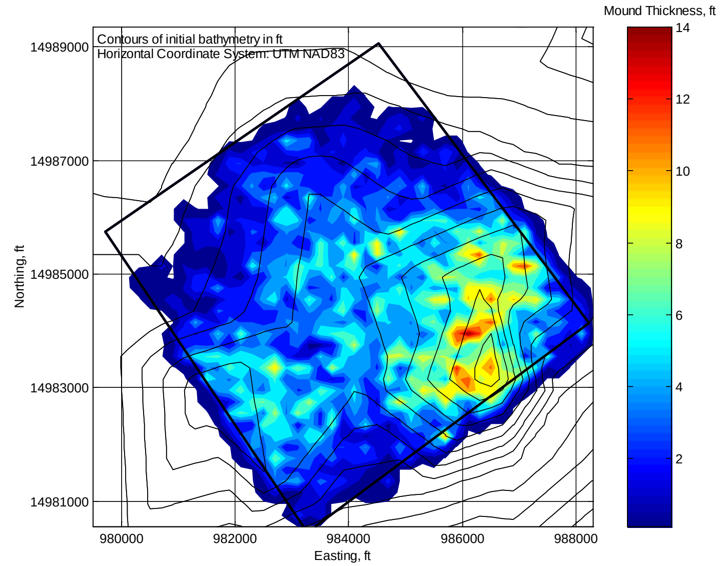


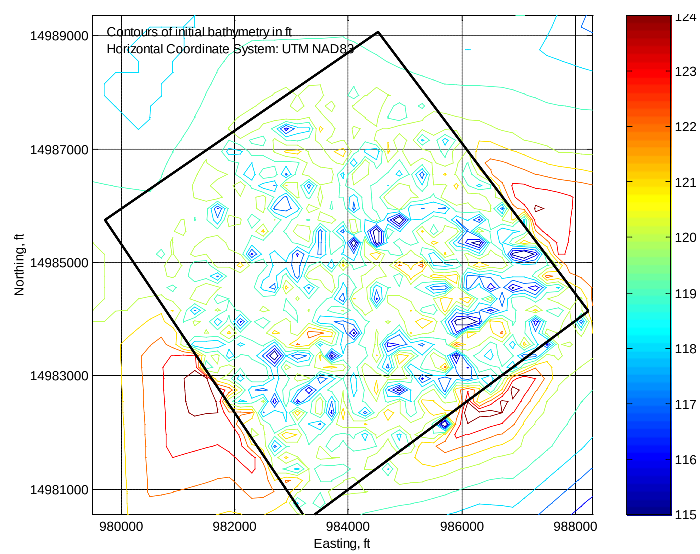
MPFATE includes multiple STFATE simulations, mound building, erosion, consolidation, and avalanching

- Cumulative resuspension from placement operations (multiple STFATE clouds)
- Generate mound configuration from placement operations
- Address Issues related to:
  - Regulatory Compliance
  - Minimizing hazards
  - Optimizing operations, long-term mgmt
  - Operational efficiency
  - Design capping operations
- Tool to optimize placement locations

MPFATE EXAMPLE



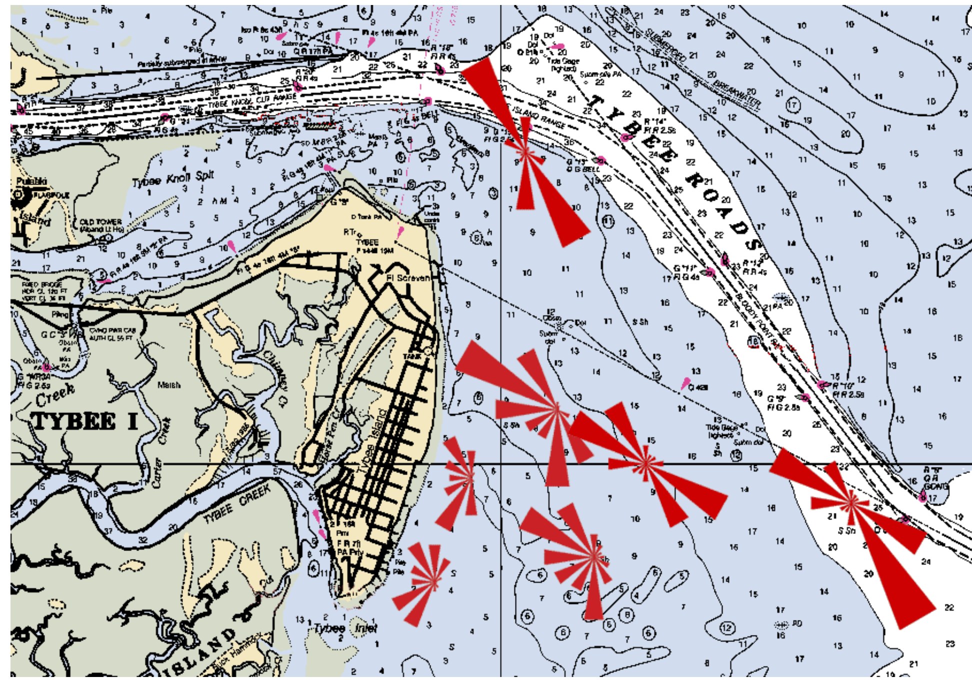




GTRAN

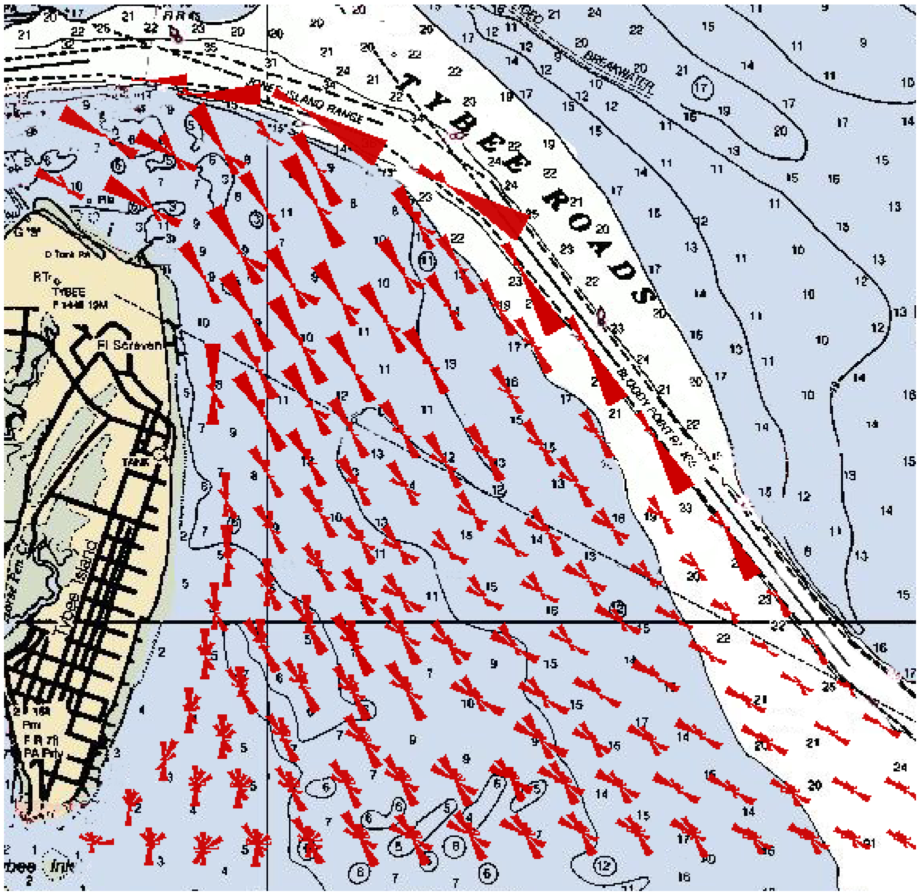
Gridded TRANsport Model

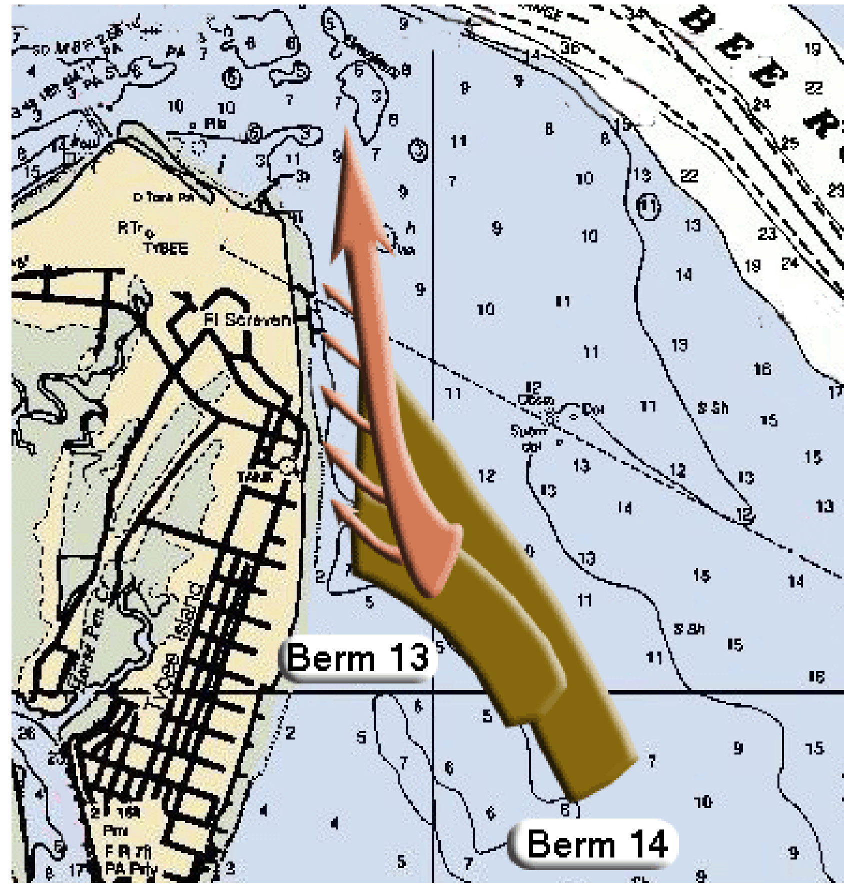
- Beneficial use and near-channel placement require screening level tools to assess transport:
  - Maximize beneficial use
  - Minimize channel infilling
  - Minimize or maximize transport toward target resources
  - Qualitatively predict transport direction and magnitude
- Sediment transport model not needed, especially in initial phases of placement study
- Interpret model output to define sediment pathways from placement sites



GTRAN calculates transport direction and magnitude at multiple locations over complex domain. Defines transport pathways and dominant transport directions due to currents, waves, and wave asymmetry

GTRAN Model Application



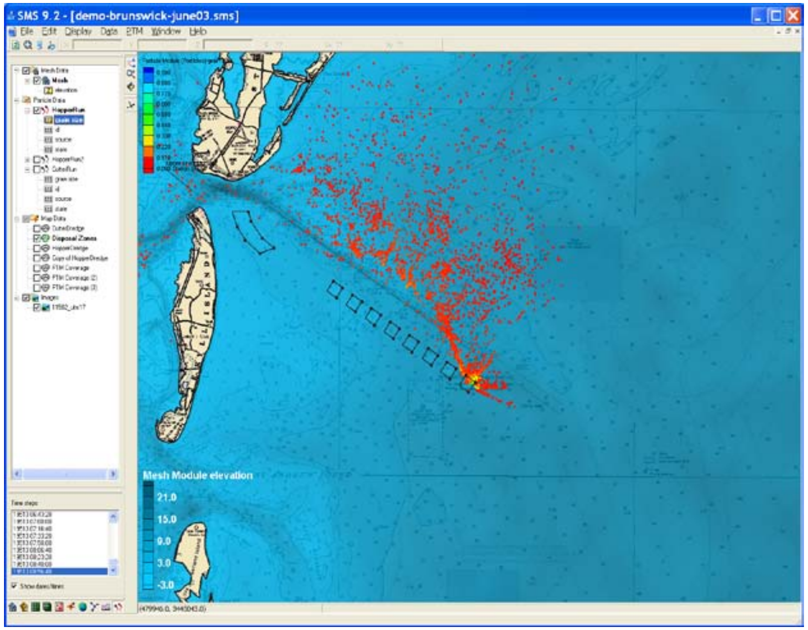


Optimize Nearshore Placement Location to maximize benefit to Tybee Island and minimize rehandling

PTM

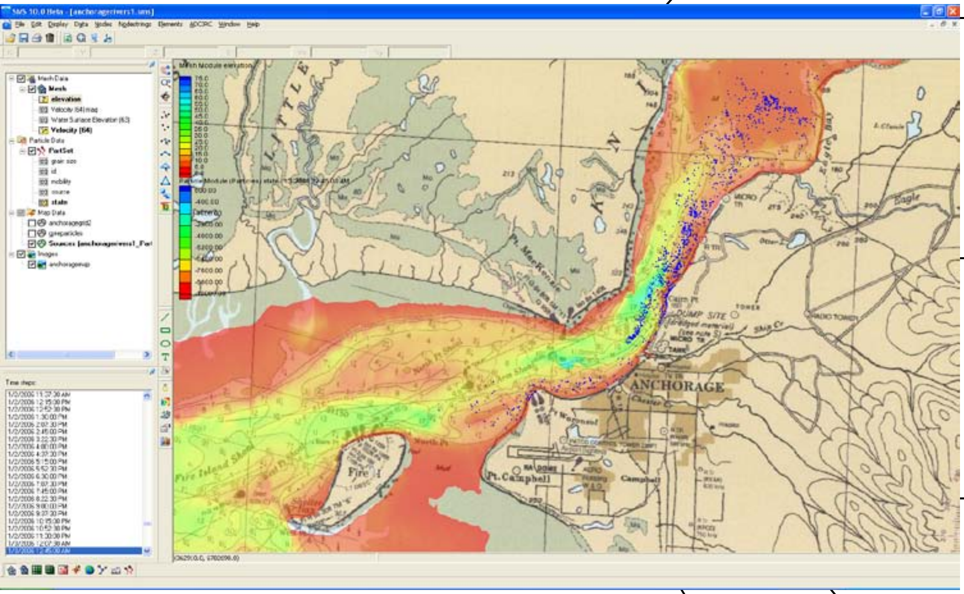
Particle Tracking Model

- A far field dredged material transport model specifically designed to simulate multiple scenarios
- Quantify DM transport and fate over large domains to assess impacts/risks
- PTM reduces computational intensity by only modeling transport of DM
- DM interactions with sediment bed treated through active layer dynamics
- Issues Addressed:
  - Far-field transport, deposition, and resuspension
  - Time-varying sediment and constituent concentration
  - Dose estimates at receptors
- Powerful post-processing tools



Quantify erosion, deposition, and dose over large domain. Map sediment and constituent pathways, can use FATE model output as DM sources

PTM Attributes



Lagrangian particle tracker models multiple constituents that are discretized into representative parcels.

PTM models important transport processes: advection, settling, deposition, resuspension, burial.

PTM utilizes Hydrodynamic and wave input from multiple state of the art models as forcings.

Surface-water Modeling System (SMS) interface.

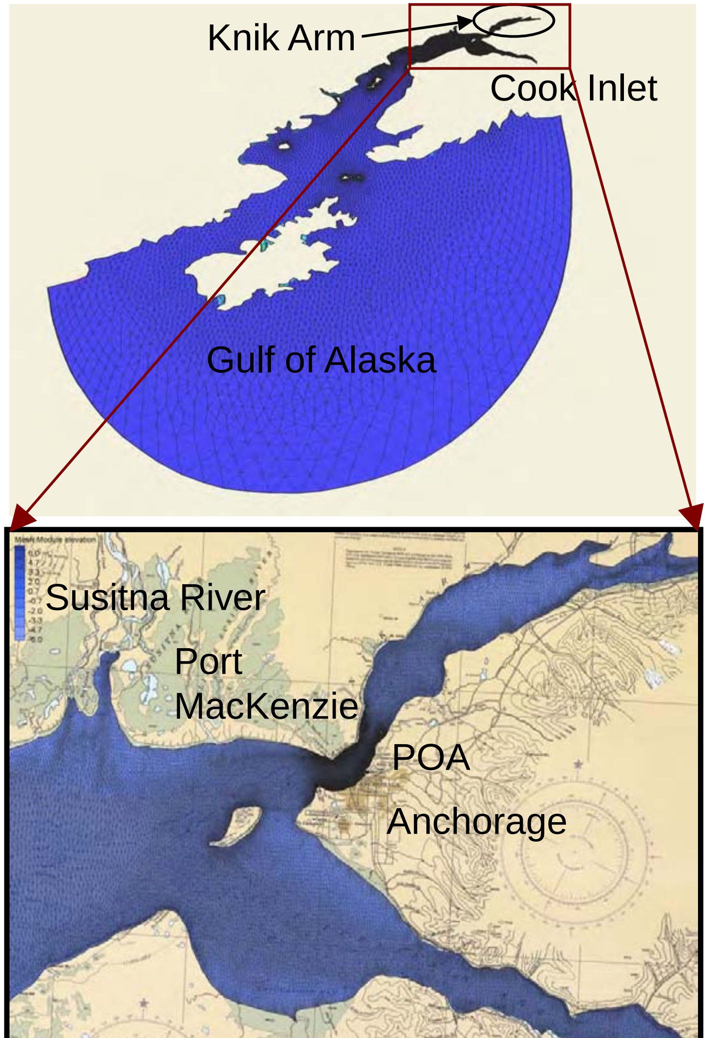
Unstructured grid permits modeling transport in complex regions

Sediment transport includes mixing with native sediments

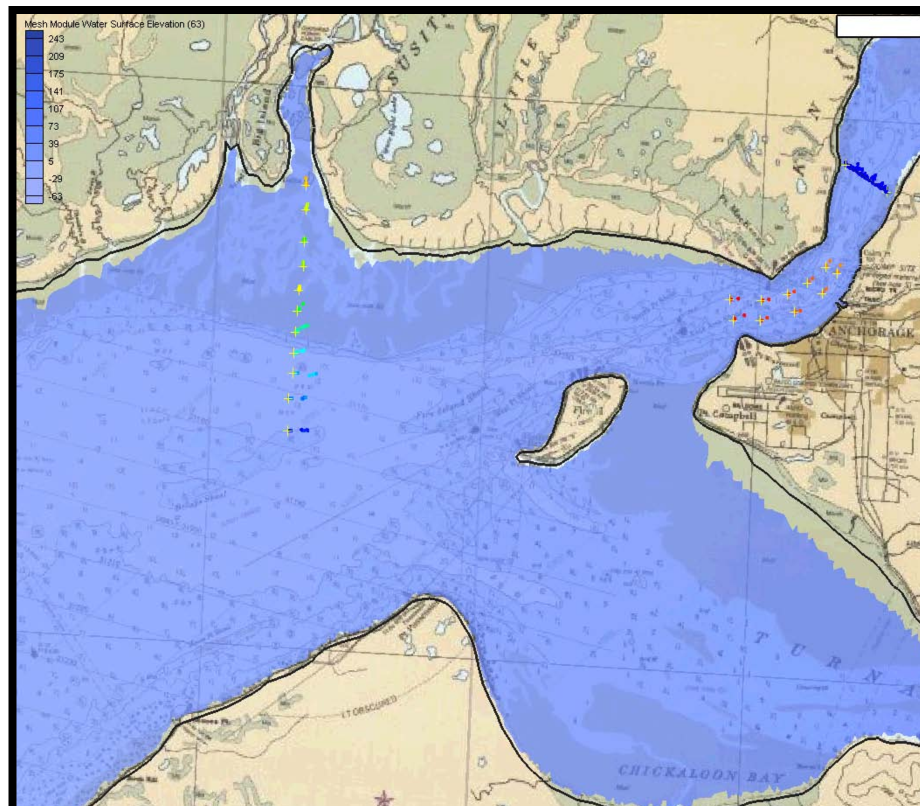
PTM Output and Post-Processing

- Final location, transport history, and properties of particles released from the source
- Deposition and concentration patterns at user-specified times
- Time history of concentration, deposition, etc at user-specified location.
- 3-D cross-section contour plots
- Dosage to receptors (exposure to sediments over time)

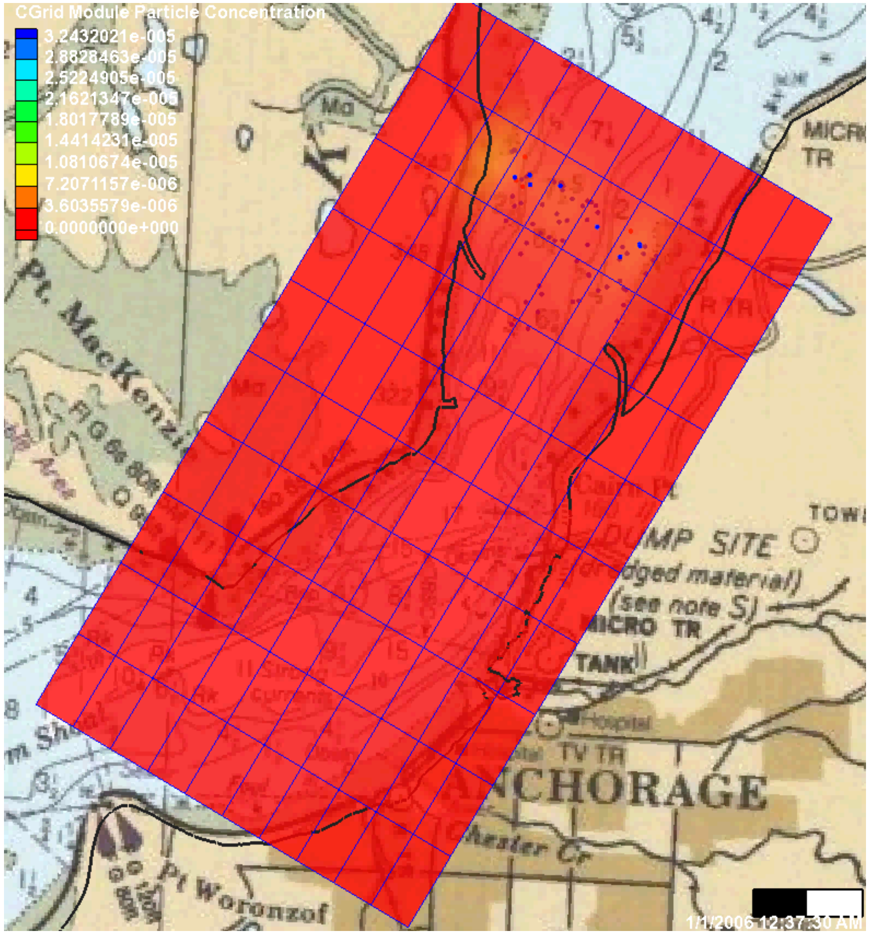
PTM Example



The primary objective of this study is to quickly and interactively investigate transport from sediment sources to Port of Anchorage



PTM Example

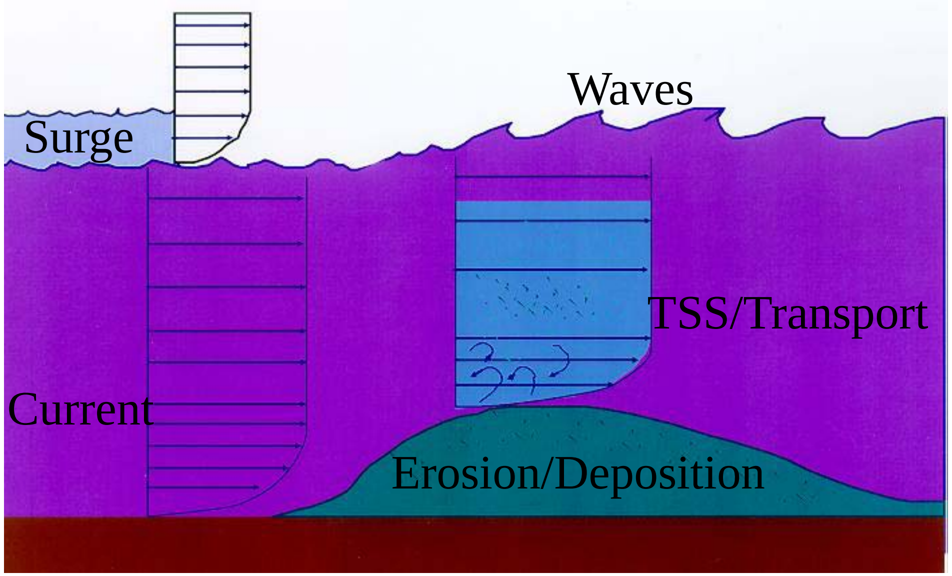


Simulation Details:

- Post-processing to develop contour plots of concentration and deposition
- These contour plots can be time-variable
- Data collected at user-specified points or regions used to estimate dosage
- Dosage data transferred to effects models and databases
- Particle colors represent deposited (red) and suspended (blue) sediments

LTFATE

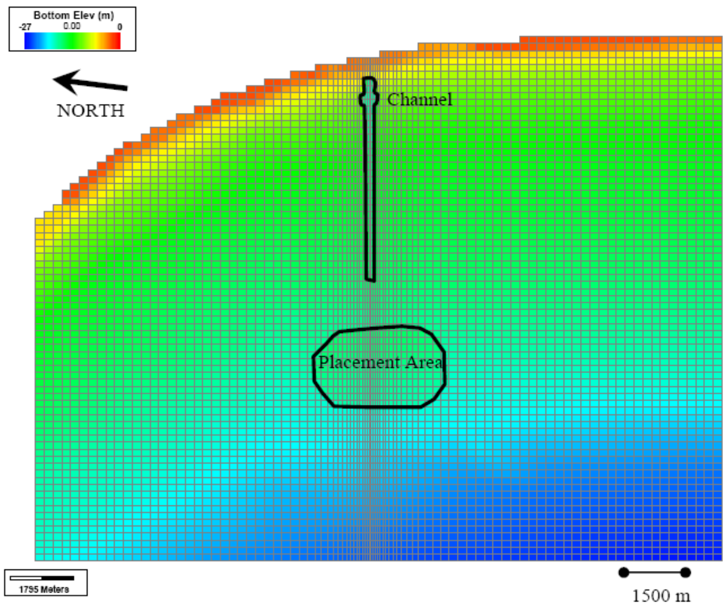
Long Term Fate of Dredged Material



LTFATE Wave/current sediment erosion, transport, and deposition. Mound morphology, mixed sediment processes, 3-D hydrodynamics

- Post-Placement migration and dispersion of dredged material mounds
- Quantify
  - Hydrodynamic-driven mound morphology change
  - Local deposition patterns and thickness
  - Mass exiting local domain
- Issues addressed:
  - Mound stability
  - Direction/fate of material removed from ODMDS
  - Long-term management of dredged material mounds
  - Regulatory compliance and resource issues
  - Dredged material mound as resource for sediment nourishment
  - Sediment rehandling

LTFATE Model Application: DMT



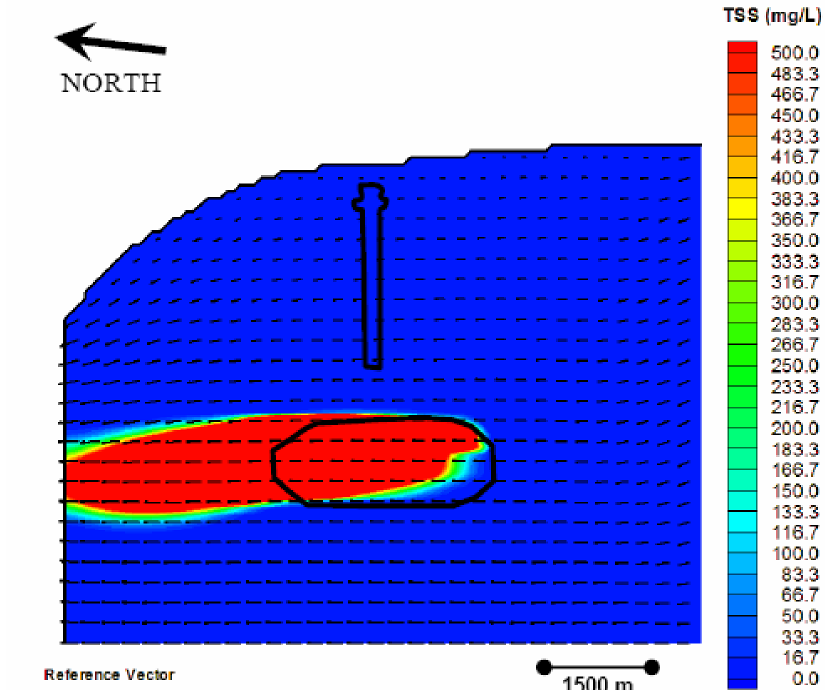
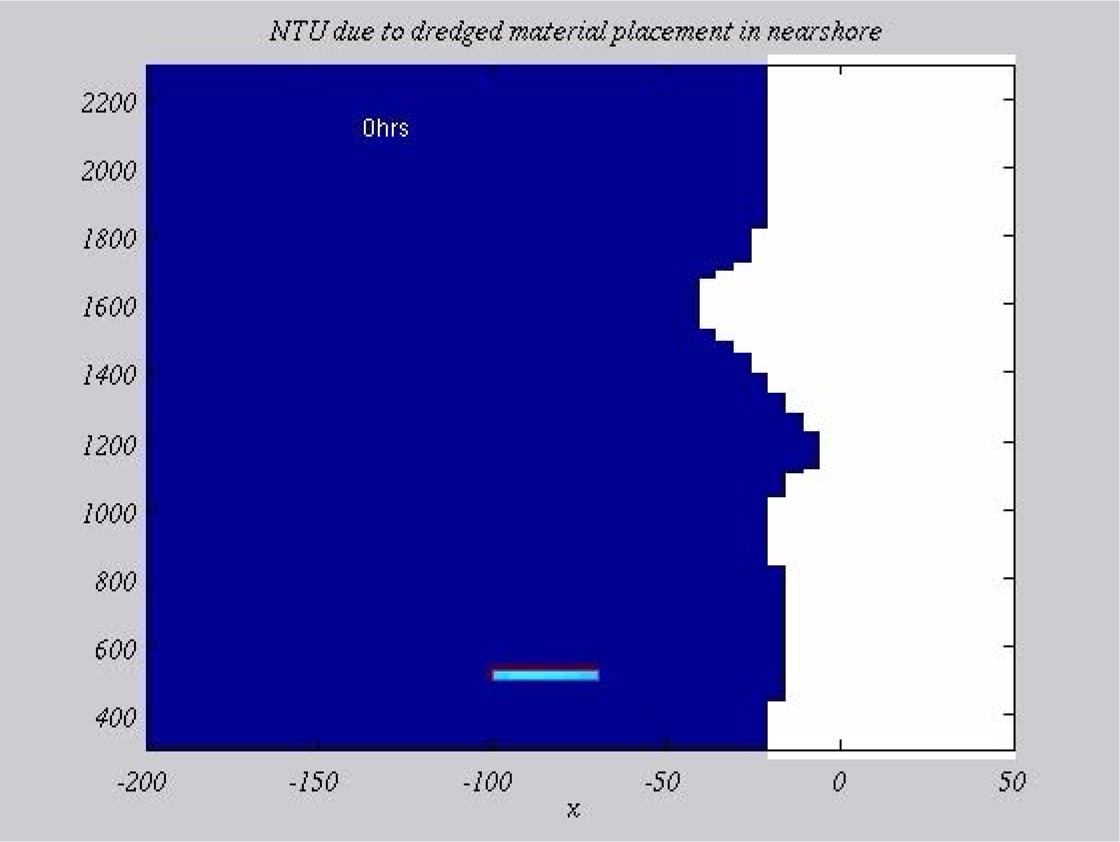


Table 2. Summary of model domain erosion and deposition.

Run	Maximum Erosion (cm)	Maximum Deposition (mm)
Storm 3	21	< 1 mm
Storm 4	75	< 1 mm
Storm 18	21	< 1 mm
Storm 32	13	< 1 mm
Storm 33	6	< 1 mm

LTFATE


NTU due to dredged material placement in nearshore
0hrs
2200
2000
1800
1600
1400
1200
1000
800
600
400
-200
-150
-100
-50
0
50
x

Summary

- Models provide important lines of evidence when developing CSM and estimating exposure
- Multiple models and levels of modeling required
- Model development is ongoing to address changing needs of Corps users
  - Continued advancement of three tiers of dredging tools for screening level through advanced applications
  - Develop interfaces and systems for interaction between models and databases, develop interfaces for efficient, improved application
  - Support modeling through continued research in dredging and sediment processes
  - Integrate exposure models into risk, habitat, DMMP, feasibility and other studies
- Distribution to users through SMS interface and web