Sediment Transport Modeling Tools for EWN Projects

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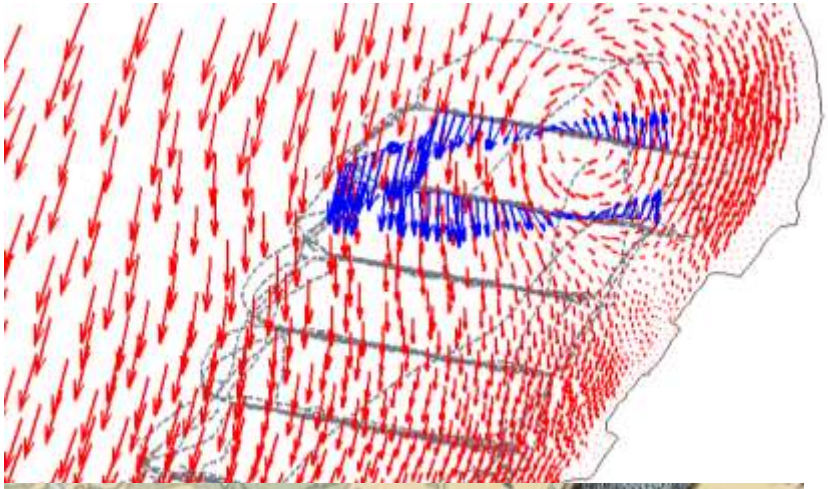
Transport Modeling Basics

- WHY: Models predict how a system will behave under conditions for which we have limited data
- Sediment models are based on:
  - Our understanding of physical processes
  - General understanding of processes at a site (CSM)
  - Site-Specific sediment process data
  - Models must be consistent with all site-specific data
- EWN requires models that accurately predict sediment transport through complex, interconnected regions
  - Pushing the envelope of transport model capabilities
  - Must be aware of model limitations
  - Process research/data collection ongoing

How Models Support EWN

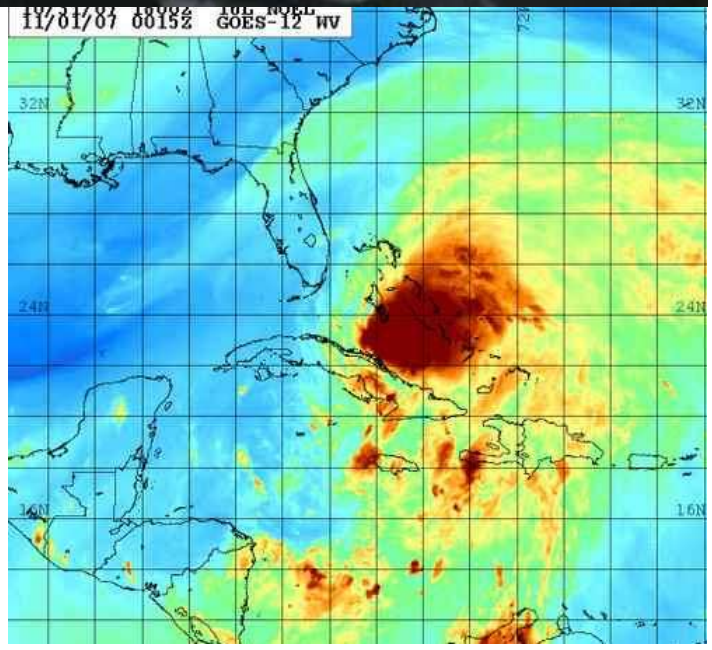
- Improve understanding of sediment pathways
- Predict effectiveness of EWN options
  - How to keep sediment from entering channels?
  - How to keep it moving through channels?
  - Cost effective DM solutions
- Quantify transport
  - When sediment moves
  - How much moves
  - Where does it accumulate



How Models Support EWN

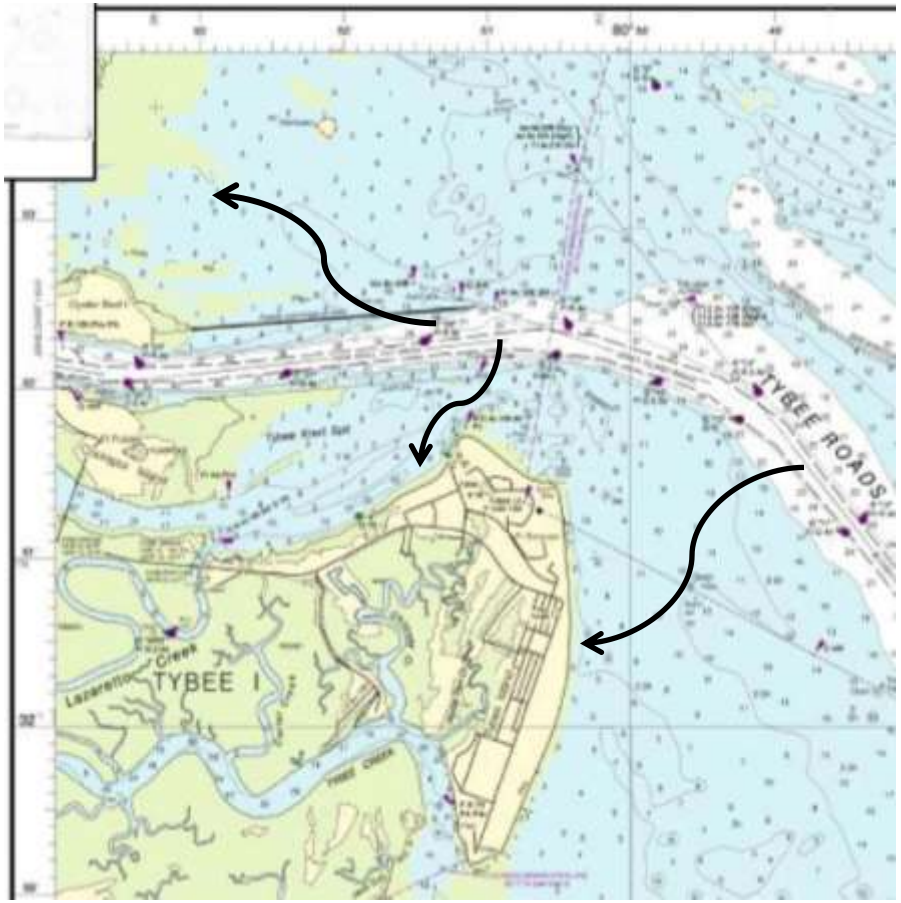
- EWN sediment management is inherently complex and models can be used to address
  - Regulatory compliance
  - Environmental Resources/Risk Assessment
  - Transport from placement site to area of interest
  - Site/lifecycle management ⟹ sustainable solutions
  - Design placement to minimize need for LDC or other expensive handling
  - Regional transport patterns
- Models are one of multiple tools (line/lines of evidence)

The Modeling Process



- CSM: Collect relevant historic, hydrodynamic and sediment data
- Develop model based on best understanding of the system
- Parameterize, calibrate, & validate model using data
- Use model to predict sediment fate for conditions without data
  - Large events
  - Post-construction
- Model output/data analysis to support project design

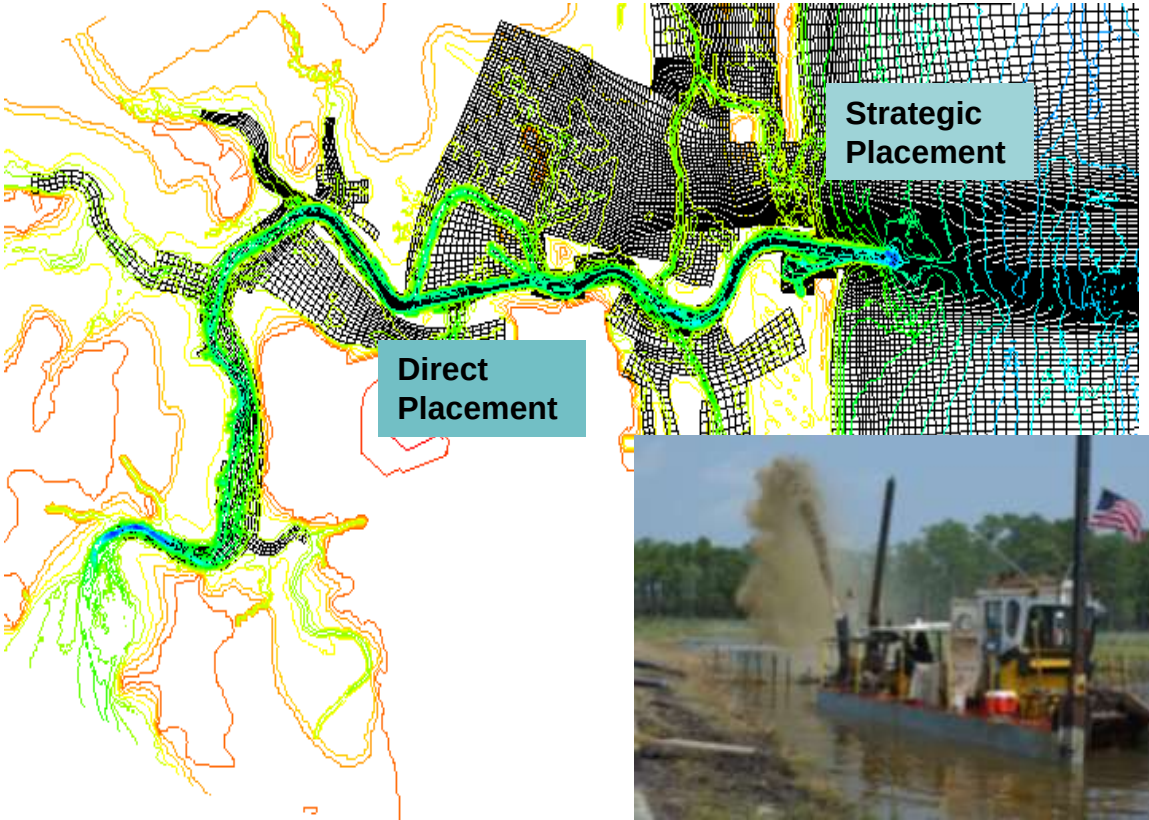
Sustainable EWN Solutions



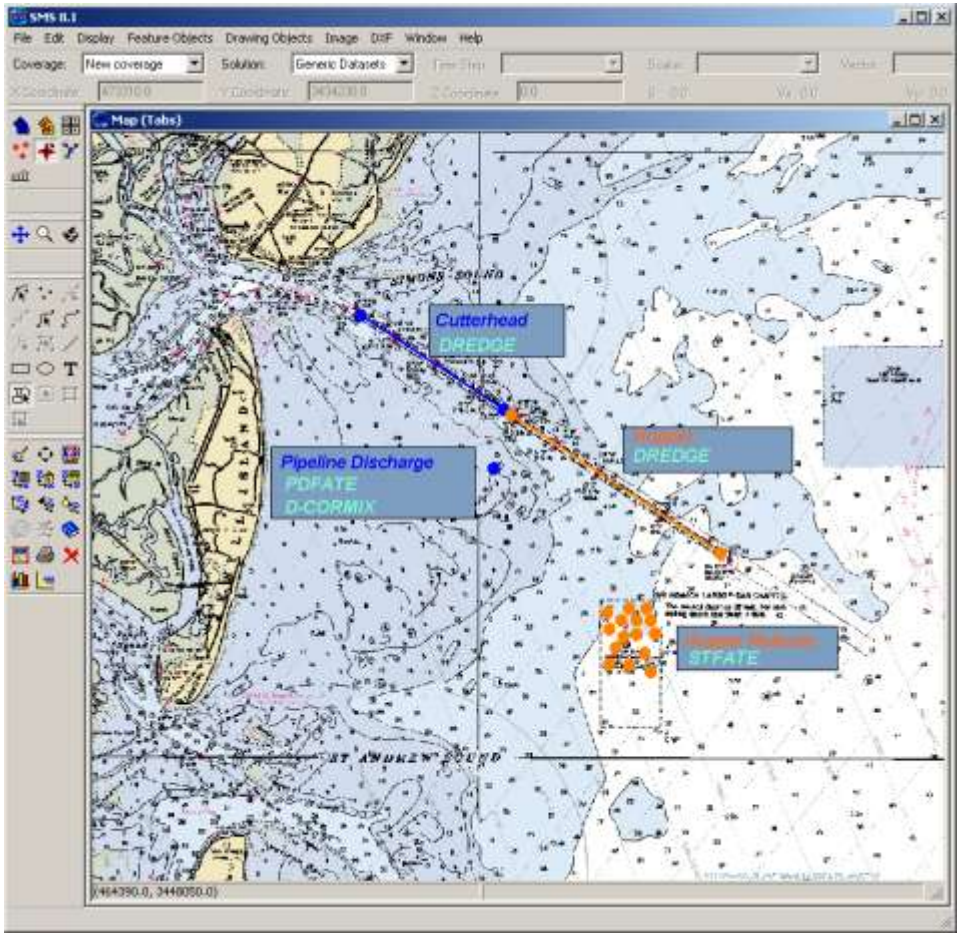
- **Many coastal regions are not receiving sufficient sand or fine sediment**
- **EWN: Mixed sediment placement in nearshore**
  - **Flood tide moves sediment into wetland**
  - **Waves move sand toward shore**
  - **Lower cost than direct placement**
  - **Sustainable placement sites**
  - **Natural sorting of mixed sediments within the wetland**
- **Appropriate design required**

New EWN Research Area

- Modeling sediment transport into and through wetlands
  - EWN strategic placement for wetland development would, optimally, reduce direct placement
    - Wetland hydrodynamic and transport processes
    - Plant/sediment interactions
  - Less intrusive
  - Lower cost
  - LDC required?
  - Dosing
  - Sustainability
- Data needed to develop process descriptions



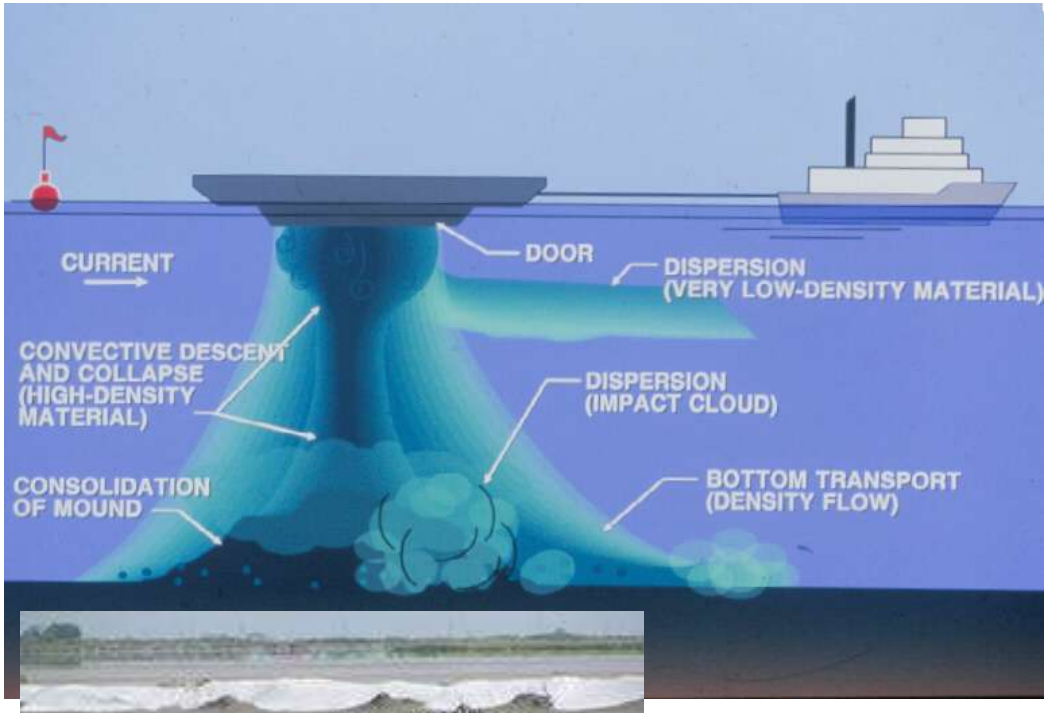
Three Tiers of Models



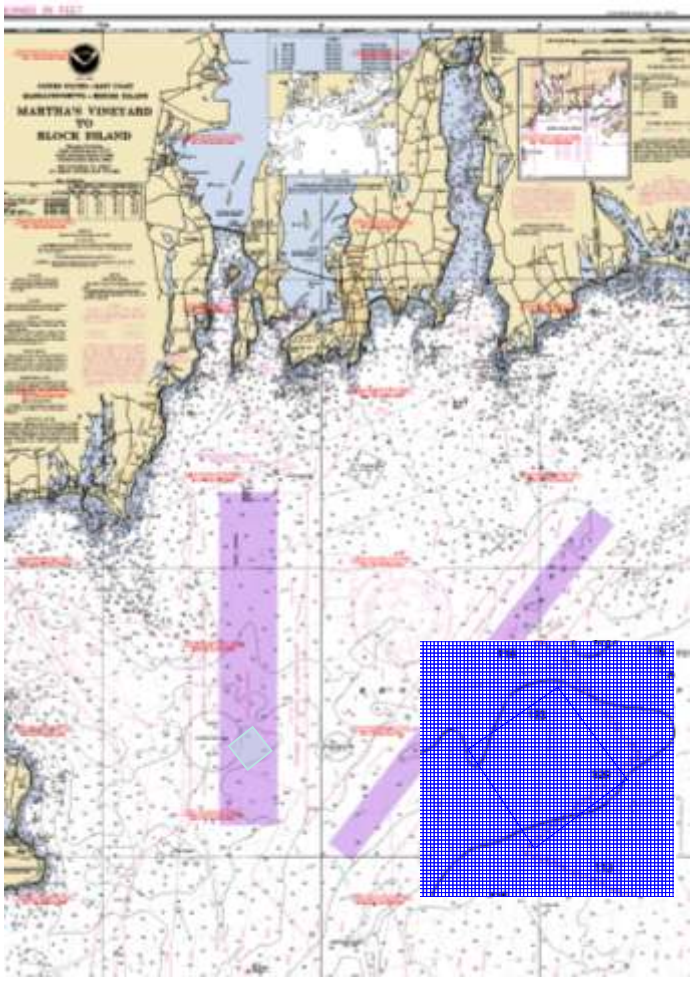
- Web-based screening level tools/models (in ADDAMS)
- Process-specific, near-field models for dredged material
  - PDFATE
  - Dredge
  - STFATE
  - MPFATE
- Large domain, far-field models
  - GTRAN
  - PTM
  - CMS
  - 3-D LTFATE
- SMS Model/data integration

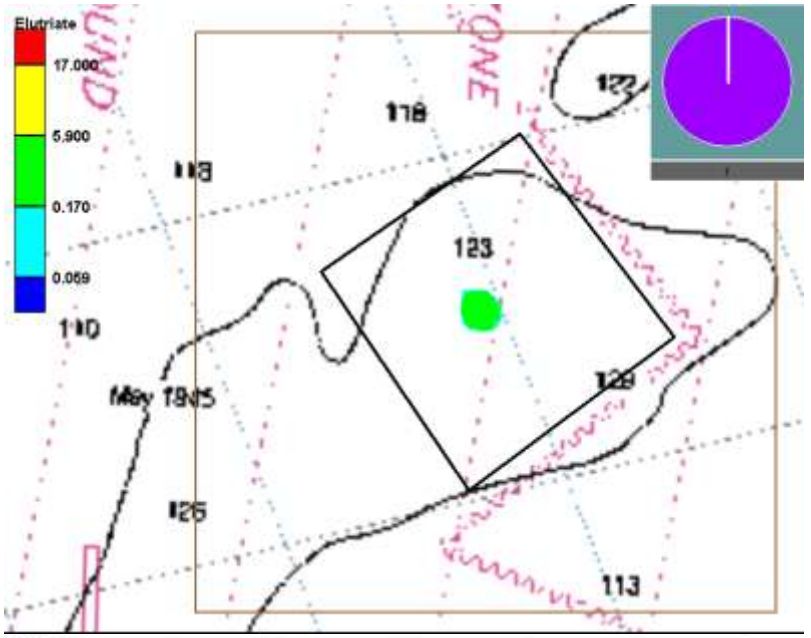
STFATE/PDFATE

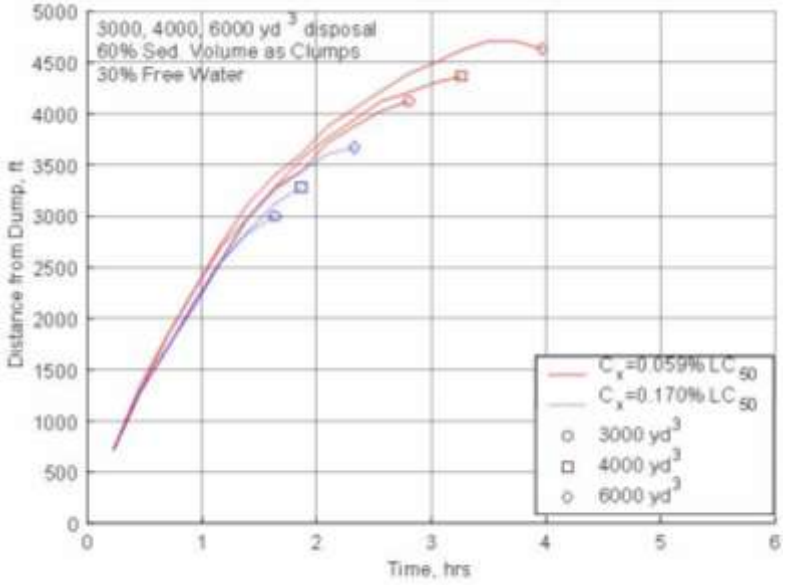
- Provide deposition pattern and resuspension from placement
- Manage placement sites
- Regulatory Compliance (water column concentration)
  - Section 103 of the MPRSA
  - Section 404 (B)(1) of the Clean Water Act
- Evaluate environmental resource issues
- Source to PTM, etc



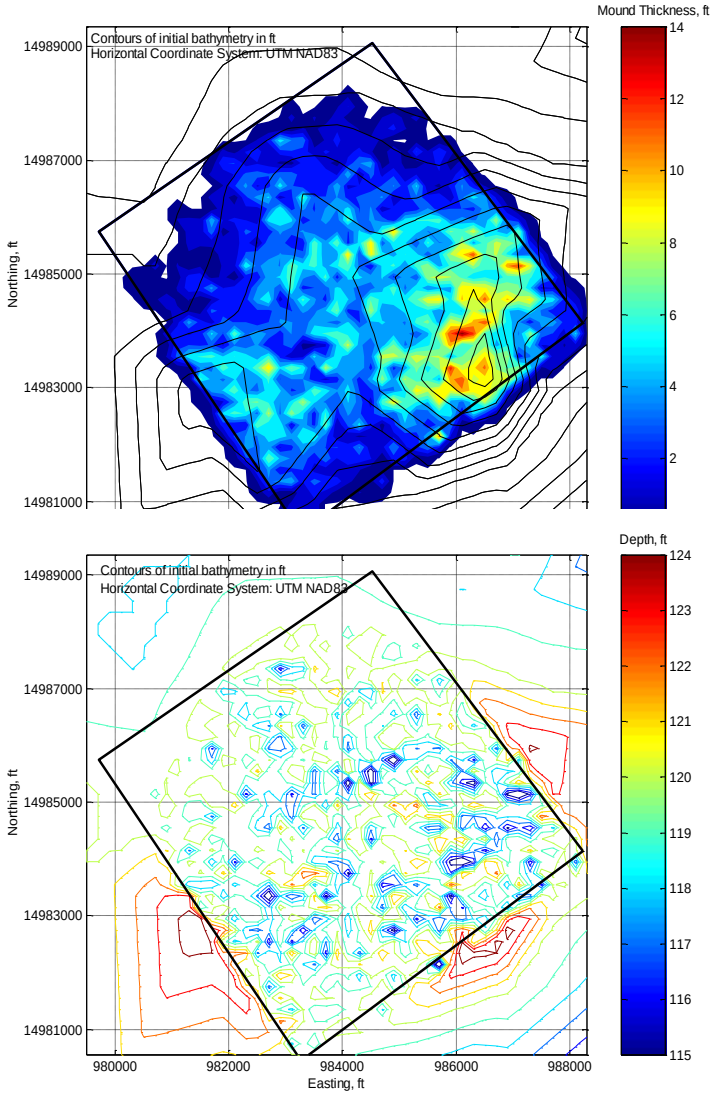
STFATE EXAMPLE







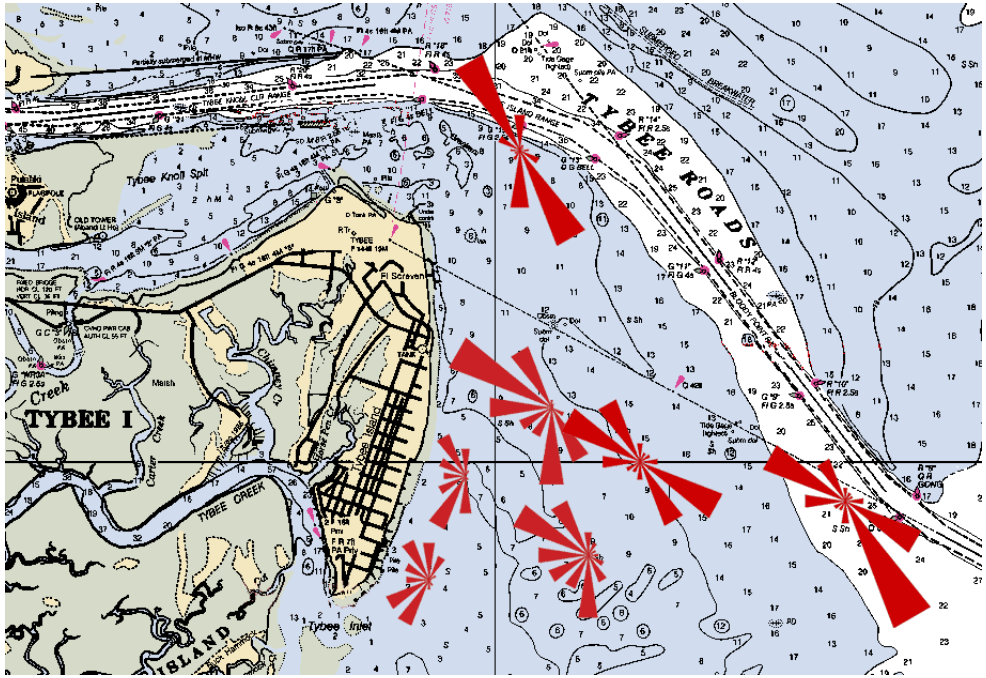
MDFATE/ MPFATE



- Cumulative resuspension from placement operations
- 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 methods

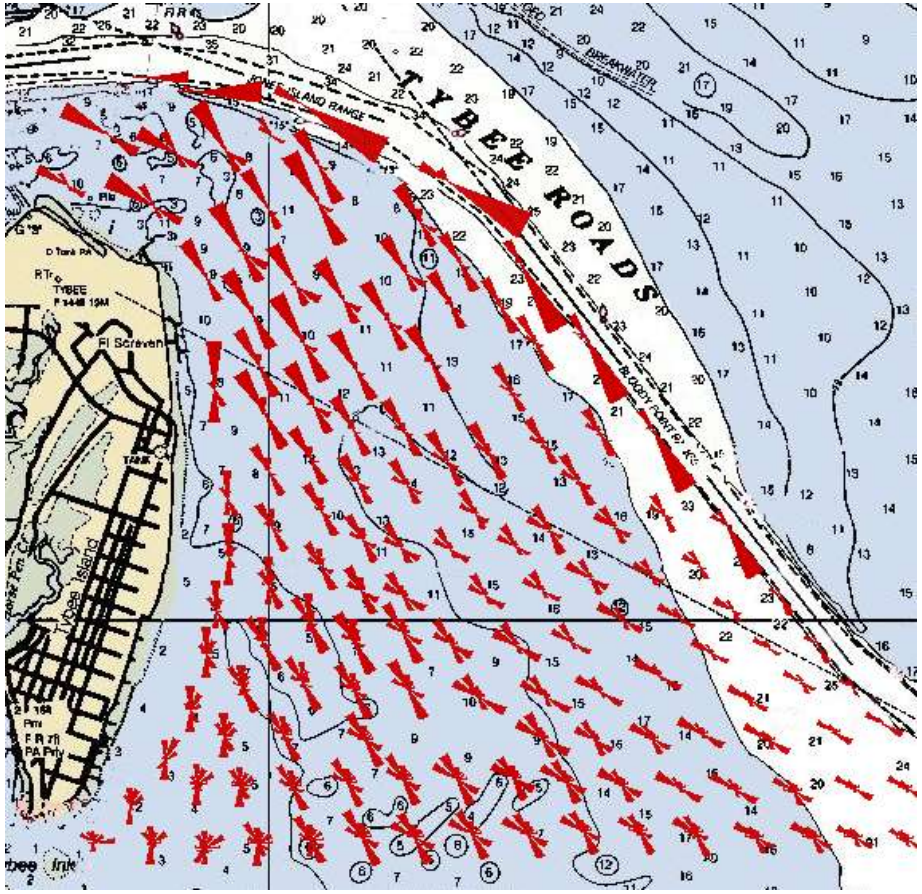
GTRAN

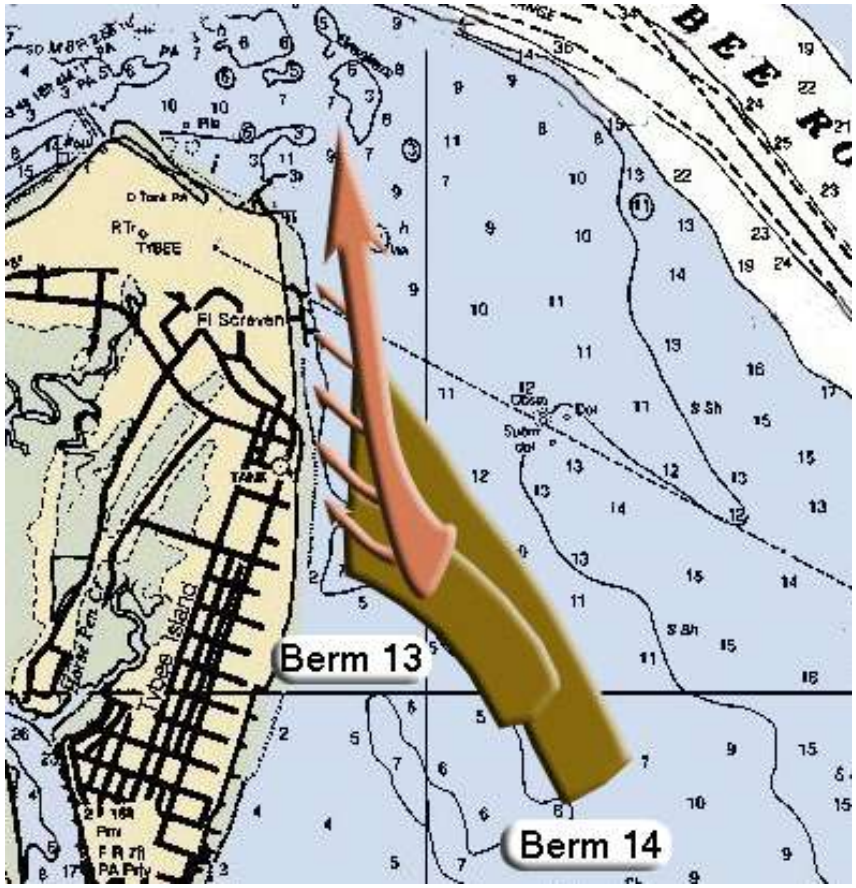
- EWN solutions require screening level tools to assess bedload transport pathways
  - Maximize beneficial use
  - Minimize rehandling
  - Minimize or maximize transport toward target resources
  - Qualitatively predict transport direction and magnitude



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

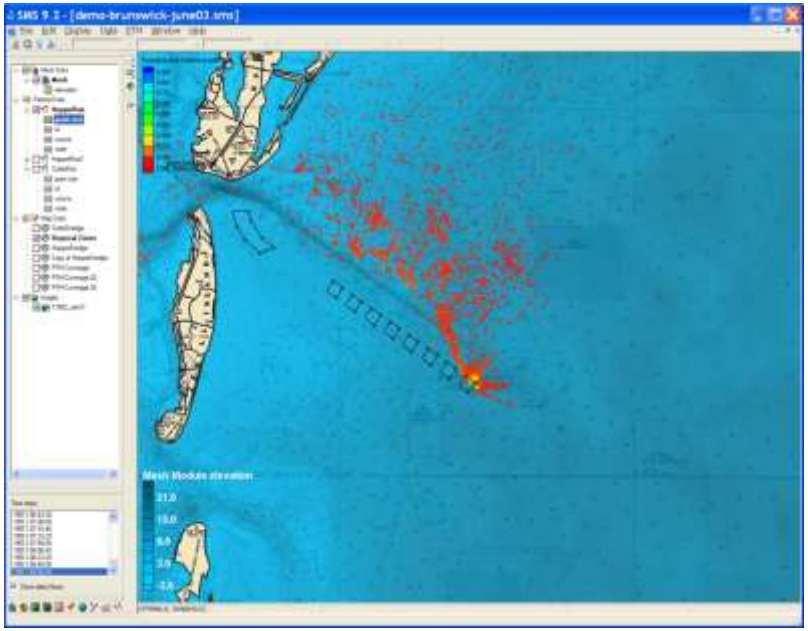
GTRAN Model Application





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

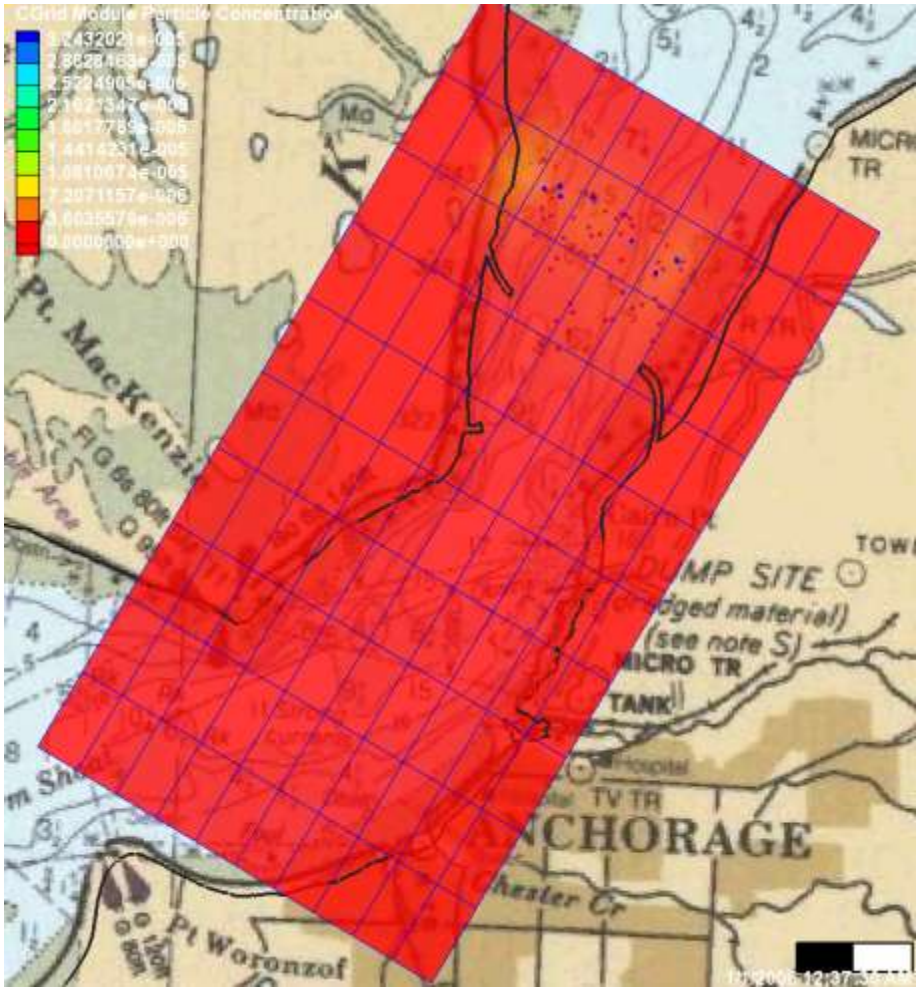
PTM



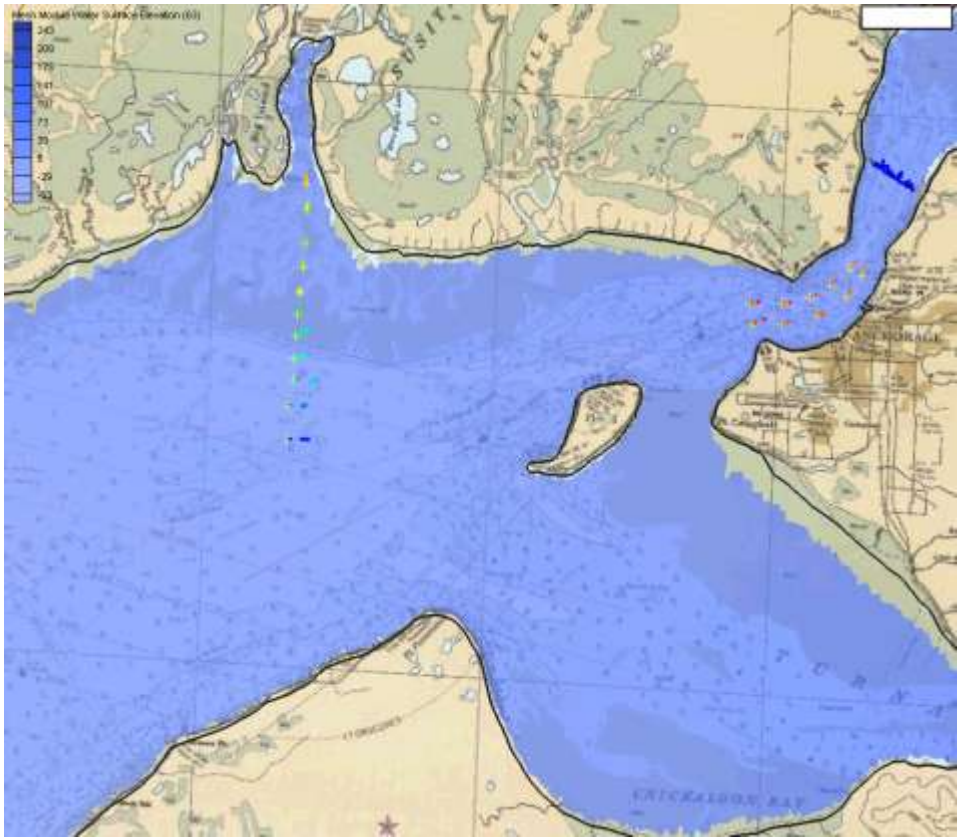
Quantify erosion, deposition, and dose over large domain.

- EWN solutions require screening level tools to assess suspended transport pathways
- 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 specific sources
- Computational efficiency permits modeling of multiple scenarios

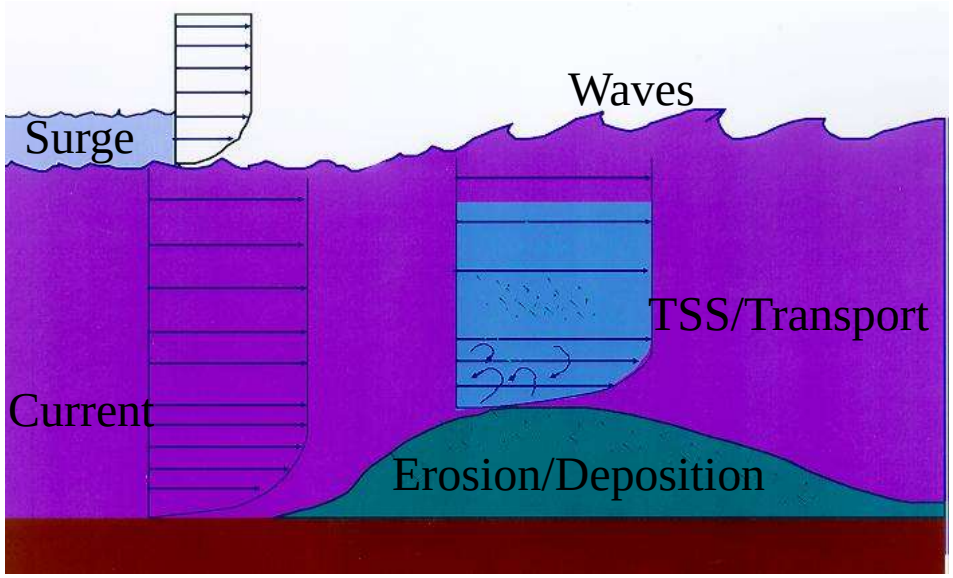
PTM Example



Knik Arm/Port of Anchorage: Understand sediment transport processes and address methods to reduce infilling at port

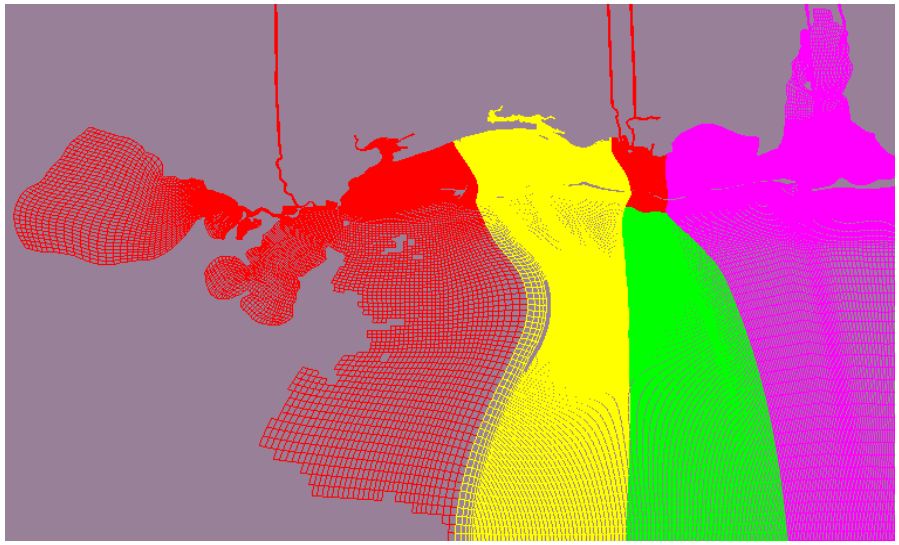


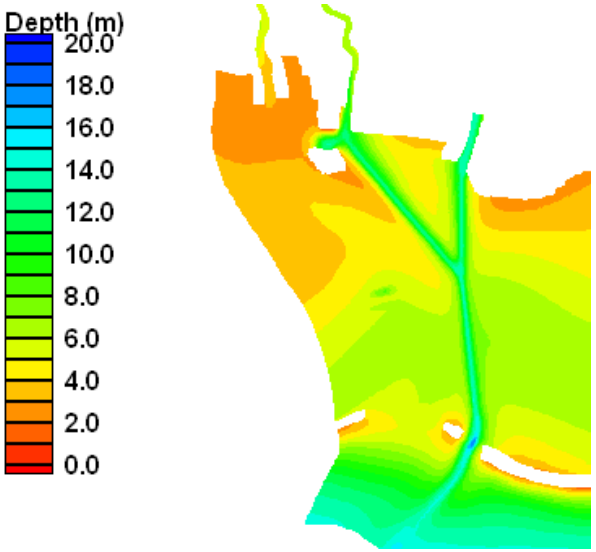
LTFATE/CMS



- 2-D or 3-D, multiple-grain class, large domain fate and transport model including morphology change
- wave – current environments
- Variable sediment bed properties
- Contaminant fate

LTFATE: Bayou Casotte Channel Widening





Model
- **hydrodynamics**
- **waves**
- **sand, silt, and clay**
  - **bedload**
  - **suspended load**

Expansion Width	Bayou Casotte Channel	Pascagoula Lower Sound Channel
75’ East & 75’ West	1.3	1.3
100’ West	1.15	1.25
150’ West	1.2	1.4

Summary

- Models provide important lines of evidence when developing CSM based on process understanding
- Multiple models and levels of modeling required
- Models require data for parameterization, calibration, and validation
- EWN often requires that we use models to address conditions for which we have no data
- Model benefit to EWN: evaluate options/improve parctice