

Innovative Systems-Approach to Understanding Southeast Florida's Navigation and Coastal Storm Risk Management Projects

Identifying Solutions to Increase Coastal Resiliency and Regional Sediment Management

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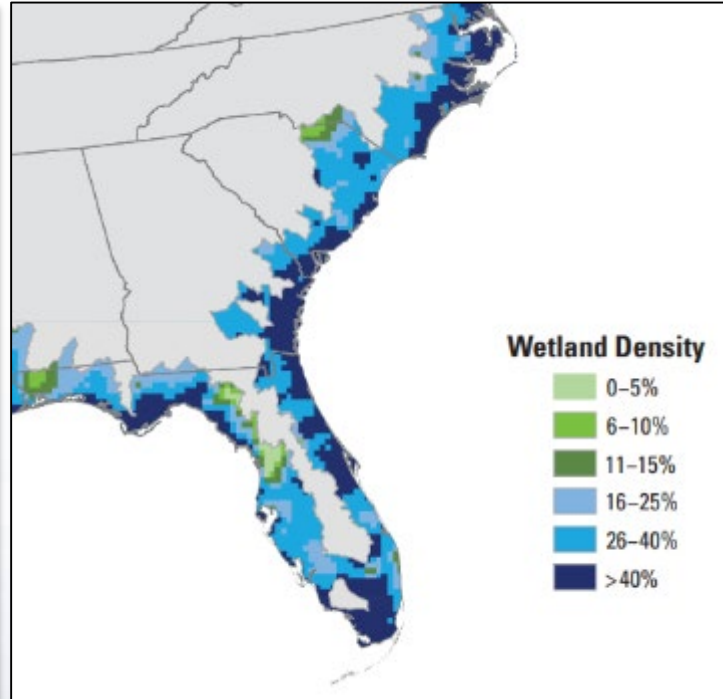
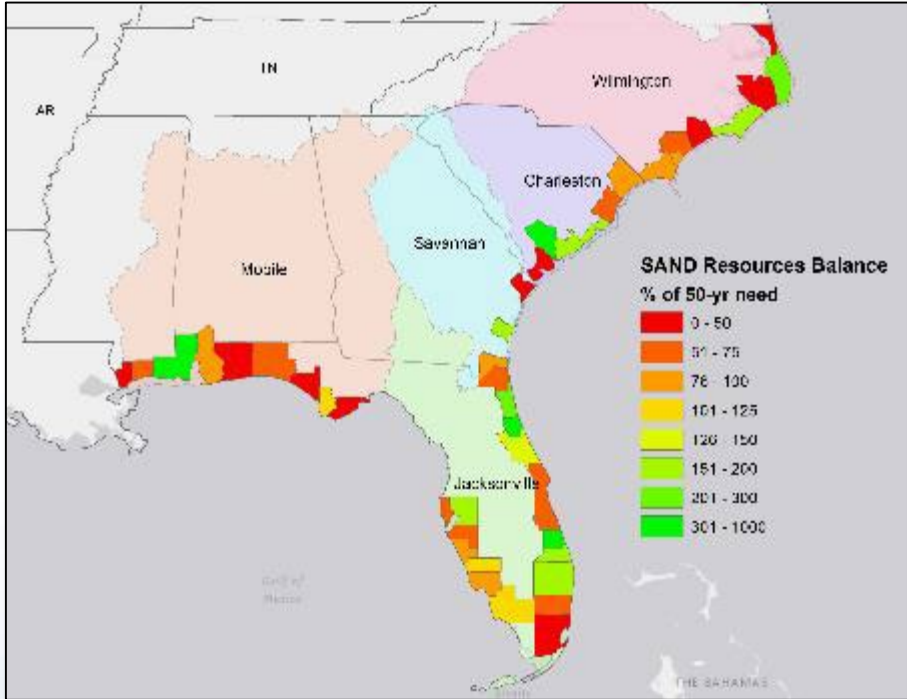


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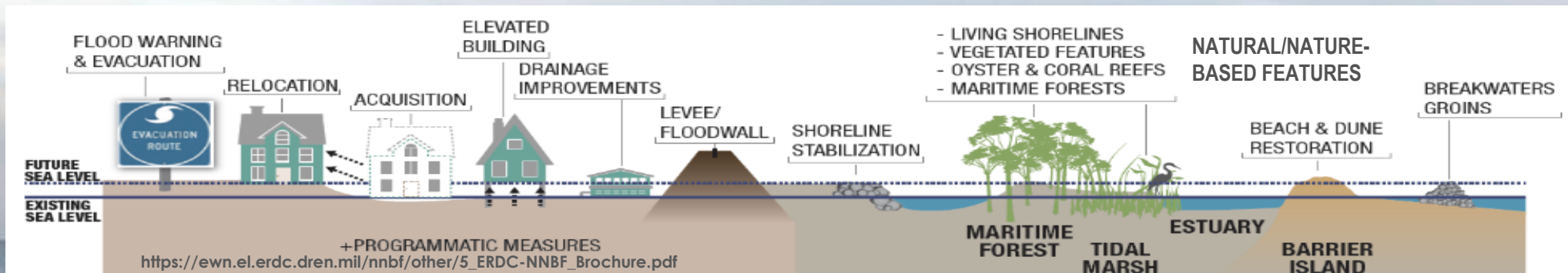
NEED FOR COASTAL RESILIENCY AND REGIONAL SEDIMENT MANAGEMENT



Sand to Support Beach Nourishment

Silts, Clays, and Mud to Support Marsh and Wetlands

Overall Coastal Resiliency





SOUTHEAST FLORIDA SEDIMENT MORPHODYNAMICS

STUDY OBJECTIVES



- Scientific approach to better understand the natural system
 - Data collection targeted to gain an understanding of natural sediment transport over variable conditions
- Delft3D model development, calibration, and validation
 - Tool for improved operational efficiencies and long-term sediment management cost savings



Working Today to Build a Better Tomorrow

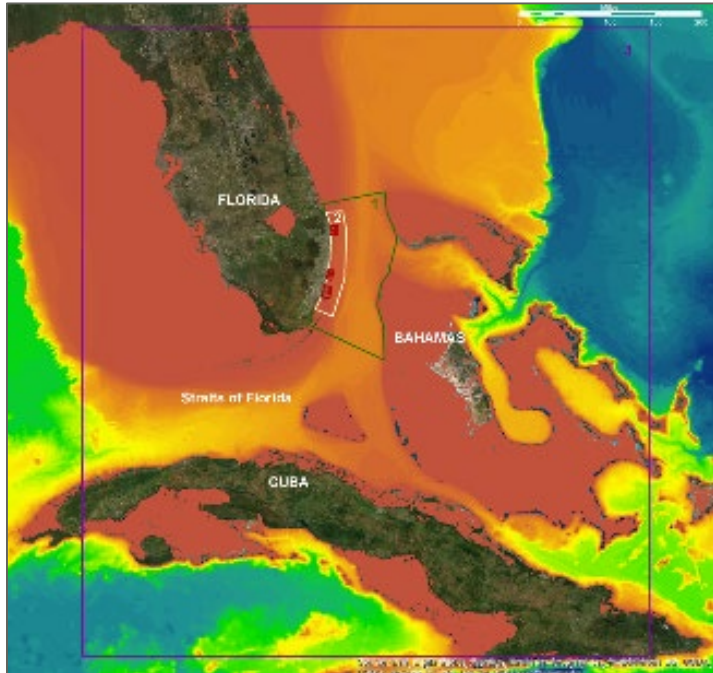


REGIONAL SYSTEM UNDERSTANDING



3 Study sites spanning ~ 80 miles along Southeast Florida coastline
Multiple Navigation and Coastal Storm Risk Management Projects

- Lake Worth Inlet - Palm Beach Harbor
- Port Everglades Harbor
- Miami-Dade County



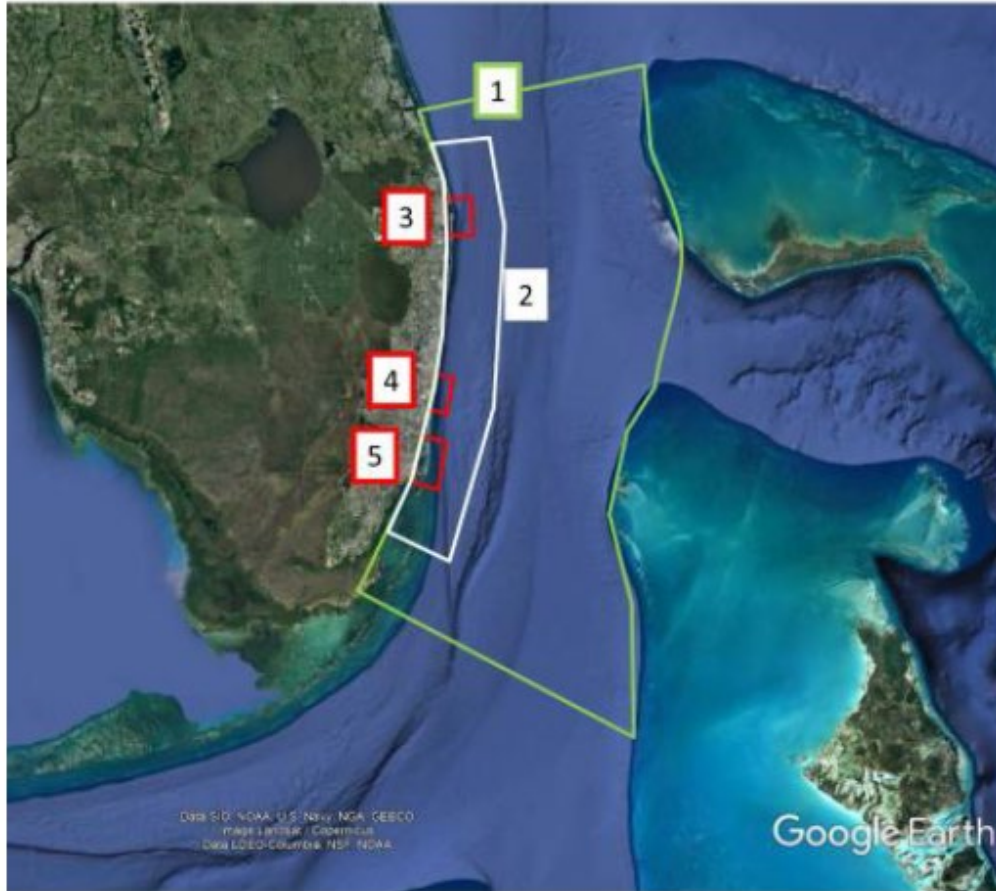
Complex physical processes

- a) Florida Current and spin off eddies leading to flow reversal
- b) North to South Net Longshore sediment transport, affected by wave climate, periods with transport directed north
- c) Varying wave action along the coasts, largest waves in north, reducing south
- d) Tidal hydraulics of (connected) multiple inlets influenced by water level variations
- e) Coastal Structures affecting longshore transport
- f) Continental shelf in close proximity to shore – deep water nearshore
- g) Reef tracts close to shore and ports
- h) Sediments are both siliclastic and biogenic (corals), which do have different settling/deposition, erosion, resuspension behavior

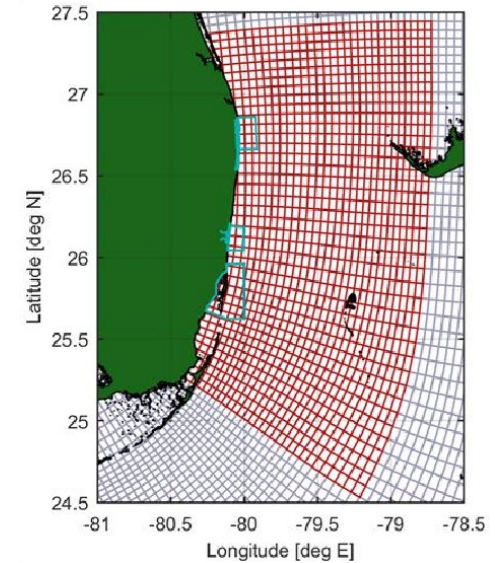
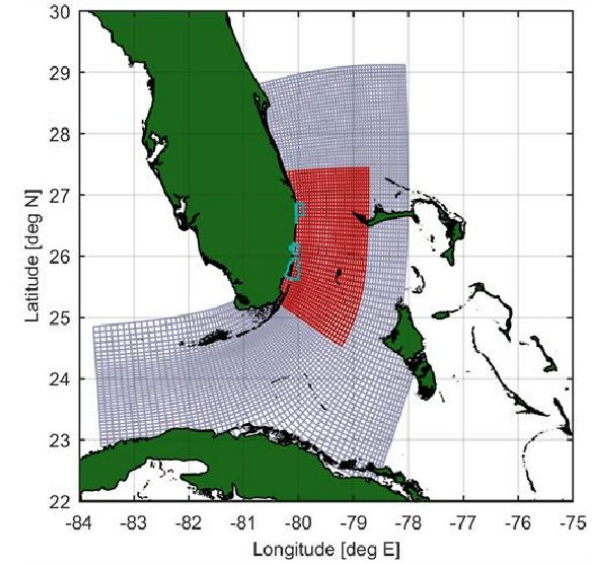


REGIONAL MODEL OVERVIEW

Iterating between small-scale and large-scale



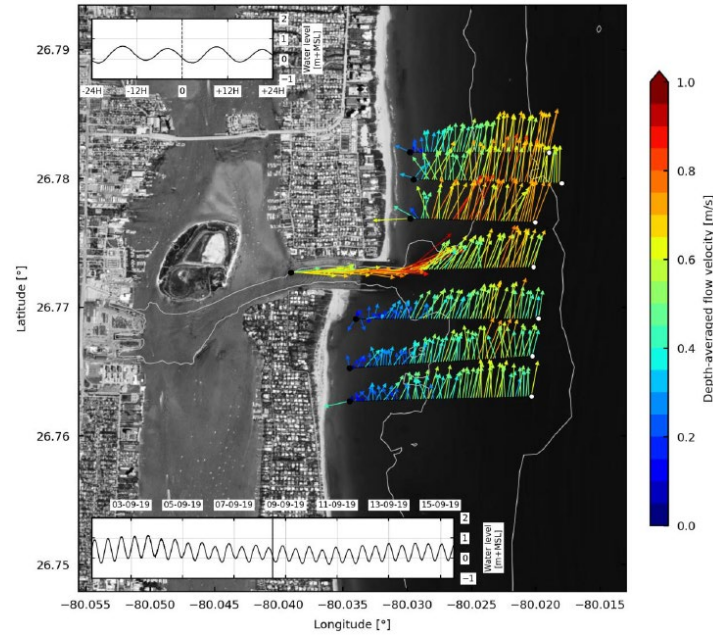
- (1) Florida Strait model ~ 100s km
 - (2) Continental shelf model ~ 10s km
 - (3) Lake Worth Inlet models
 - (4) Port Everglades models
 - (5) Miami-Dade County models
- ~ 1 km



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FLORIDA CURRENT CHALLENGES / IMPORTANCE

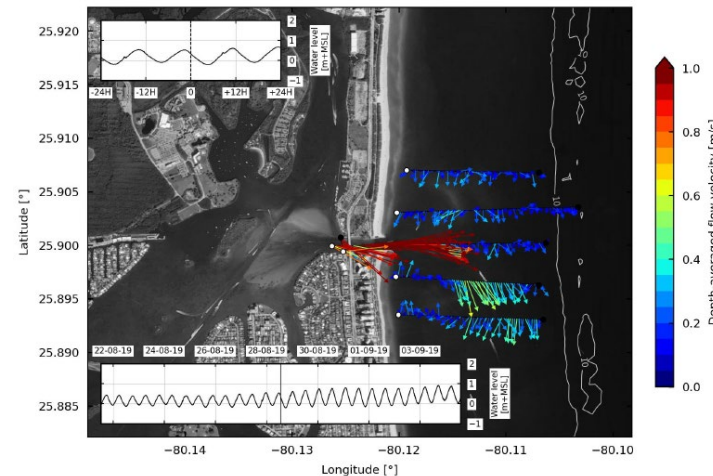
Lake Worth Inlet



Lake Worth Inlet

- Very pronounced Florida Current signal offshore
- Nearshore up to approximately 0.6 – 0.7 m/s (~1.25 knots depth avg.)
- Also present in shallow water, close to shoreline

Bakers Haulover Inlet



Port Everglades

- Weaker Florida Current, but still noticeable
- Up to approximately 0.3 – 0.4 m/s (~0.75 knots depth avg.)
- Not present in shallow water, but only offshore (10 m (33 ft) depth and greater)

Miami Dade County (Bakers Haulover Inlet)

- Little to no Florida Current signal

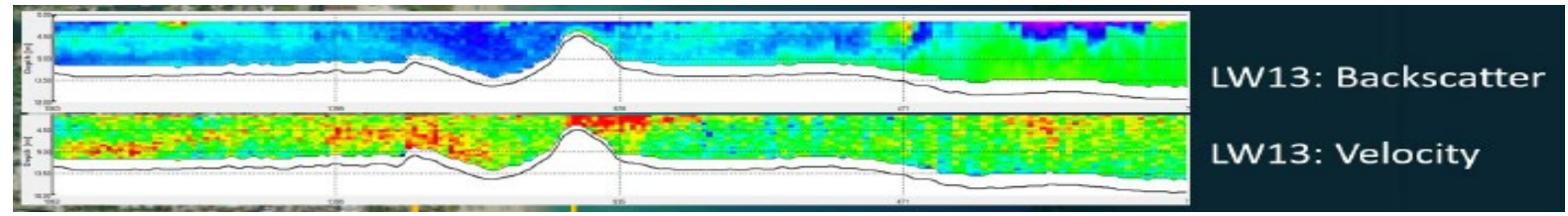
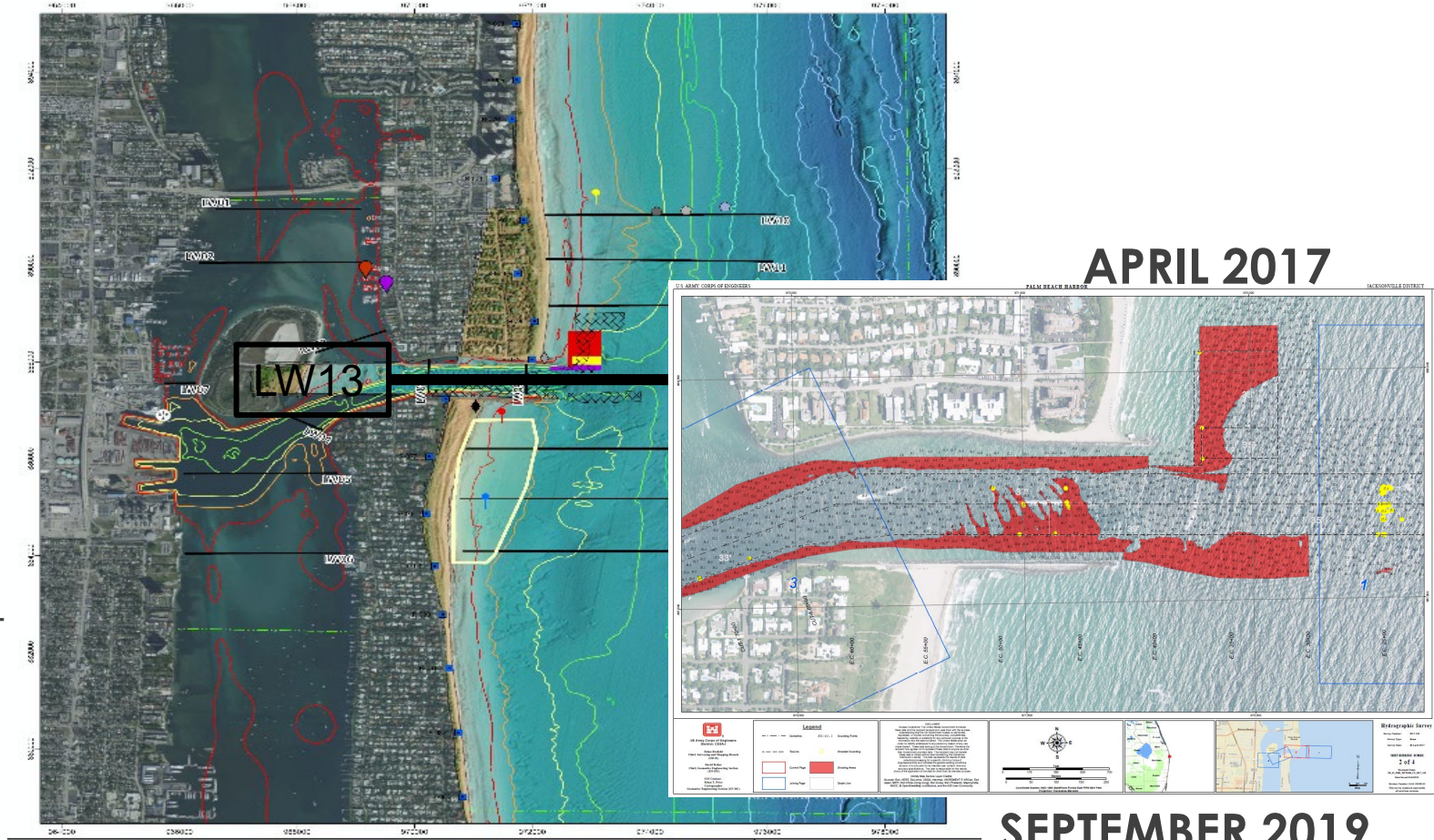


PROJECT SCALE FOCUS



Lake Worth Inlet

- Plagued by emergency shoaling events (mostly storm driven)
- Already a multitude of management measures in place: Advanced maintenance dredging, jetties, multiple sediment catch basins, and a sand transfer plant.



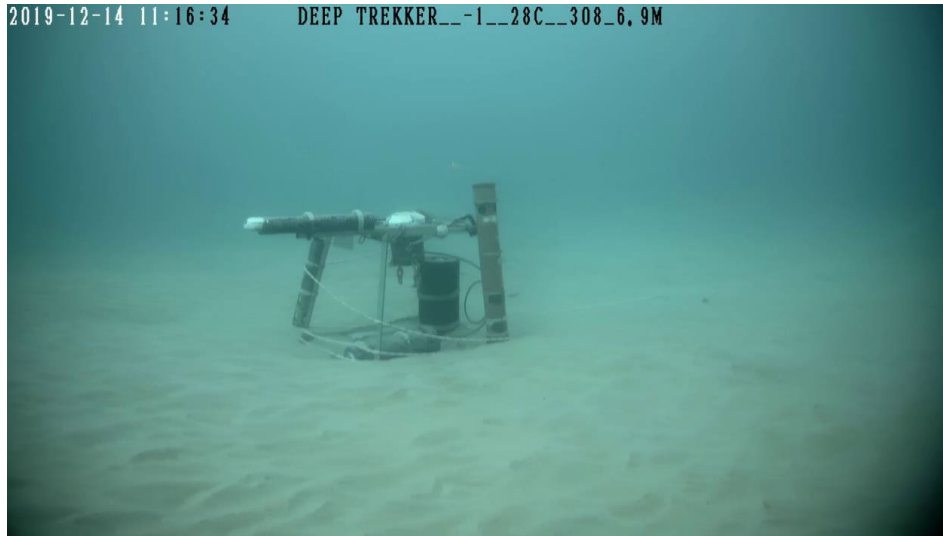
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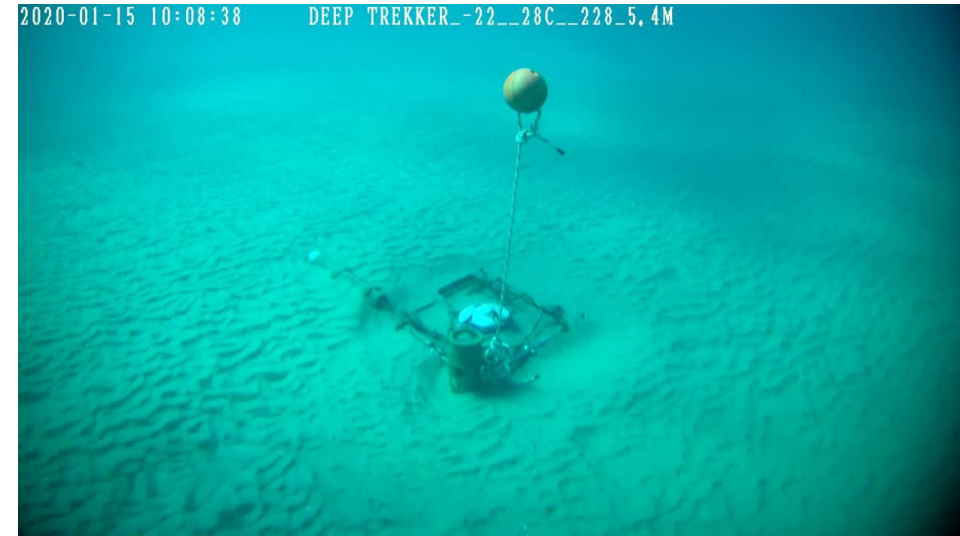
METOCEAN MEASUREMENTS



Deployment: 14 December 2019

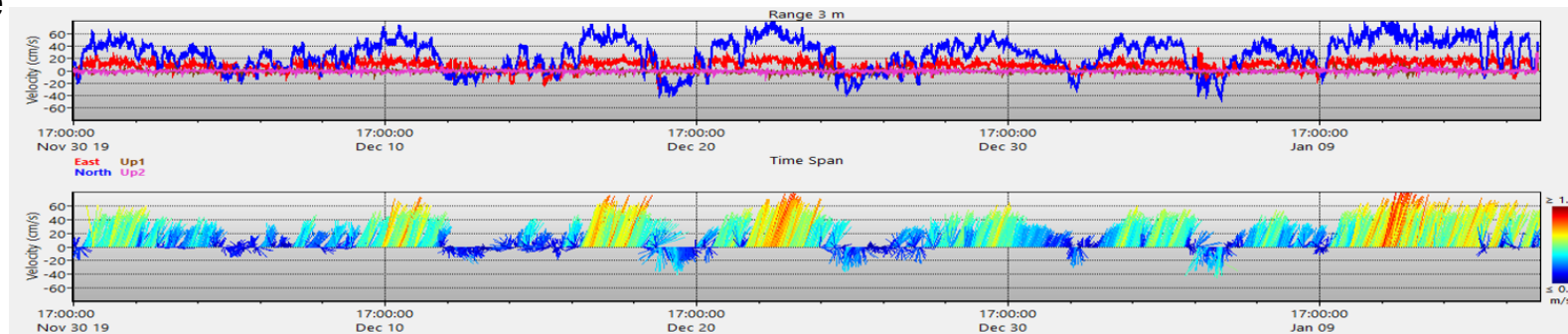


Recovery: 15 January 2020



Repeated burial despite movement to deeper water

- 25 ft → 38 ft → 55 ft
- 1 knot ~ 50 cm/s



Depth Averaged Currents

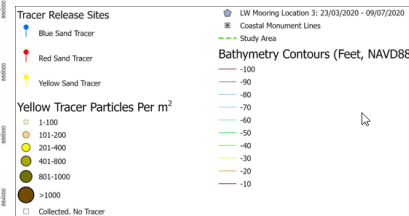
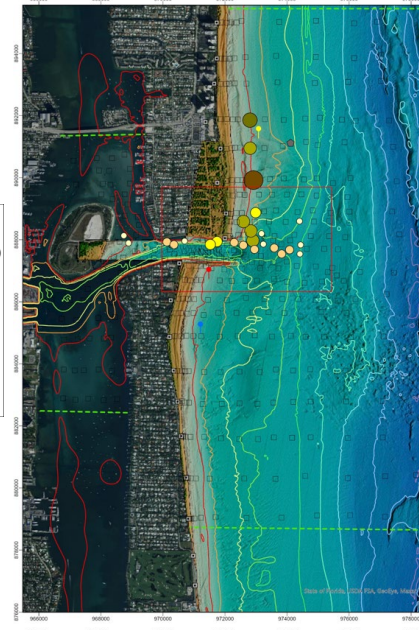
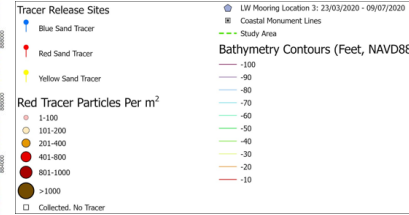
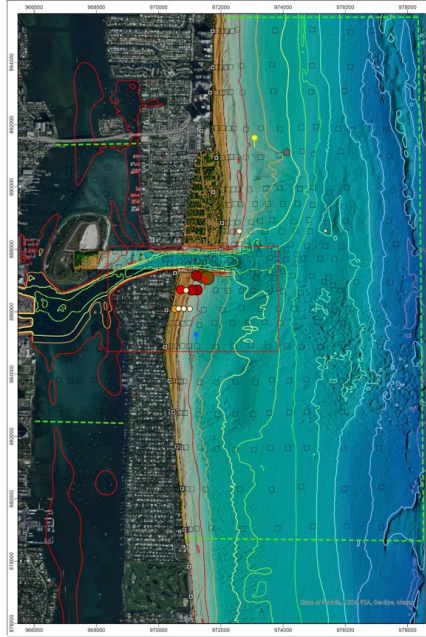




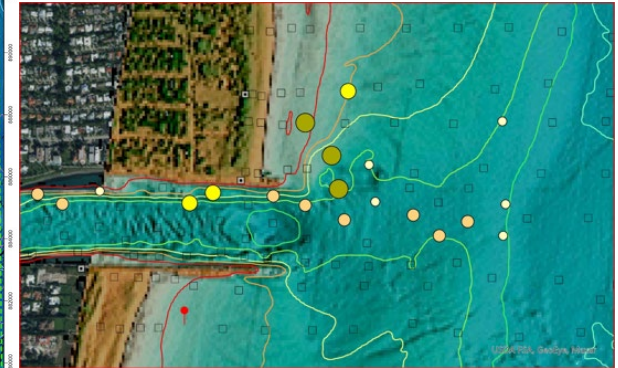
SEDIMENT TRACING RESULTS



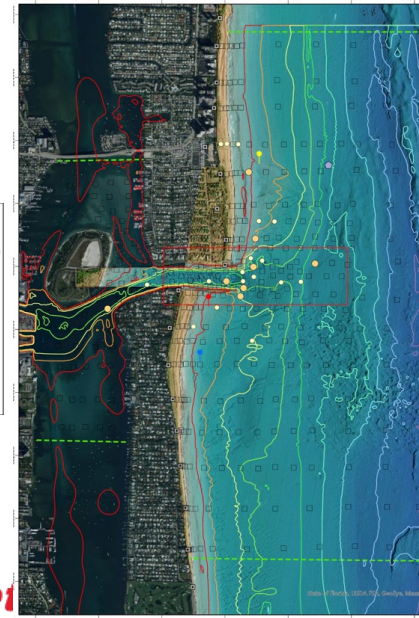
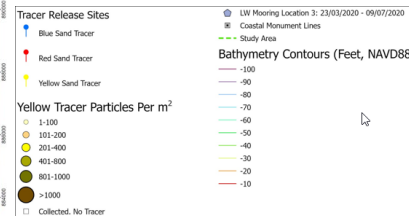
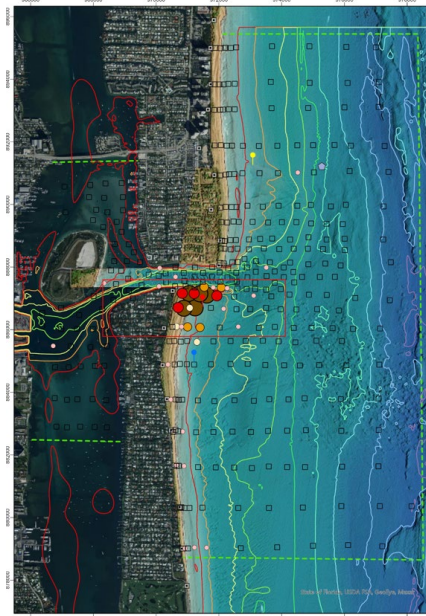
5 Weeks



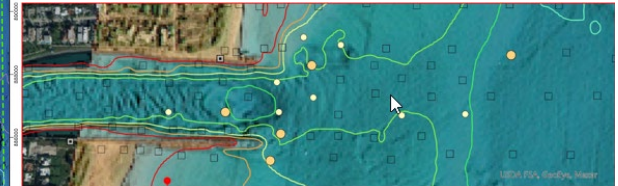
5 Weeks



32 Weeks

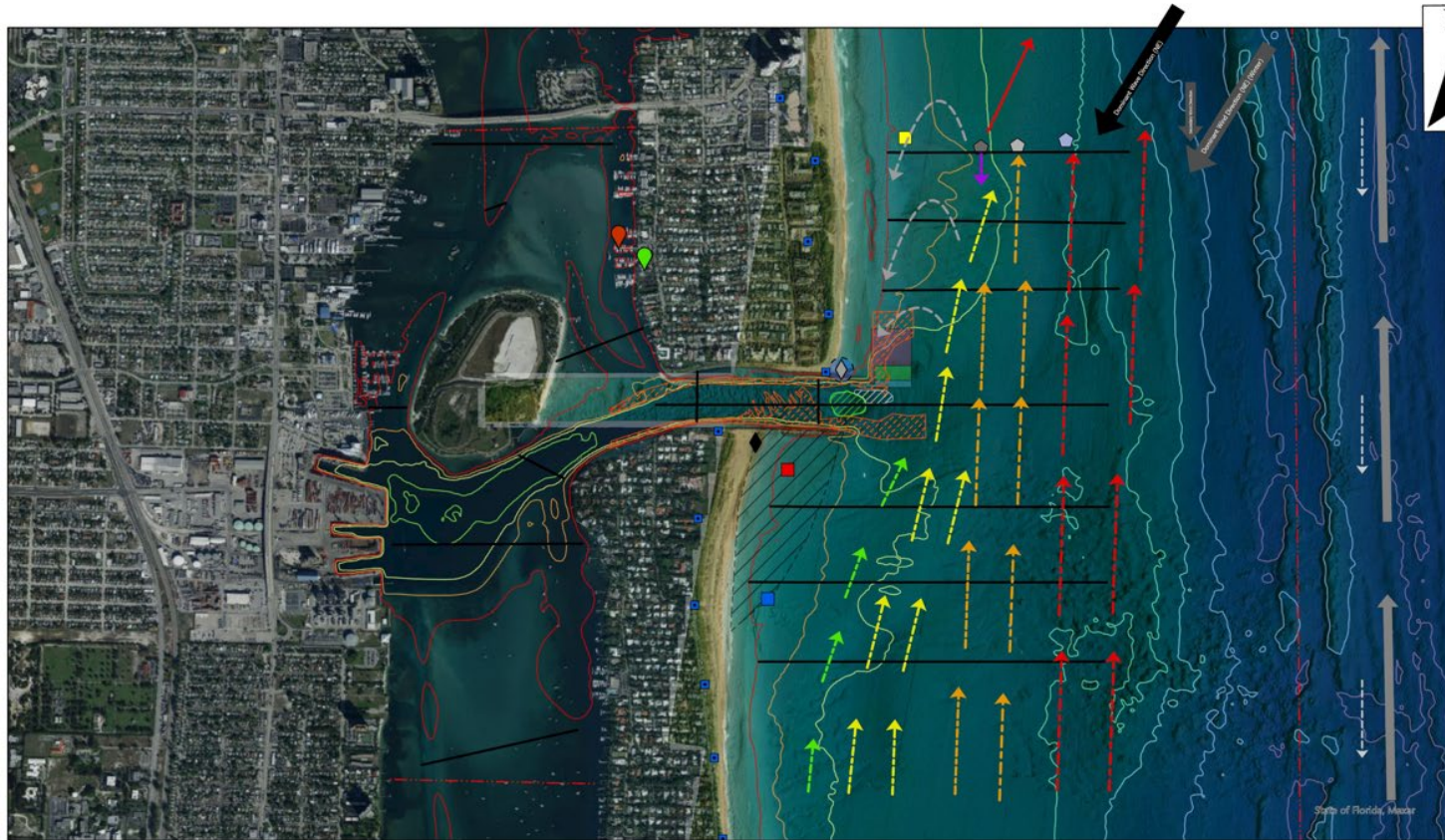


32 Weeks





DRAFT CONCEPTUAL MODEL - HYDRODYNAMICS



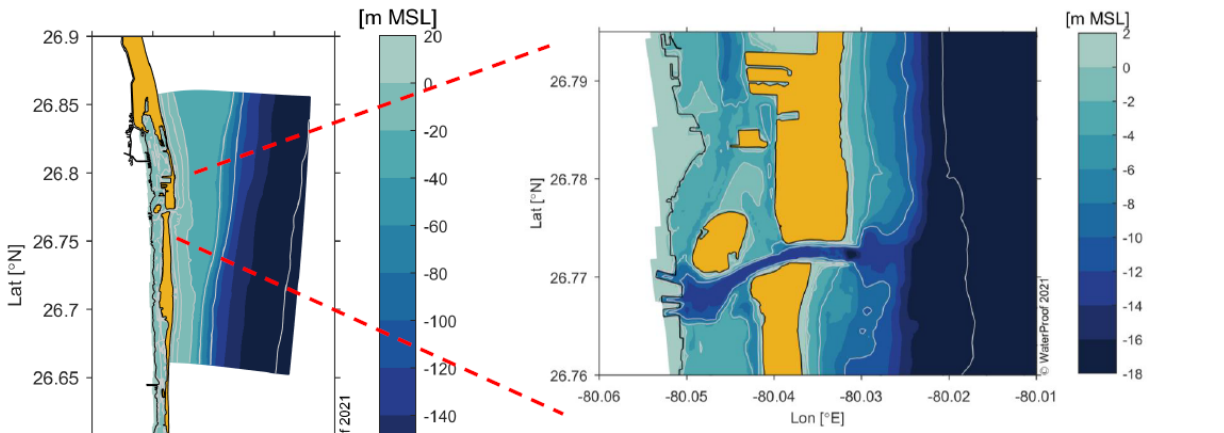
Metocean data and sediment tracer data lead to DRAFT Conceptual model of circulation

- Florida Current nearshore mainly N up to 1.6m/s in 67m / 220' water depth. South intermittent & weak
- Measured currents north of LWI: 25 ft to 55 ft water depth. Depth-averaged NNE 0.9 - 1.0m/s, South @ 0.2m/s



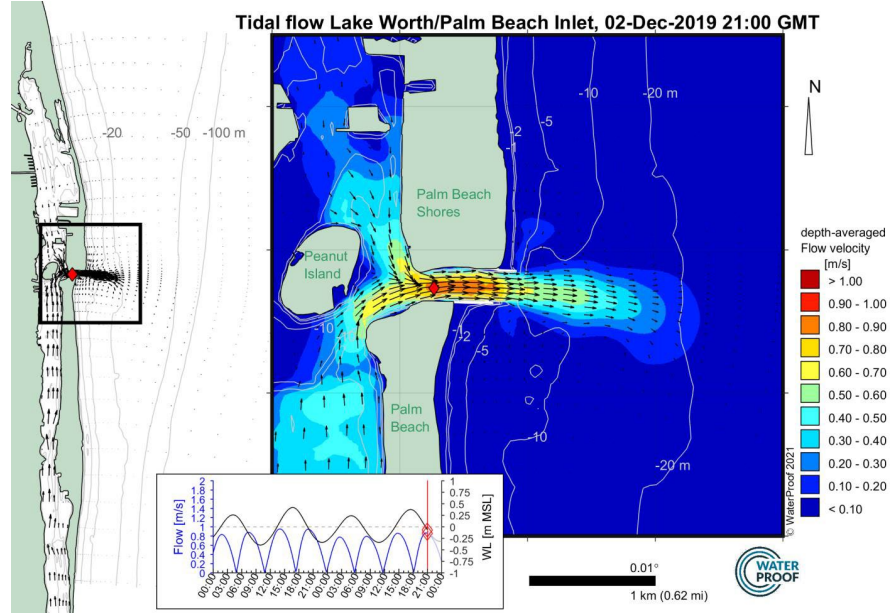


NUMERICAL MODELING – DELFT3D

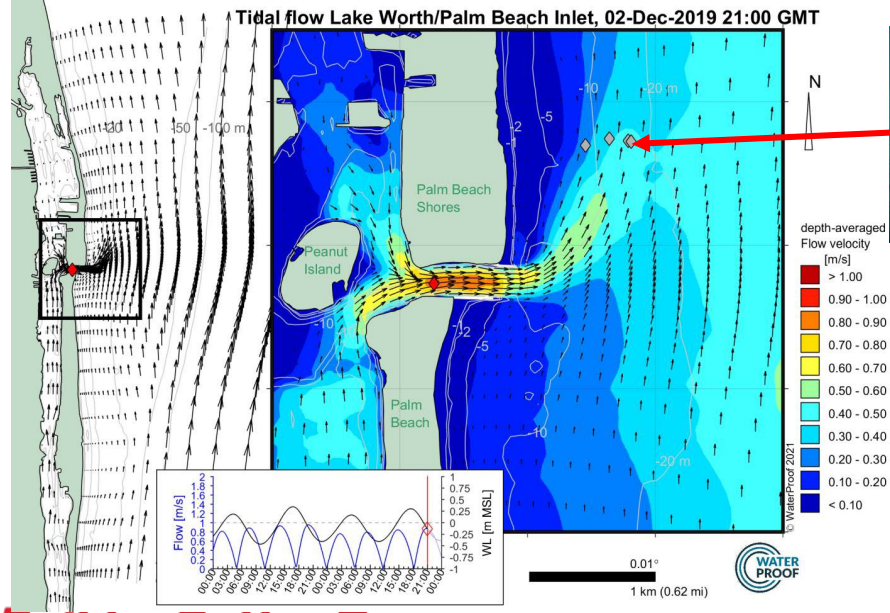


- From deep (MSL -200 m) to shallow in 1 model
- Bathymetry based on SFLSSS-ADCIRC model
- $\Delta t = 3$ seconds
- Astronomical boundary conditions

• Project scale and alternative modeling is currently underway



Maximum Ebb



- Measurement frame in ebb jet deceleration zone
- Storm effects

Maximum Ebb + Florida Current





KEY TAKEAWAYS

- Understanding the system takes investment of time and money.
- The natural system drivers are larger than our projects. In many cases we need to take a big picture look then focus down to the project scale
- Optimizing engineering design features -> sediment basins, jetty restructuring, nearshore disposal, etc. will lead to longer term more sustainable solutions.
- For Lake Worth Inlet, Palm Beach Harbor
 - Alternative modeling is still to be carried out. The data suggests that the Florida Current has large impacts on the nearshore morphodynamics.
 - There is a need to modify the sand transfer plant that captures sand more effectively over a wider area and in active transport zone, and re-design settling basins.
 - Current day nearshore placement area to the south of the inlet, does not appear to be impacting shoaling within the inlet



THANK YOU



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