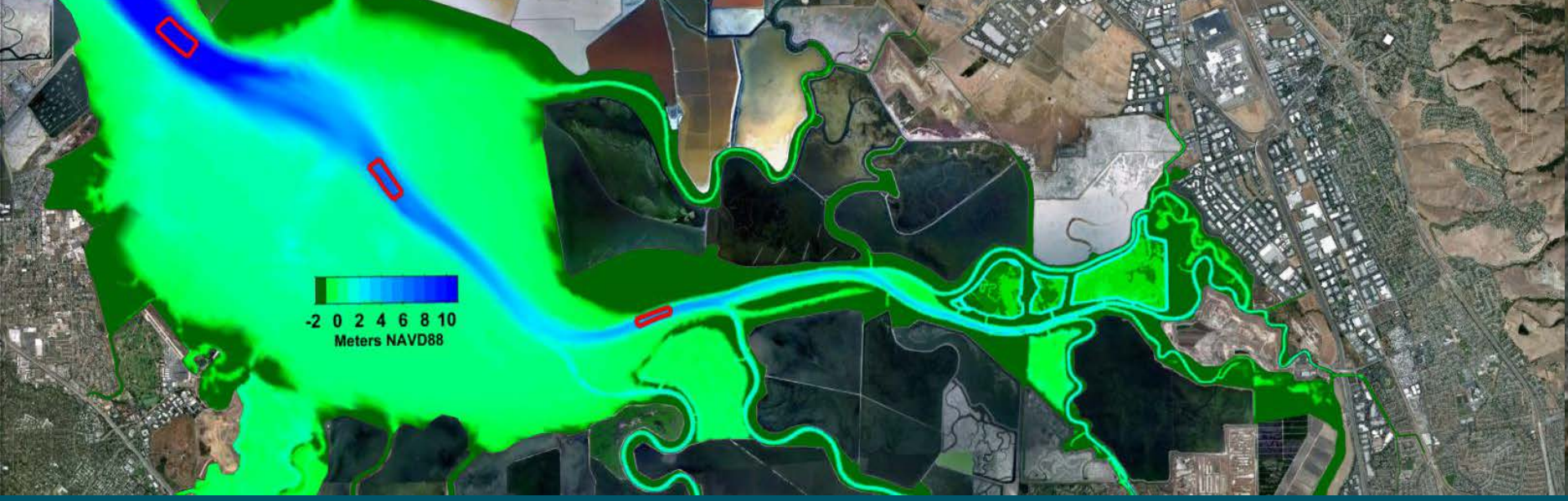

The Potential for Using Open-Water Dredged Material Placements to Augment the Sediment Supply to Mudflats and Marshes in San Francisco Bay

ANCHOR QEA

WEDA Pacific Chapter Meeting

November 5, 2015

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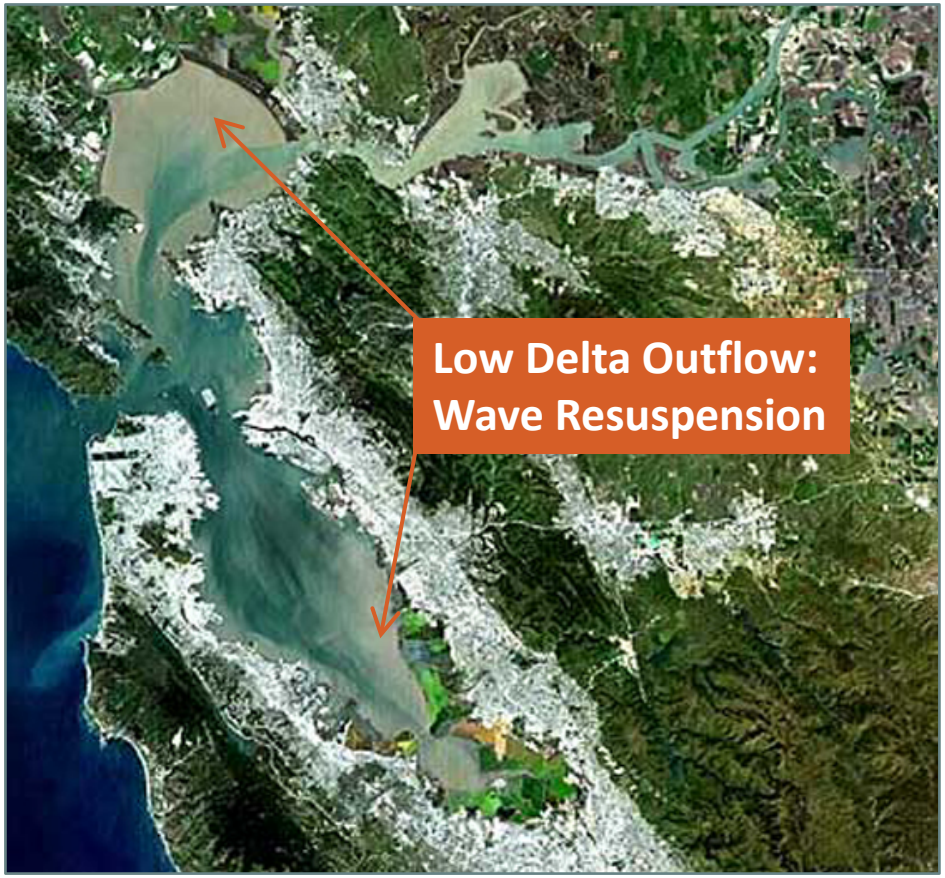
Motivation

- The majority of tidal marshes surrounding San Francisco Bay are not likely to keep pace with sea level rise
- A minimum of 40% of material dredged from San Francisco Bay is required to be put toward beneficial reuse
- Natural dispersal of dredged material may be incorporated into a nature-based strategy for augmenting mudflat and marsh sedimentation and improving coastal resiliency

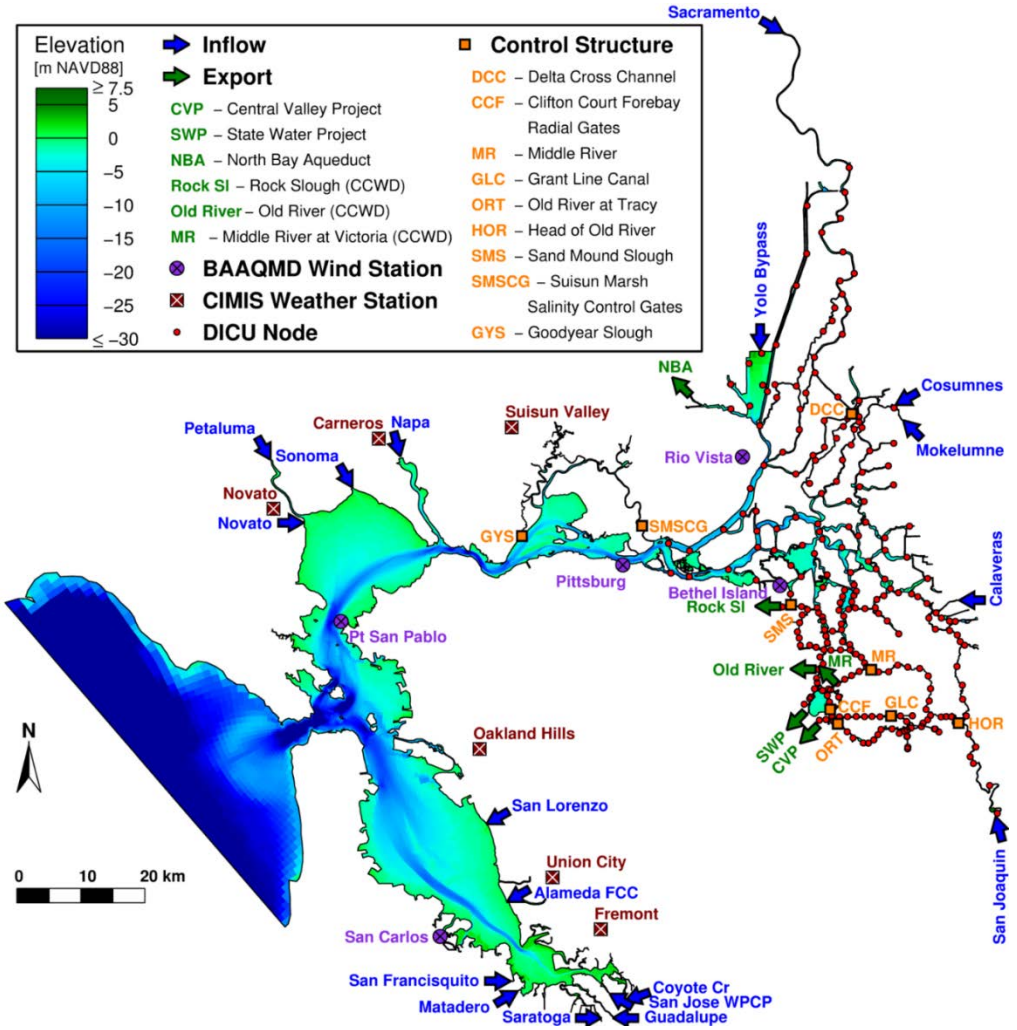
Study Approach

- Simulate erosion, deposition, and transport of sediment immediately following dredge material placement event
- Track this sediment as it is transported throughout the entire Bay-Delta system
- Assess whether dredged material placements at strategic locations can be used for wetland nourishment
- Identify potential pilot study locations where open-water dredged material placements are likely to result in the greatest potential for beneficial reuse through enhanced accretion on mudflats and marshes

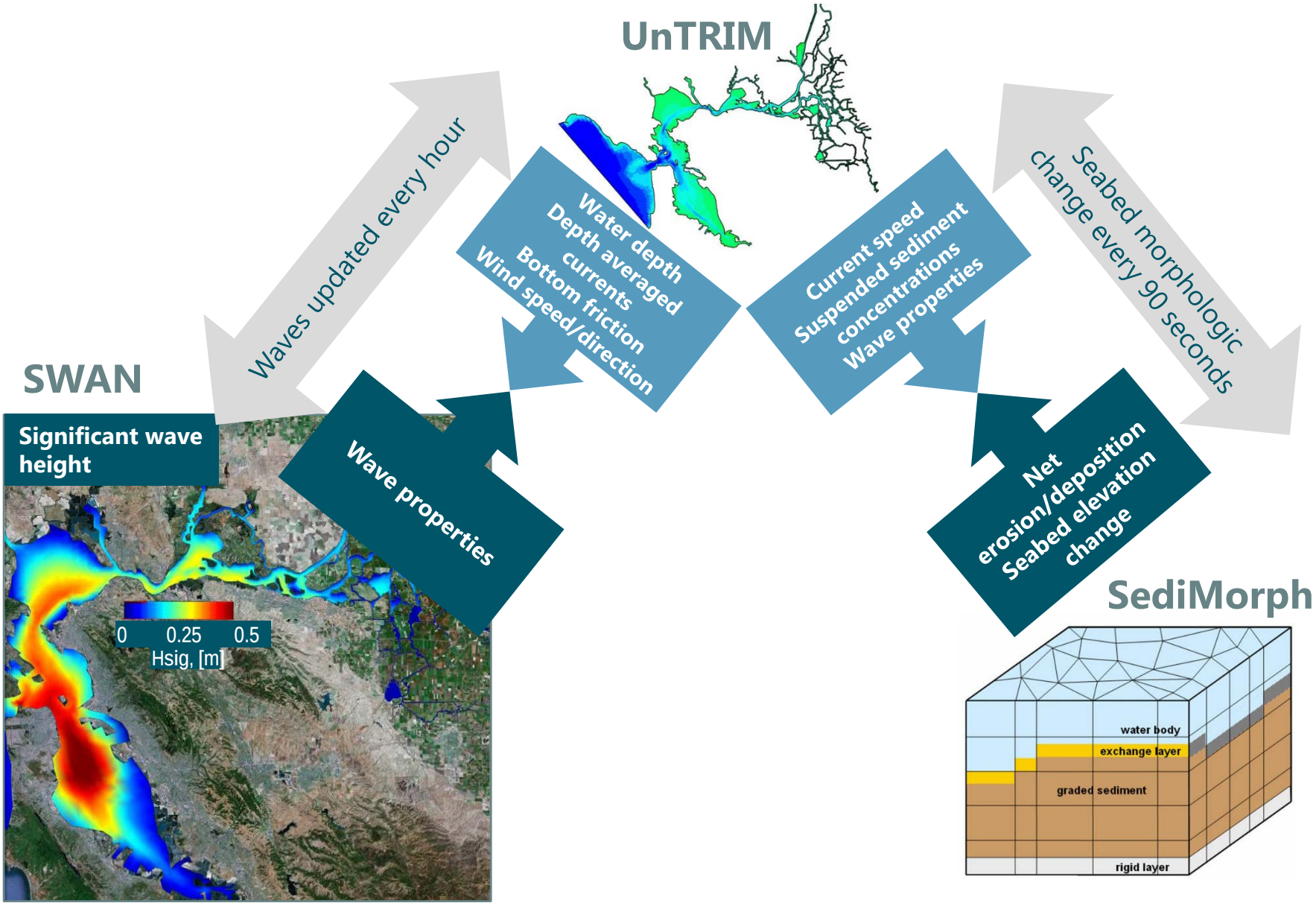
San Francisco Bay Sediment Transport



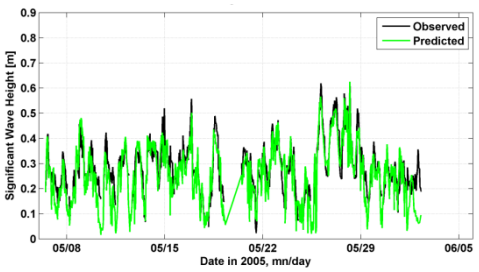
UnTRIM San Francisco Bay-Delta Model

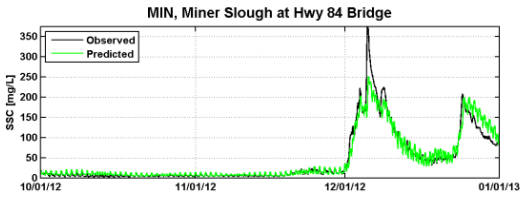


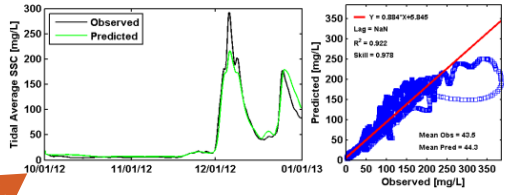
UnTRIM-SWAN-SediMorph Model Coupling

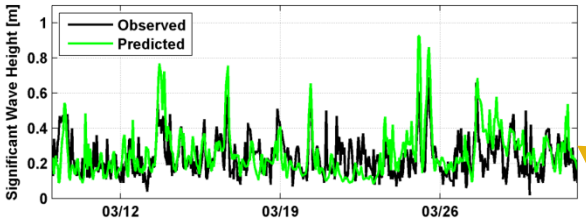


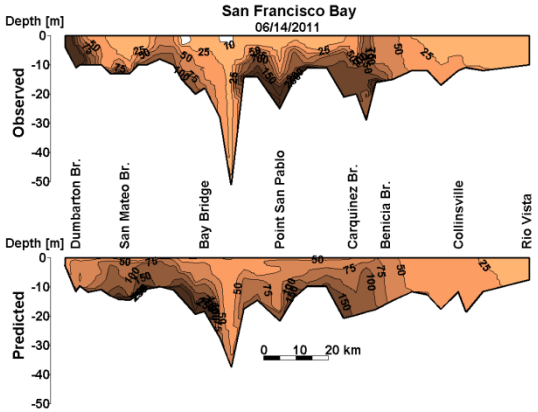
Sediment and Wave Validation Locations

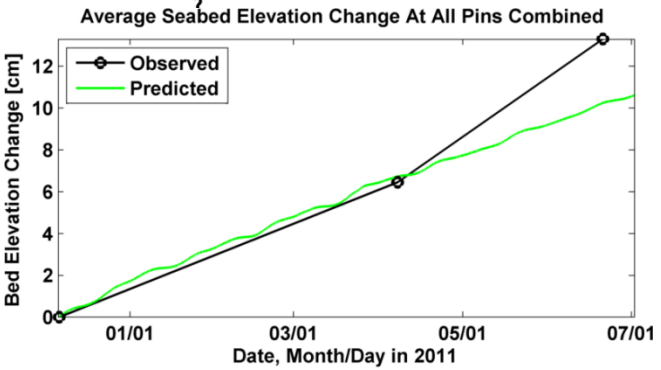












Dredged Material Placement Overview

- Percentages of sediment in deposit and in suspension are based on USACE simulations using the Short-Term Fate of Dredged Material (STFATE) model
- Each placement occurs within a single grid cell
- Following placements, sediment undergoes continual erosion, deposition, and transport throughout San Francisco Bay

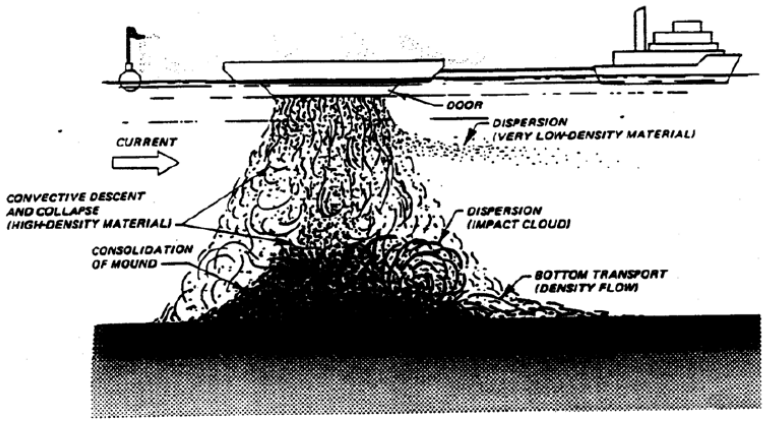
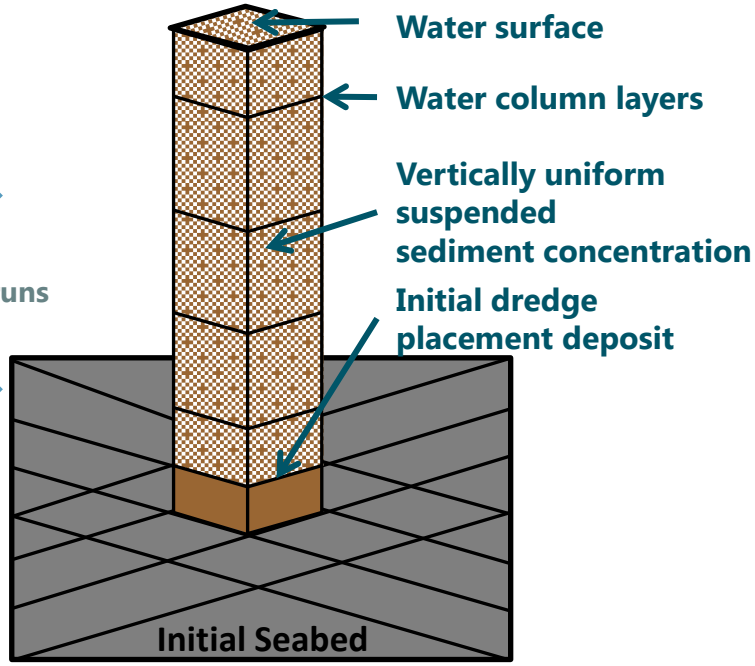
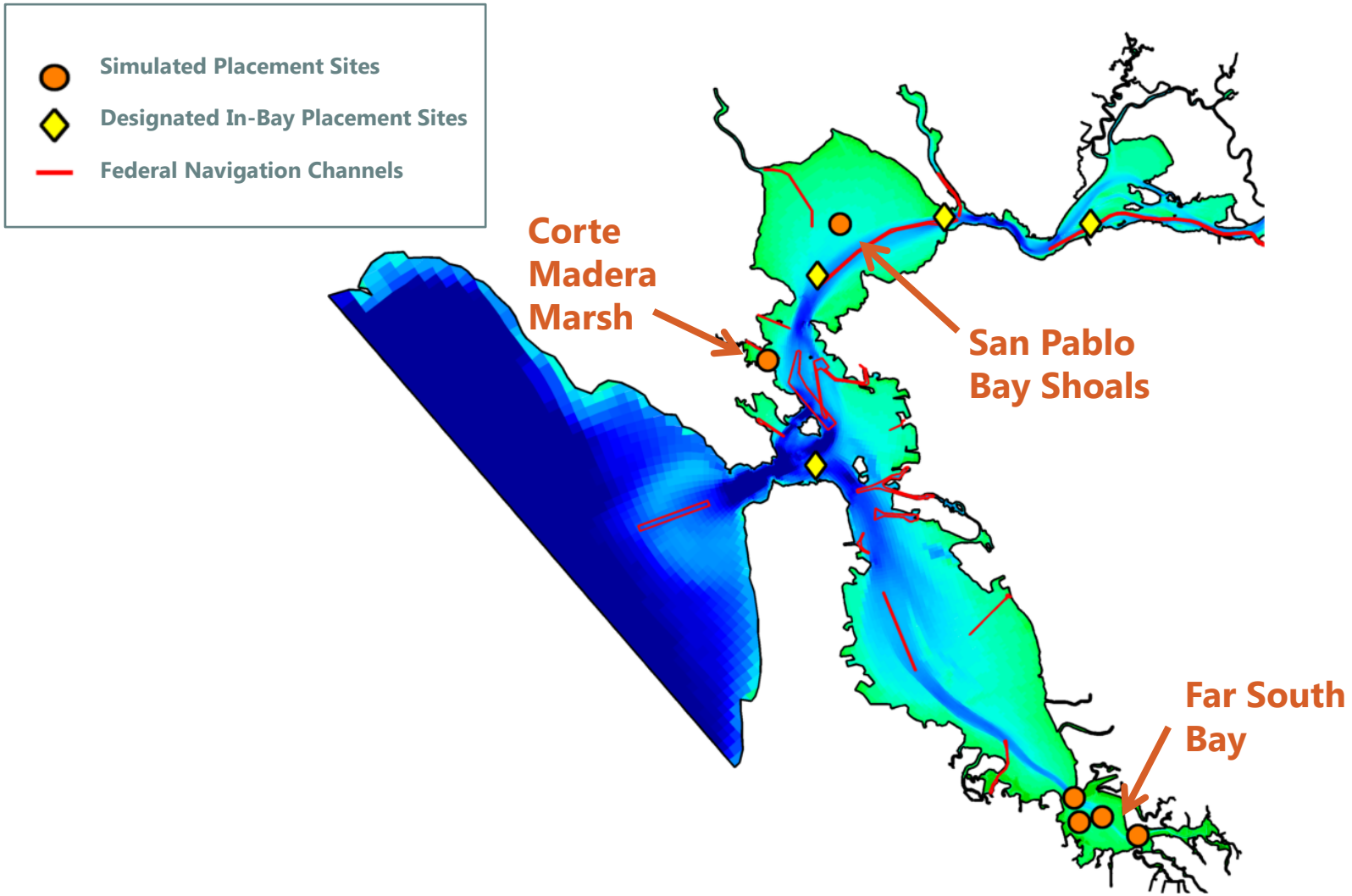


Figure 1. Processes modeled in STFATE

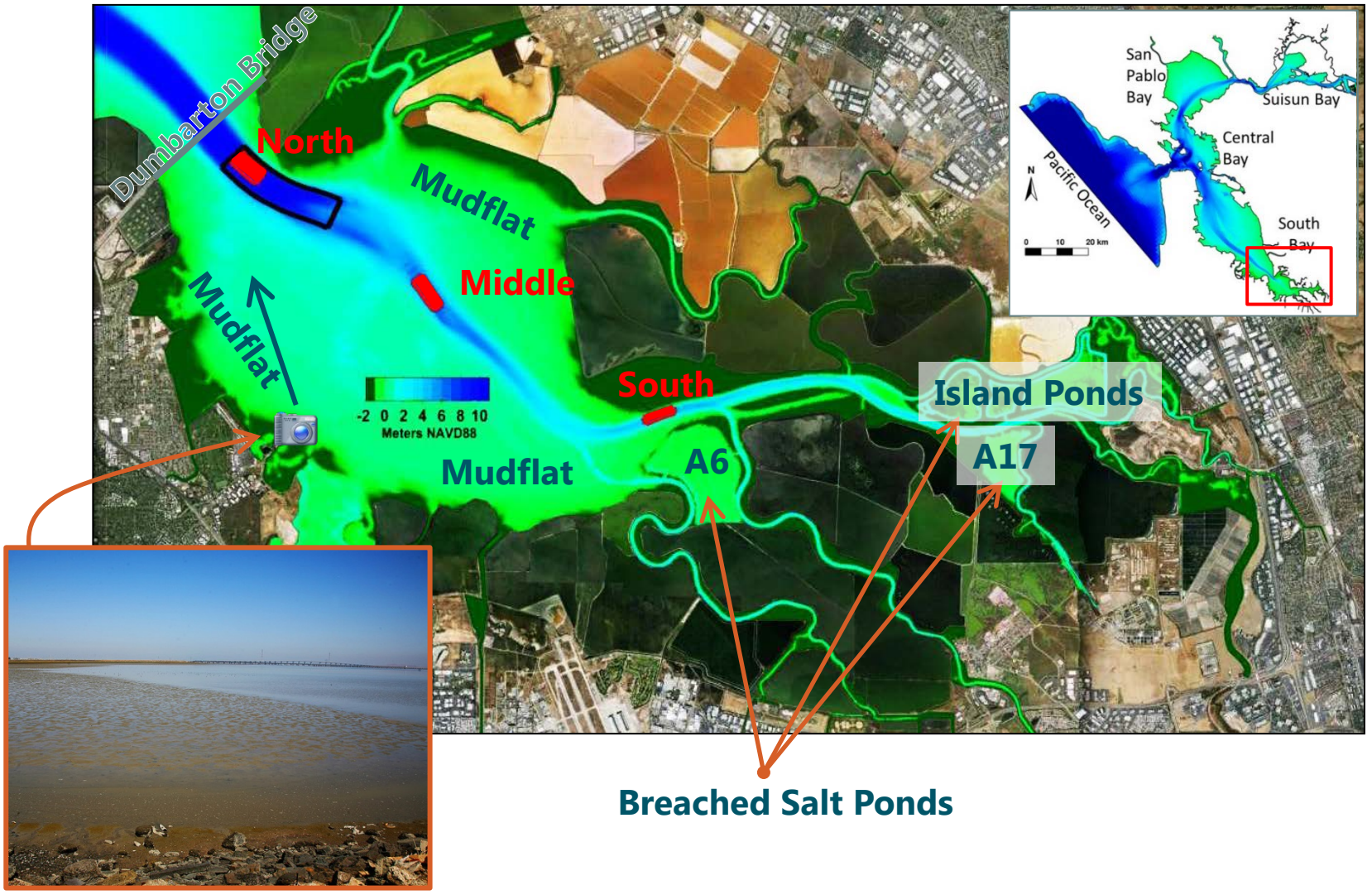
STFATE model runs



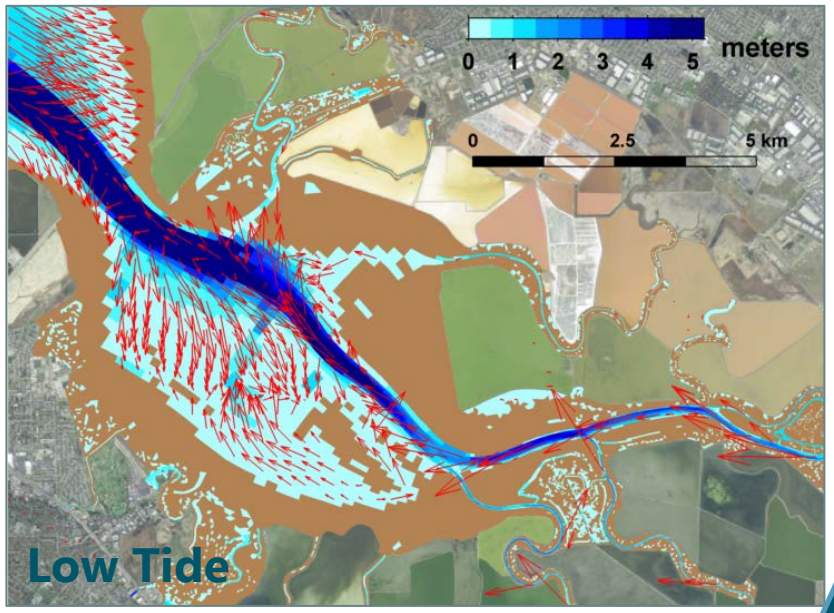
Dredged Material Placement Locations

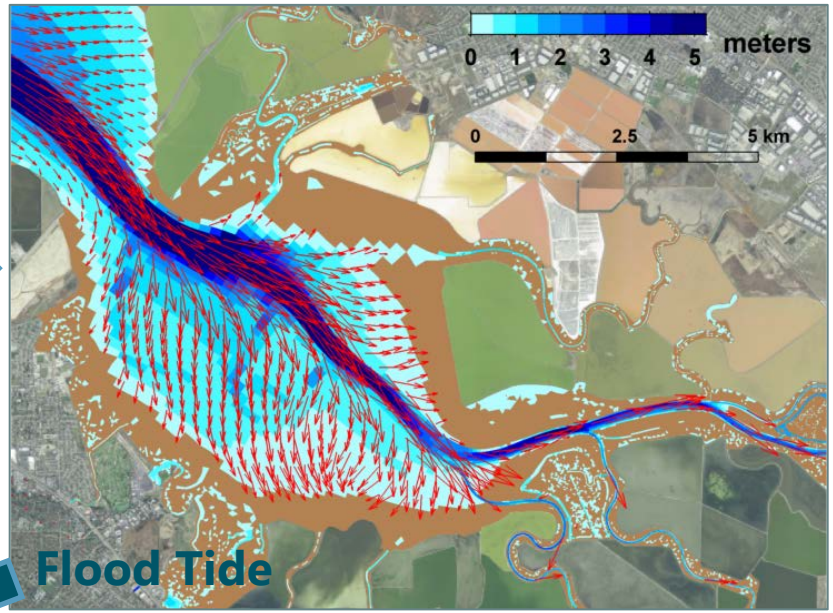


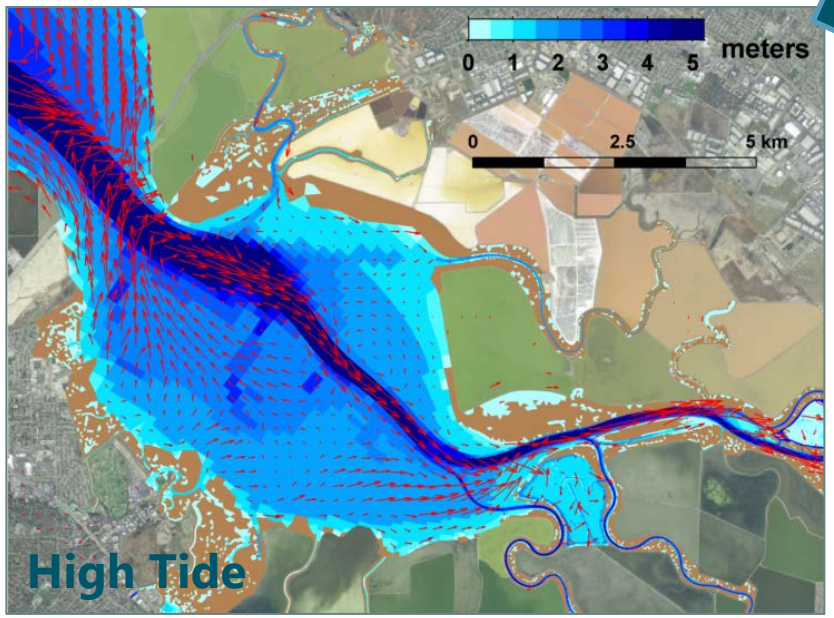
Application: Far South Bay Dredged Material Placements

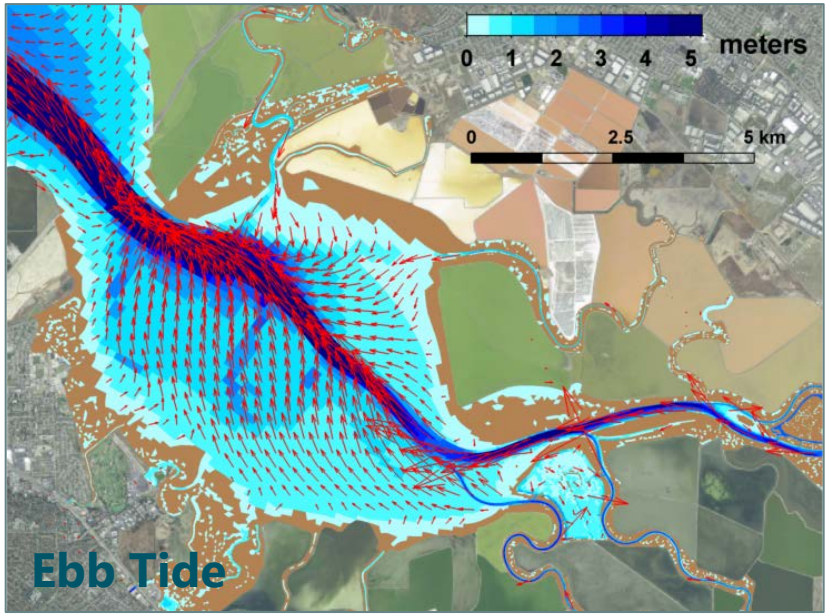


Far South Bay Hydrodynamics





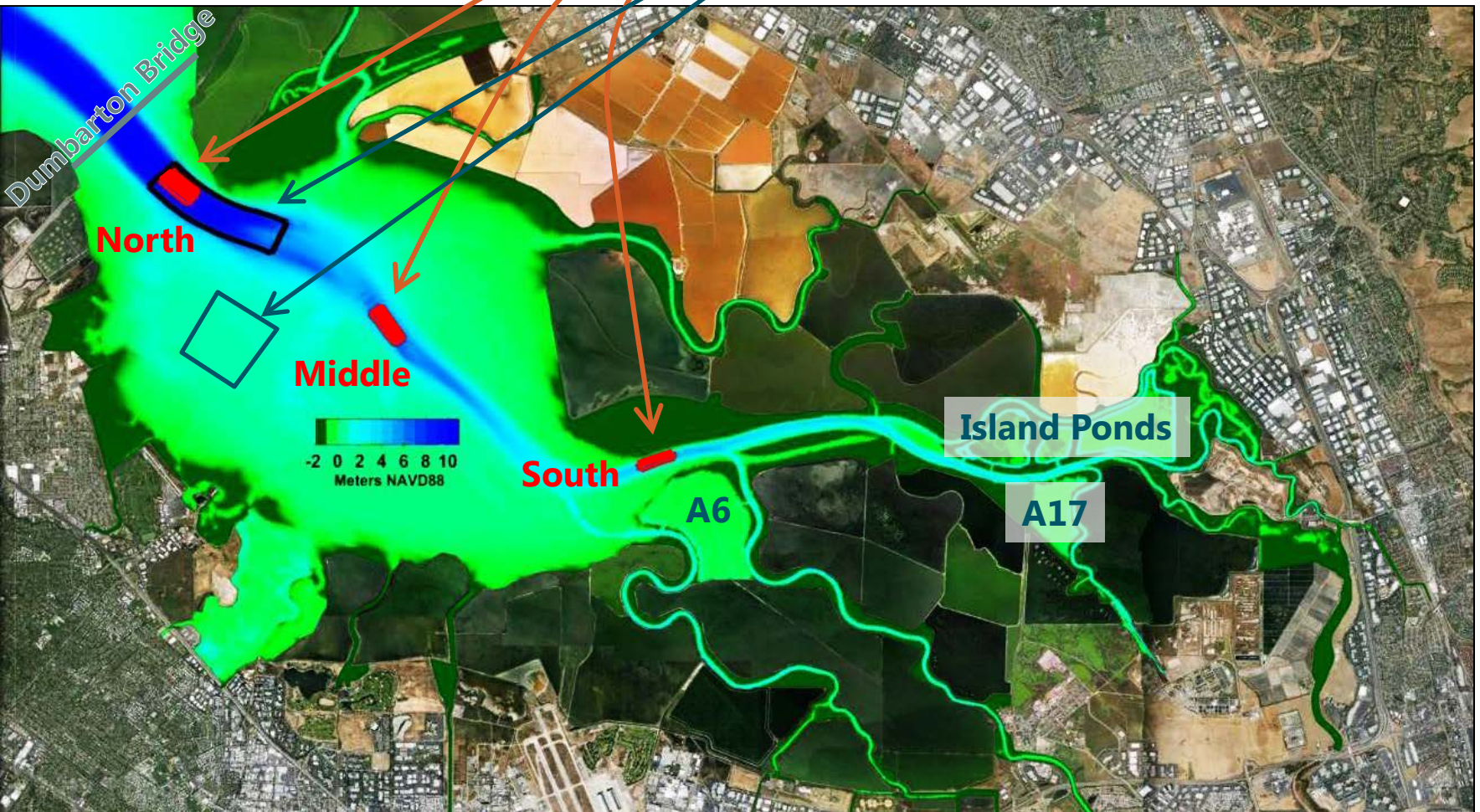




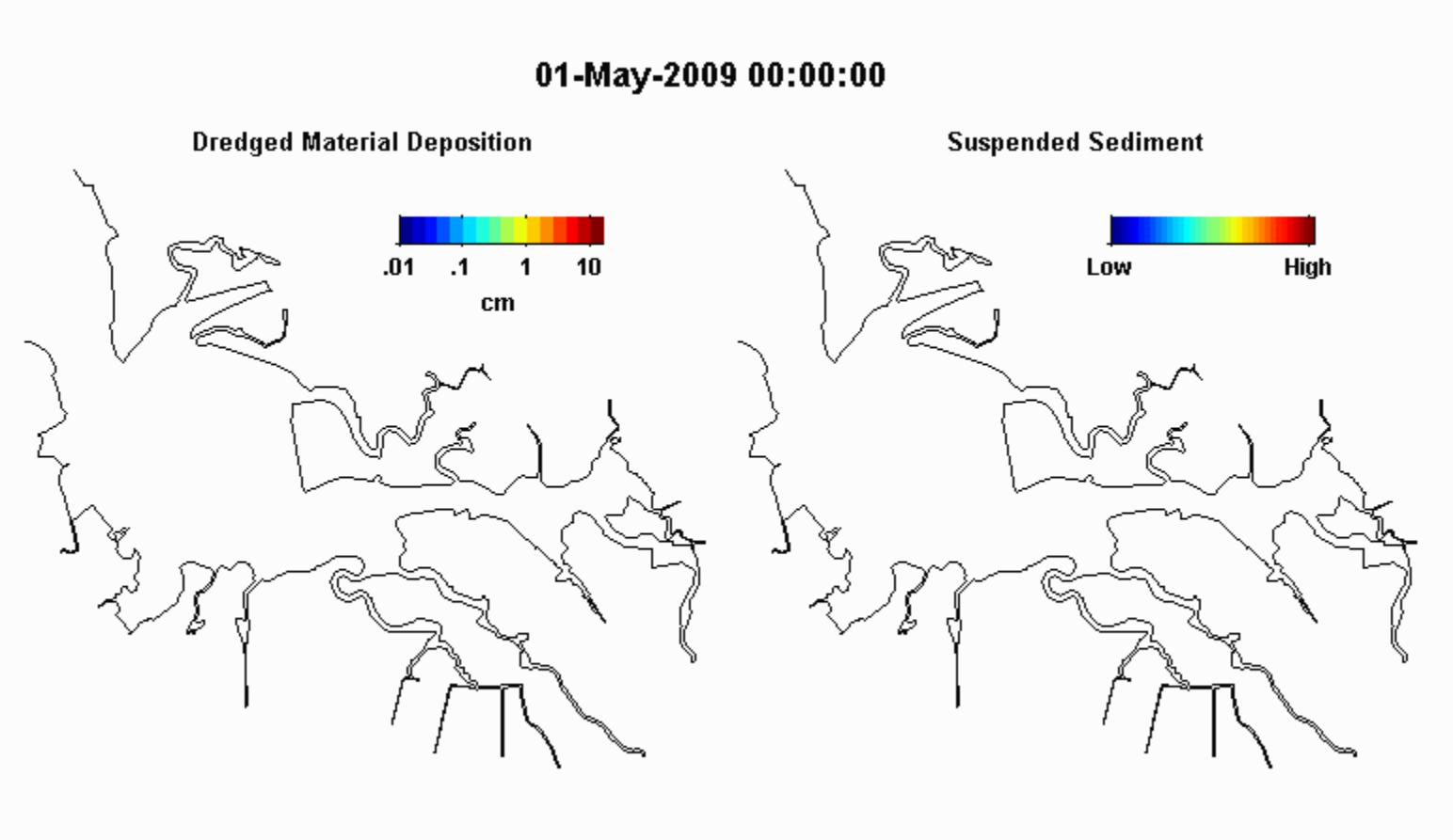
Dredged Material Placement Simulations

- Placements evaluated at five locations in Far South Bay
- Two different sediment volumes simulated

Scenario Number	Placement Location	Simulation Duration	Placement Volume, yd^3
1	North	5 Months	48,000
2	Middle	5 Months	48,000
3	South	5 Months	48,000
4	Near Dumbarton Bridge	1 Year	350,000
5	Western Mudflat	5 Months	48,000

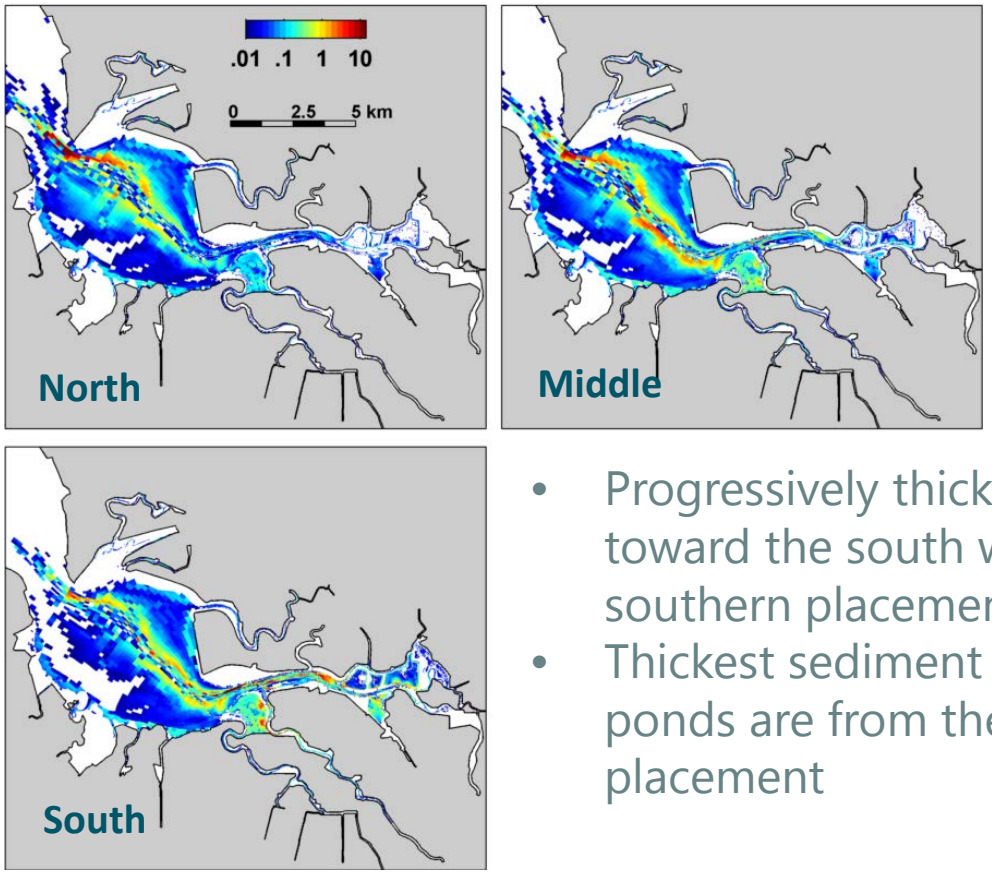


Results: Dredged Material Placement Simulations (5 Months)



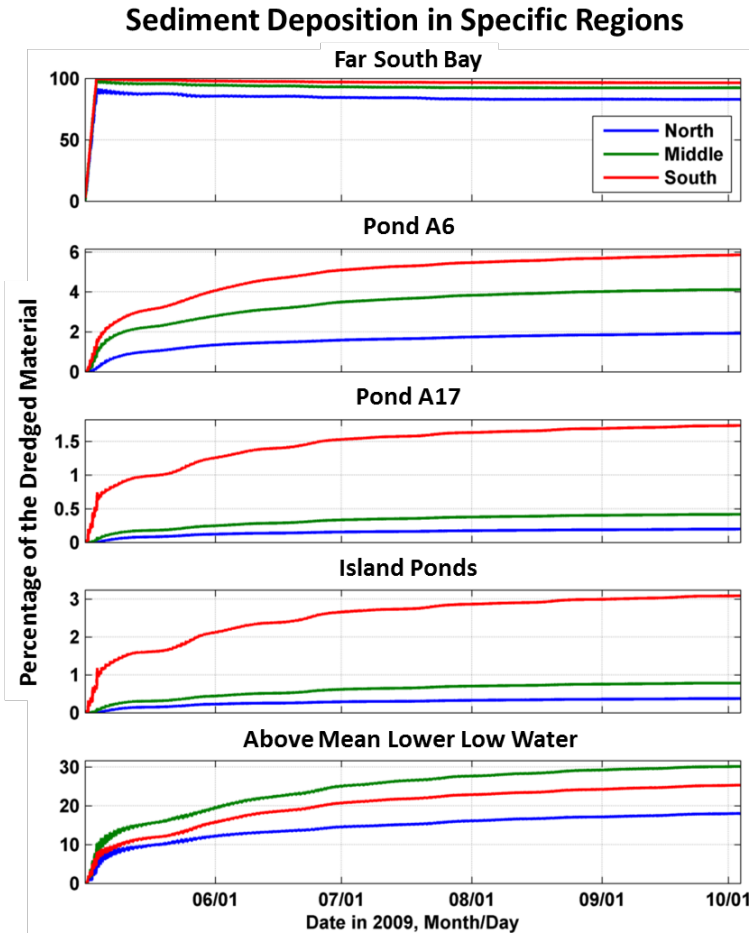
Results: Dredged Material Placement Simulations (5 Months)

Placement Seabed Sediment Thickness

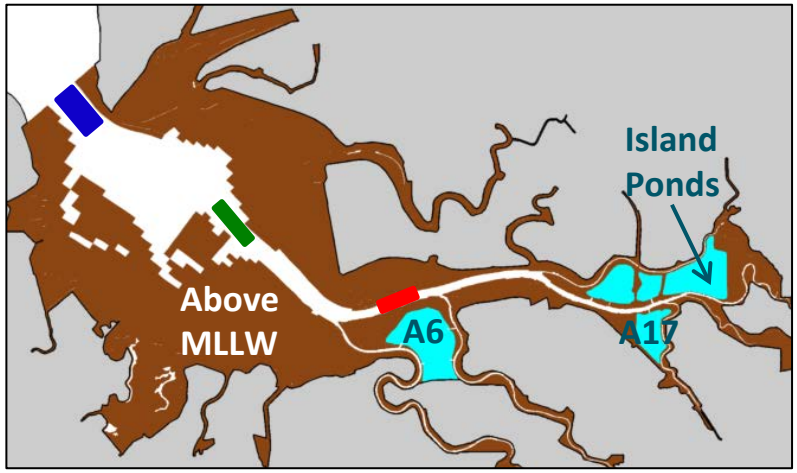


- Progressively thicker deposits toward the south with more southern placement location
- Thickest sediment deposits in salt ponds are from the southern placement

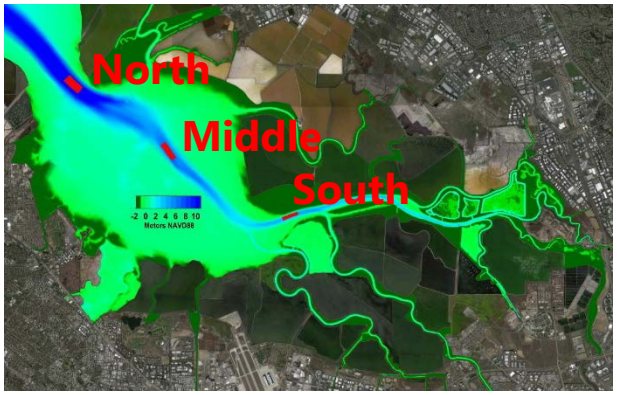
Results: Dredged Material Placement Simulations (5 Months)



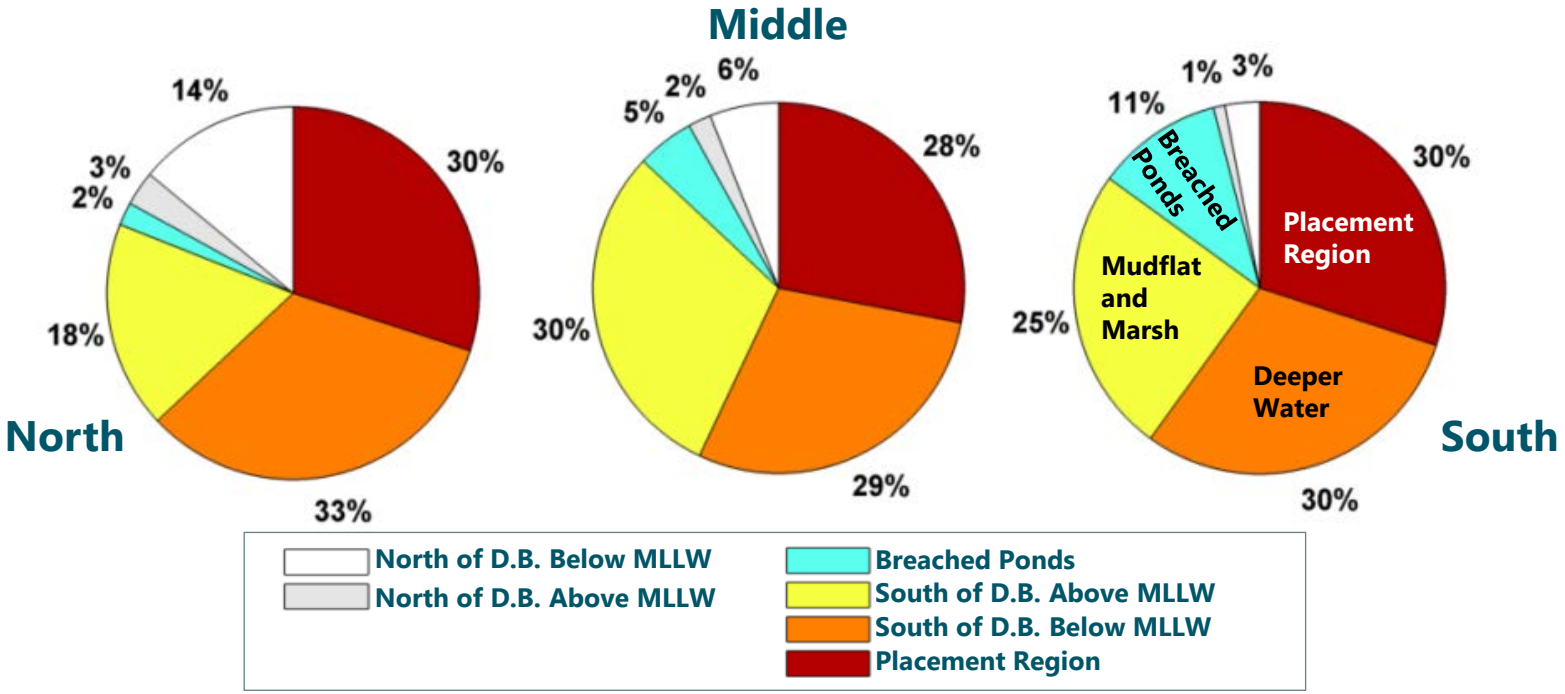
- Initial rapid dispersal of the dredged material
- Middle placement maximizes deposition on mudflats and marshes
- South placement maximizes deposition in salt ponds



Results: Dredged Material Placement Simulations (5 Months)



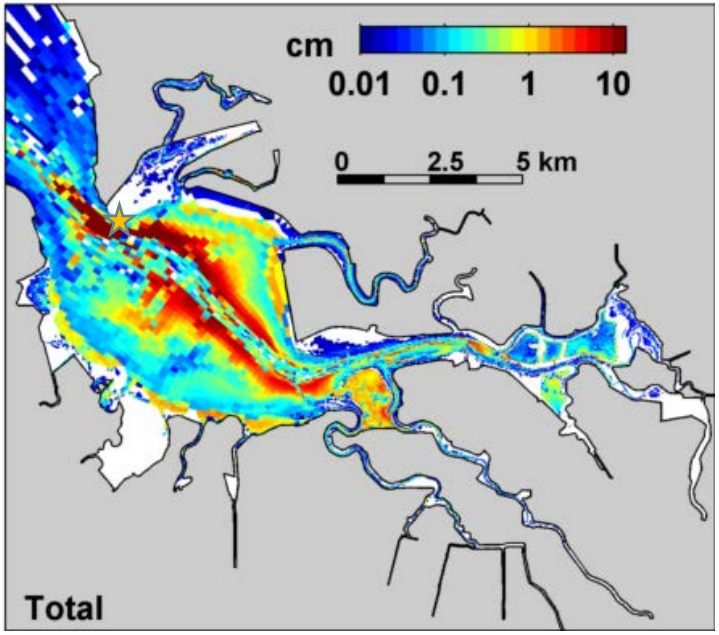
- About 30% of dredged material is predicted to be retained in the placement region after 5 months
- Middle and South placements both supplied 37% of dredged material to mudflats/marshes and breached salt ponds over 5 months
- Less than 0.4% was transported back into federal navigation project channels



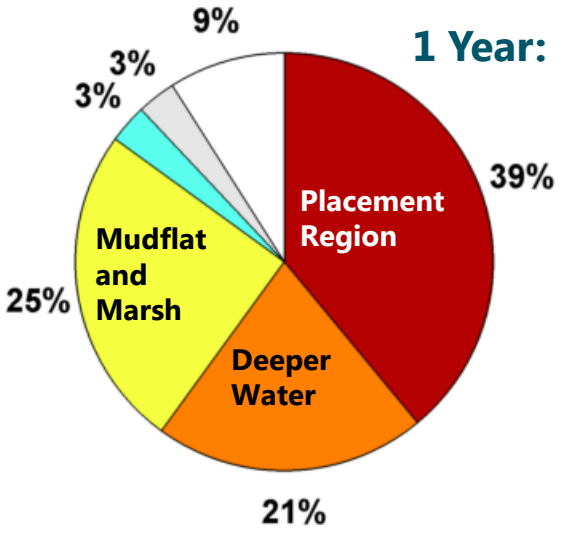
Large Placement Volume Simulation (1 Year)

- Dredged material volume and scow size representative of maintenance dredging in Redwood City Harbor
- Results qualitatively similar to smaller placement at North placement location
- Demonstrates feasibility of periodic large-scale dredged material placements for marsh and mudflat augmentation

1 Year: 350,000 yd³



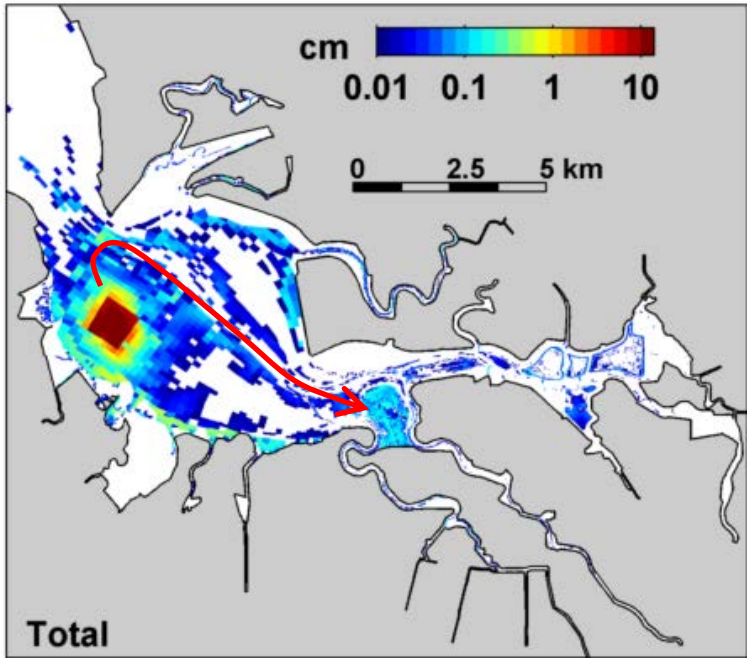
1 Year: 350,000 yd³



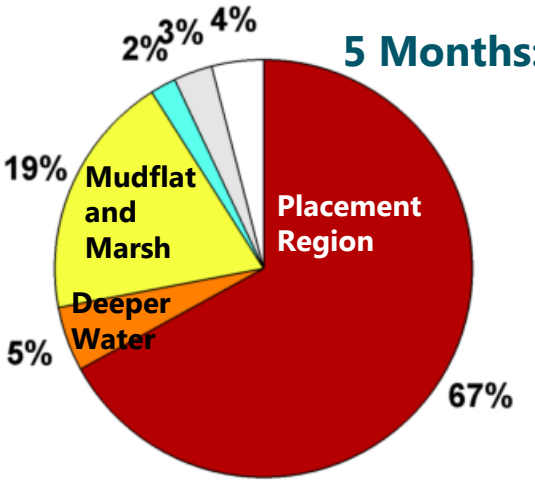
Thin Layer Placement on Mudflat (5 Months)

- Least sediment dispersal from the placement region of any scenario
- Little sediment transported into breached salt ponds
- The most sediment deposited on the mudflat
- The least deposition in the channel

5 Months: 48,000 yd³



5 Months: 48,000 yd³



North of D.B. Below MLLW
North of D.B. Above MLLW
Breached Ponds
South of D.B. Above MLLW
South of D.B. Below MLLW
Placement Region

Conclusions

- 3-D hydrodynamic, wave, sediment transport, and morphologic models can be applied to evaluate potential sites where open-water dredged material placements could be used to augment sediment supply to mudflats and marshes
- Locations were evaluated in San Pablo Bay, Corte Madera Bay, and Far South Bay
- All five placement locations evaluated in Far South Bay maintained the majority of dredged material south of Dumbarton Bridge and supplied sediment to breached salt ponds, existing marshes, and mudflats
- Increasing sediment accretion within restored ponds will improve shoreline resiliency and complement flood risk management goals of South San Francisco Bay Shoreline Study
- In-bay placement has the potential to provide a low-cost placement option that also achieves goals of beneficial reuse

Path Forward

1. ✓ Develop and validate a 3-D hydrodynamic, wave, and sediment transport model for San Francisco Bay
2. ✓ Apply the model to identify potential sites where dredged material placement could be used to effectively augment sediment supply to marshes
3. ➡ Implement and monitor a pilot study to confirm model results, measure potential benefits, and provide additional data for model validation
   - Pre-placement bathymetry, benthic, and marsh surveys
   - Small pilot placement with tracers and extensive monitoring
   - Post-placement bathymetry, benthic, and marsh surveys
4. Refine model assumptions and validate the refined model using data collected during the pilot study
5. Policy changes will be required to allow for open-water dredged material placements for beneficial use

Acknowledgments

Sediment Transport Modeling

- Aaron Bever (Anchor QEA)

Dredged Material Discussions

- Craig Conner (USACE)
- Frank Wu (formerly with USACE)
- Lisa Andes (formerly with USACE)
- Brian Ross (EPA)
- Brenda Goeden (BCDC)
- Elizabeth Christian (SWRCB)
- Rob Lawrence (USACE)
- Jessica Burton Evans (USACE)
- Al Paniccia (USACE)

SWAN

- Ed Gross (RMA)
- Jeremy Bricker

Sediment Data and Discussions (USGS)

- Tara Morgan-King
- Scott Wright
- Greg Schellenbarger
- Maureen Downing-Kunz
- David Schoellhamer

SediMorph

- Holger Weilbeer (BAW)

JANET Grid Generator

- Christoph Lippert

UnTRIM Model

- Vincenzo Casulli

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