Modeling Sediment Pathways around an Inlet

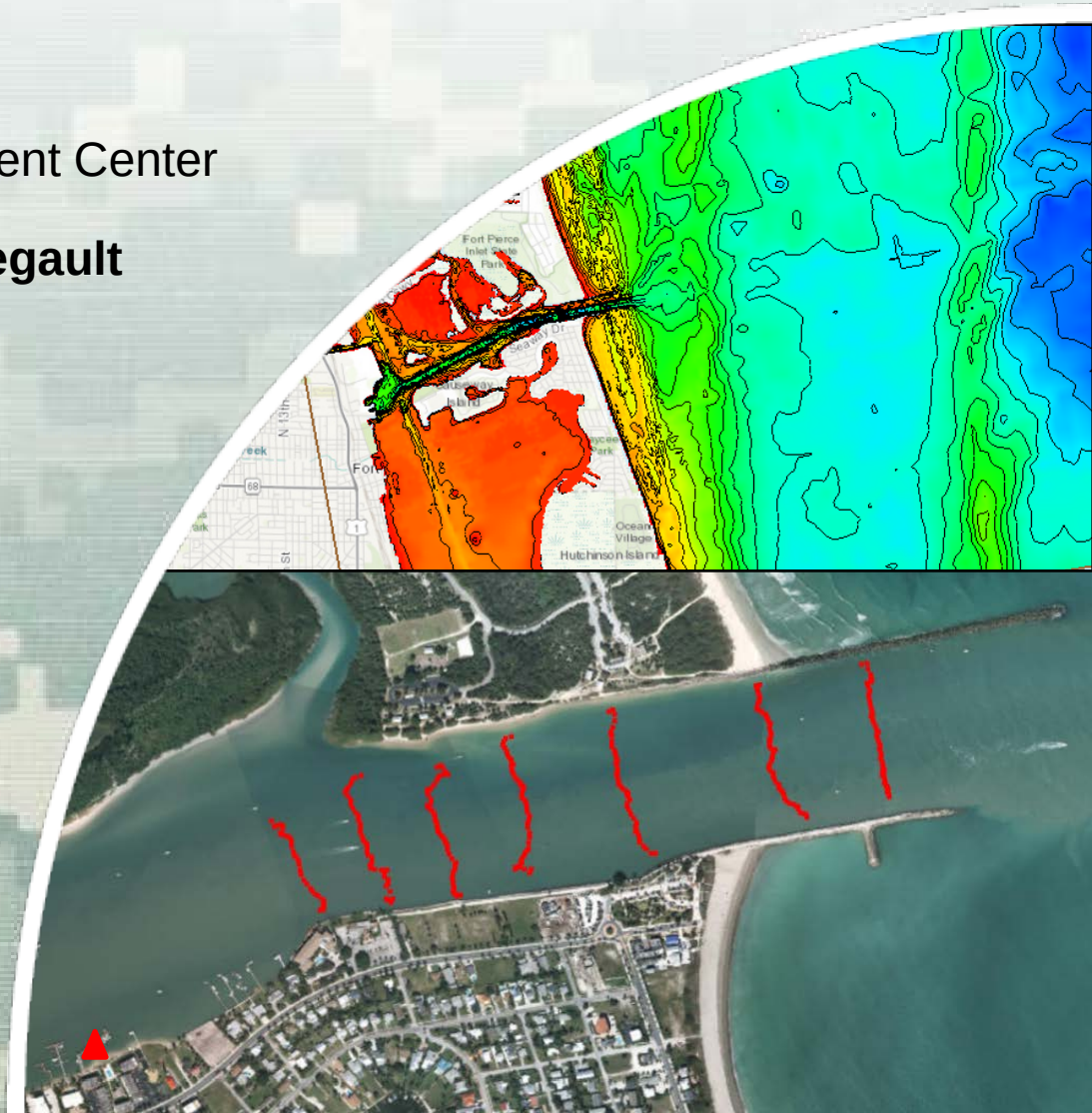
Honghai Li

Coastal and Hydraulics Laboratory
U.S. Army Research and Development Center

Kevin C. Hodgens and Kelly R. Legault

Jacksonville District
US Army Corps of Engineers

CIRP TD
23 October, 2018



US Army Corps of Engineers
BUILDING STRONG®

Outline

- Introduction
- Sediment Tracer Study
- Numerical Modeling Method
- Results
- Summary

Background

- Inlet structures, longshore sand transport along the adjacent shorelines and sediment dynamics around the system
- Evaluation of channel conditions (shoaling) and dredged material placement for future navigation operation and maintenance planning, and sediment management
- Investigation of nearshore sand transport pathways

Sediment Tracer Study
(March-May 2016)

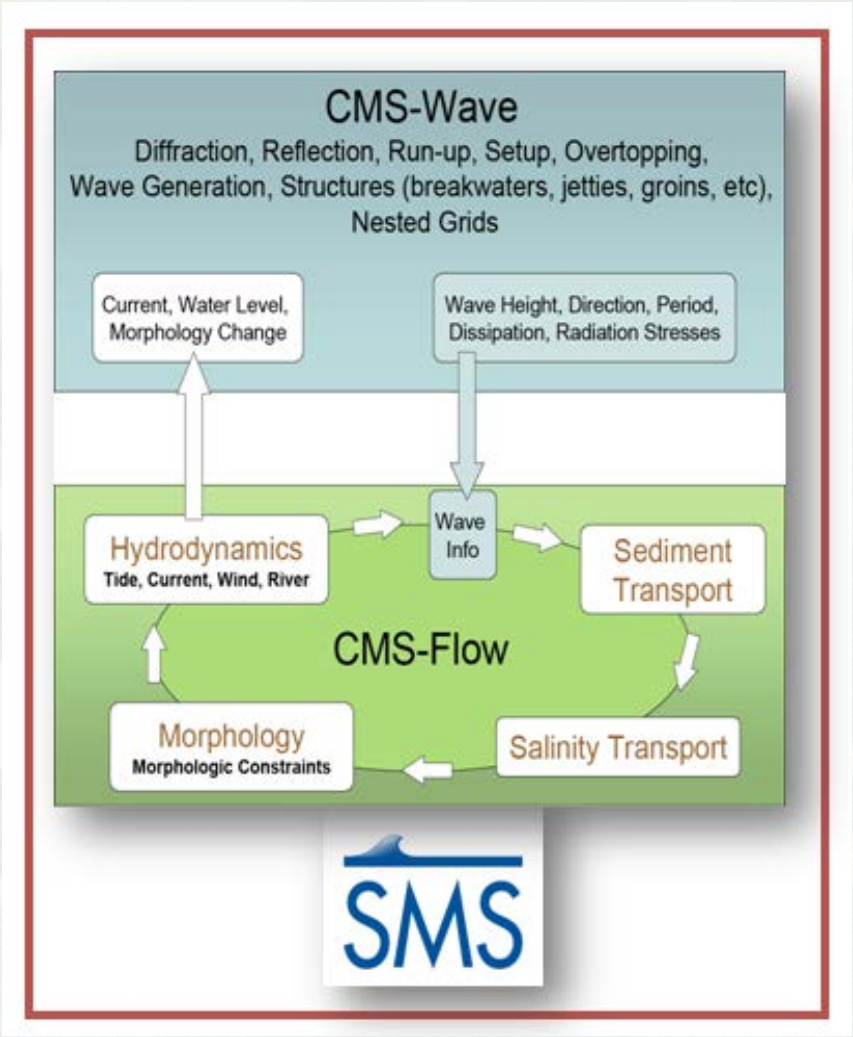
- **Sand tracer release**

  Red tracer (250 kg)
  Yellow tracer (250 kg)
  Green tracer (200 kg)

- **Grab samples around the inlet and nearshore areas 40-45 days after the tracer releases**

  106 grab samples (20 beach samples and 86 nearshore and inlet samples

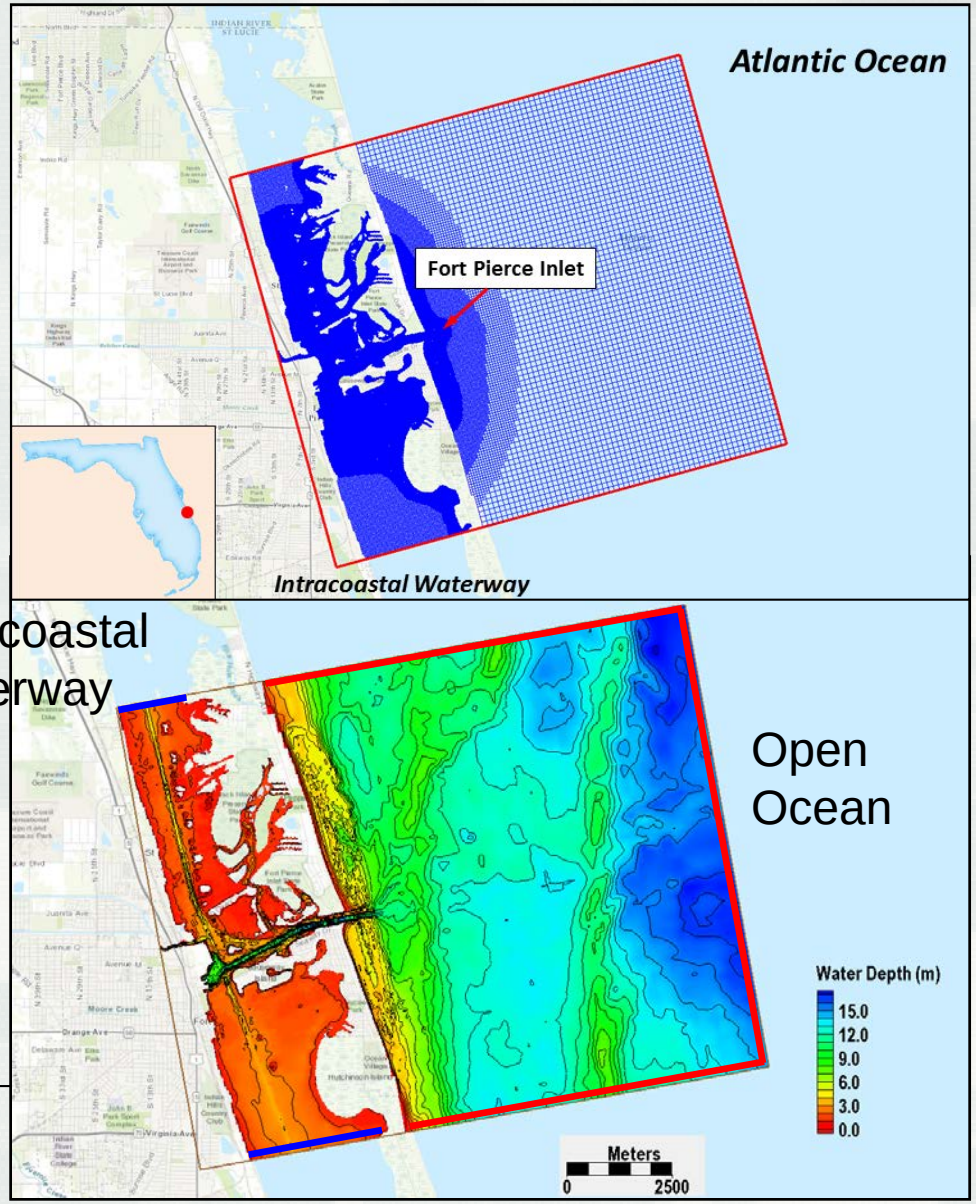
Numerical Modeling Method
(Coastal Modeling System)



- CMS-Flow: Two-dimensional (2D) finite-volume model and calculate hydrodynamics, sediment transport
- CMS-Wave: 2D spectral wave transformation model, simulate important wave processes, including diffraction, refraction, reflection, wave breaking and dissipation mechanisms …
- Coupled system for waves, flows, and sediment transport and morphology change
- Sediment mapping

Study Domain
(Coastal Modeling System)

- Domain Size:
  - 11 km along shore
  - 13 km cross shore
- No of Cells:
  - ~ 75,000
- Cell Size:
  - 5 ~ 160 m
- Water Depth (MSL):
  - -3 ~ 17 m
- Boundary Forcing:
  - ~ Open ocean
  - ~ Intracoastal Waterway



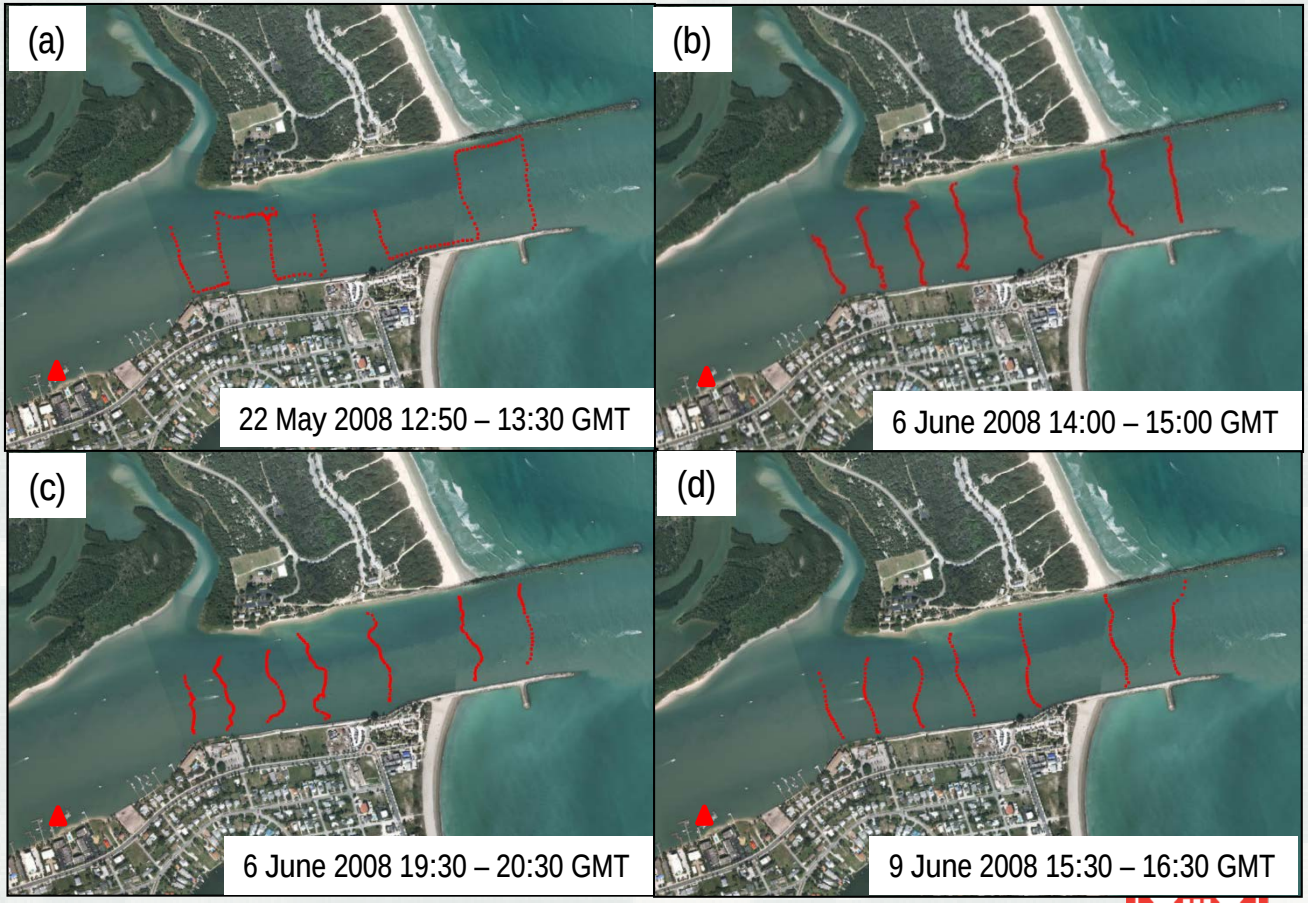
Model Calibration/Validation

Water Surface Elevation Gage (time series)

- May-June 2008

Current Measurements (snapshots)

- May 22, June 6, and June 9, 2008



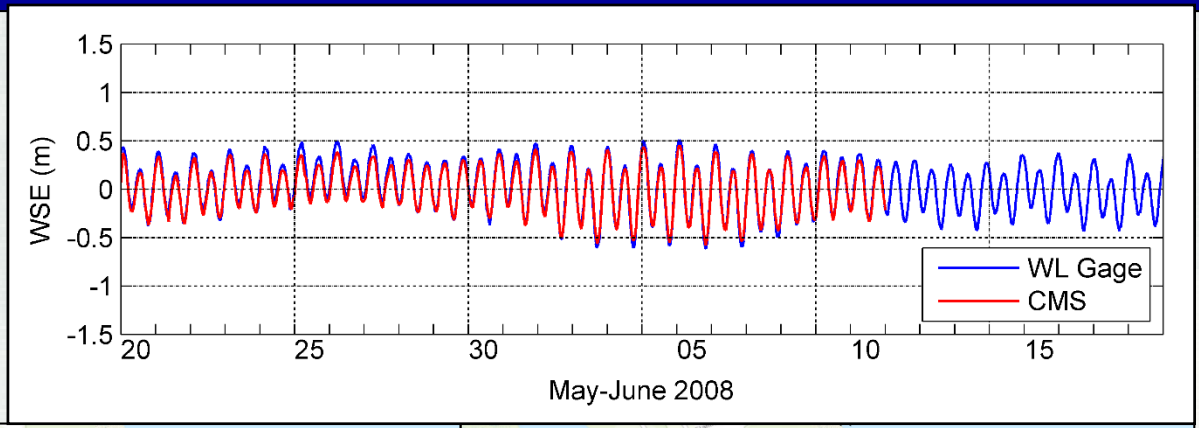
Water Surface Elevation and Current

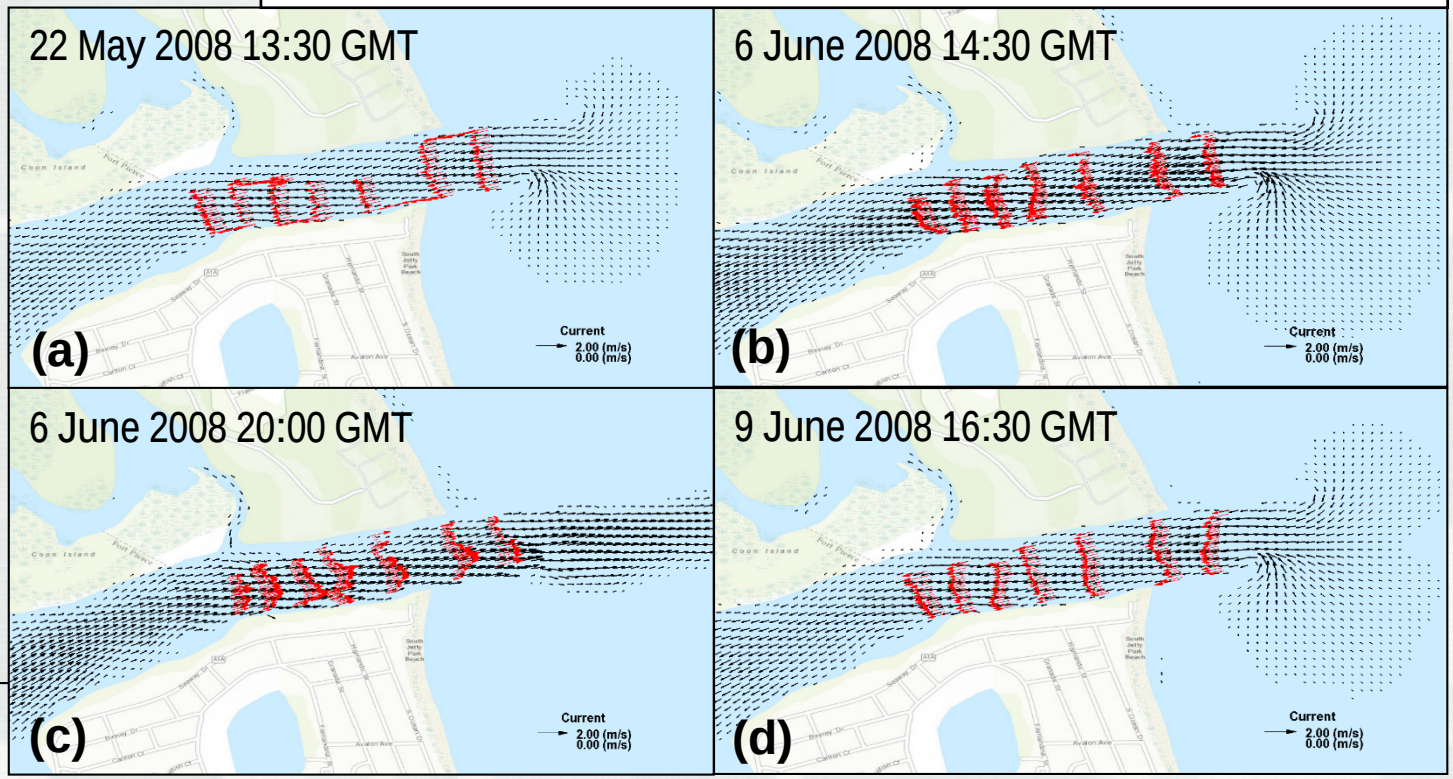
Water Surface Elevation

RMSE = 5.7 cm/sec
CC = 0.992
RRMSE = 5.2%

Peak Ebb/Flood Current

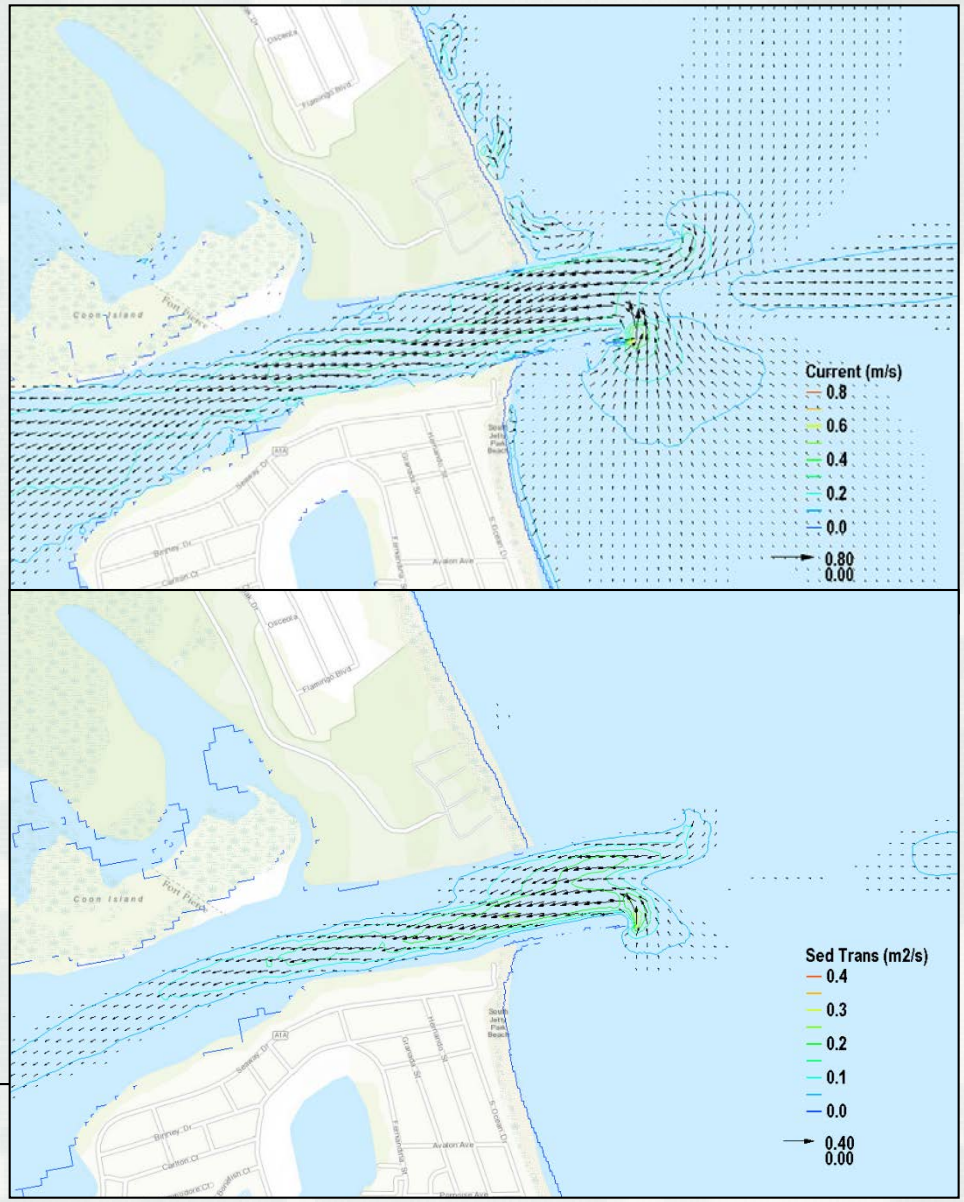
> 2.0 m/sec





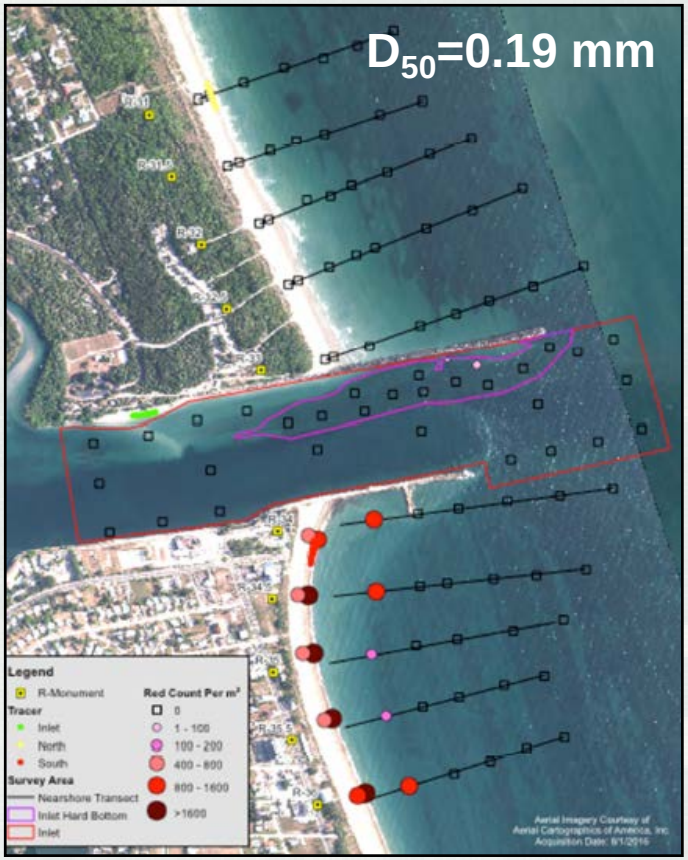
Current and Sediment Transport

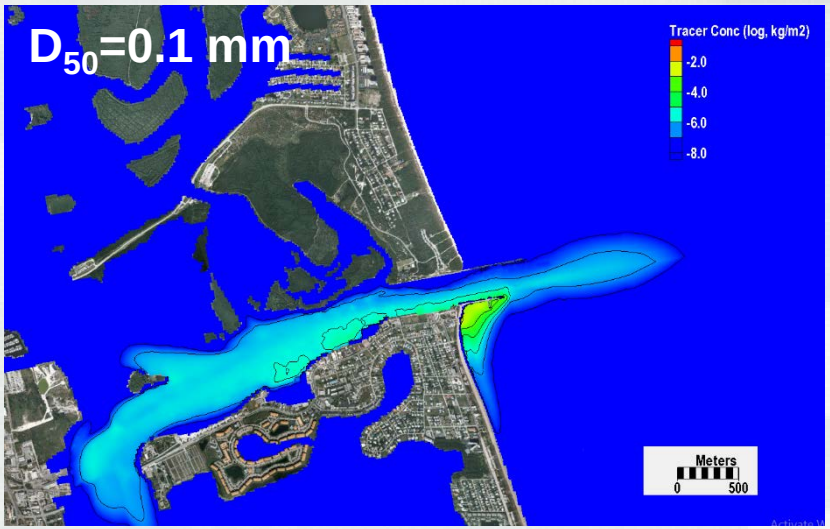
- 50-day averaged current and sediment transport vectors
- Flood dominated current brings sediment into the inlet
- More longshore influence south of South Jetty
- Maximum currents though the inlet ~ 0.4 m/sec

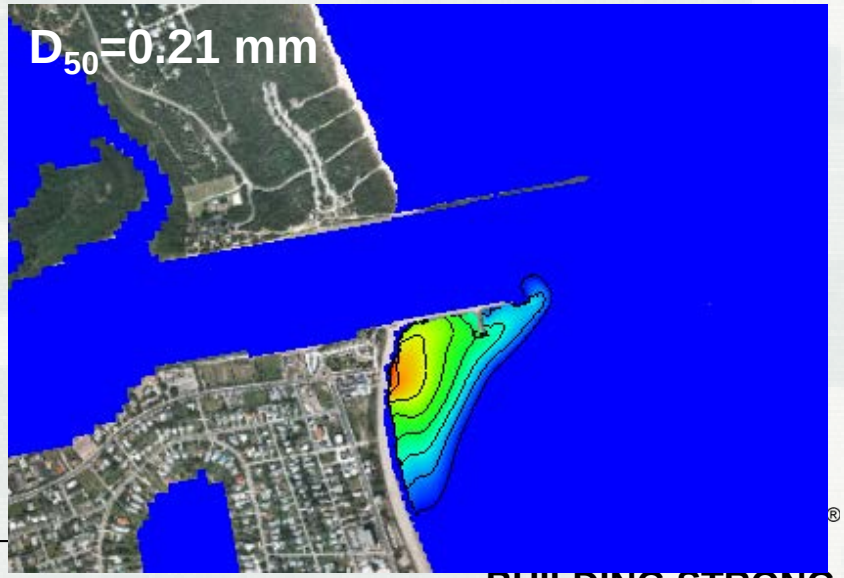


Sediment Tracer Distribution

- Red sand tracer

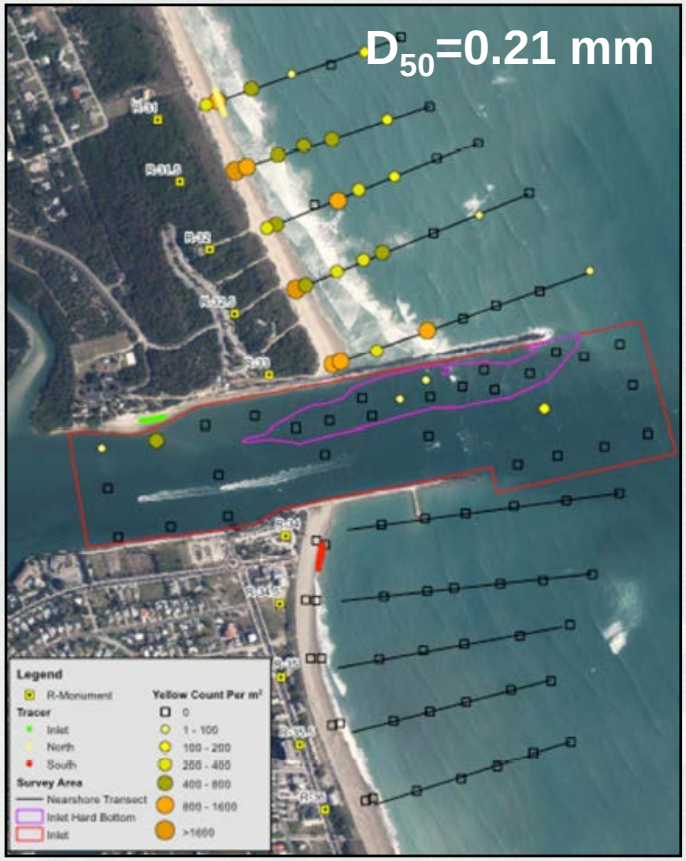


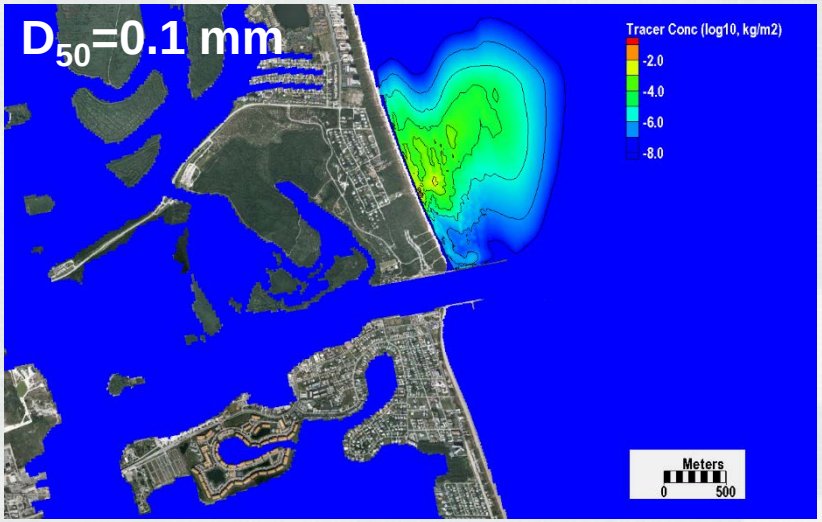


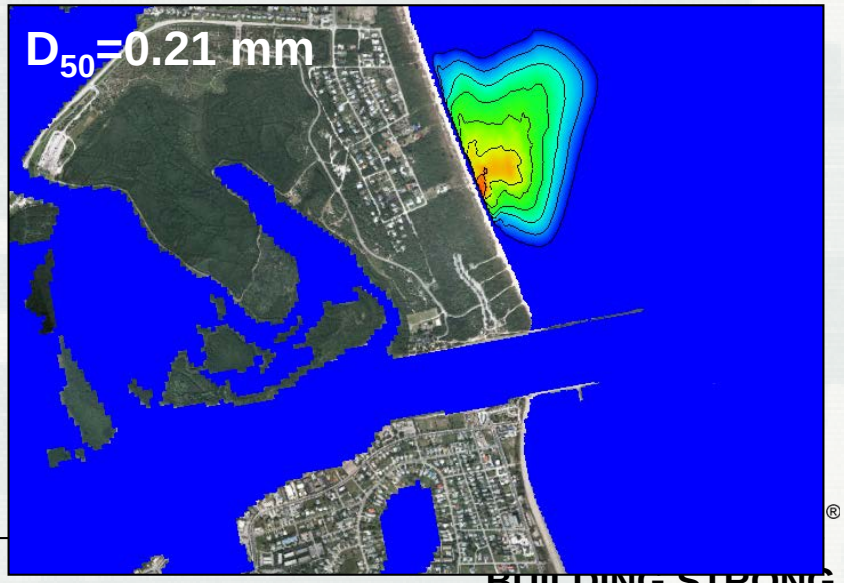


Sediment Tracer Distribution

- Yellow sand tracer

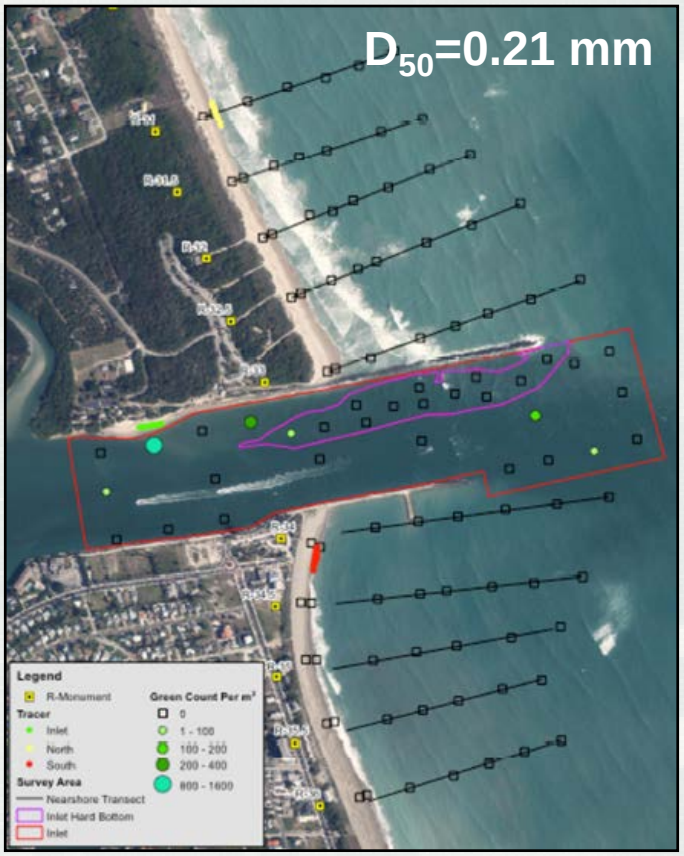


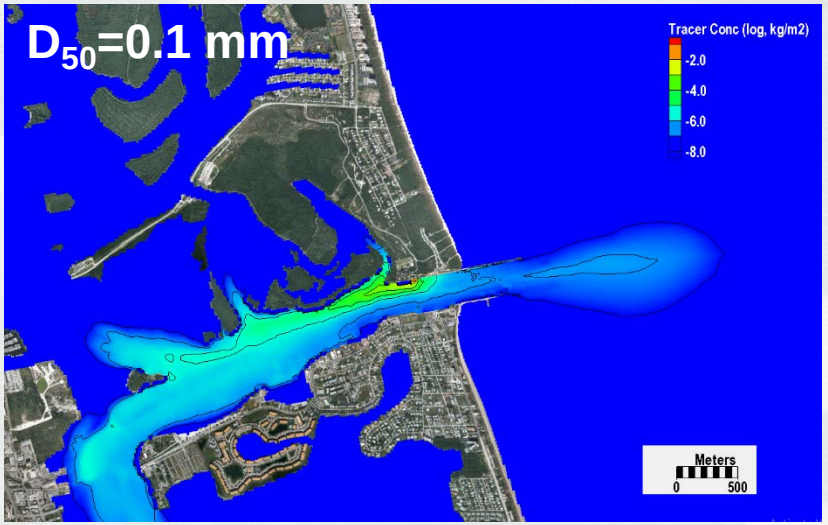


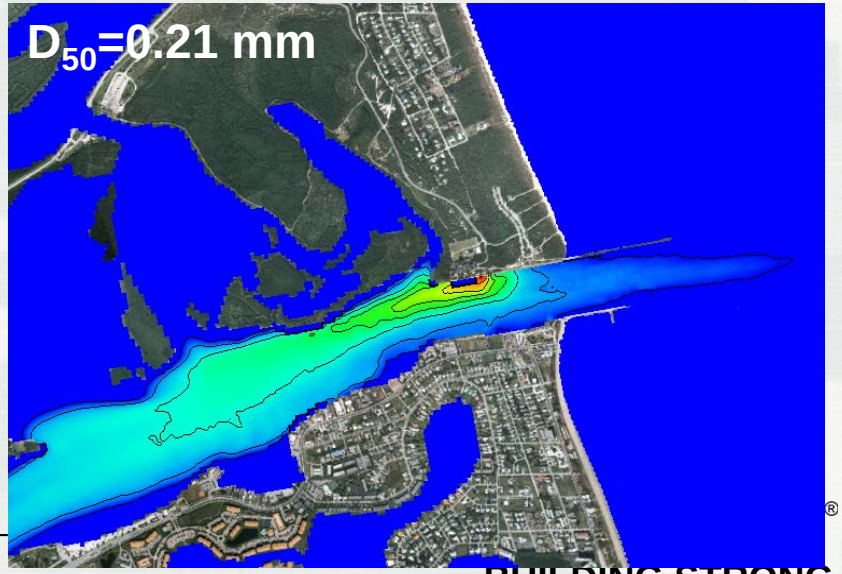


Sediment Tracer Distribution

- Green sand tracer







Summary

- CMS results and the sediment tracer sampling data indicate that the sediment tracer released on the north beach moves primarily in longshore direction and no tracer into the inlet. The tracer released on the south beach is only found in longshore sampling locations and no tracer in offshore sampling locations. The sediment tracer released within the inlet only moves and diffuses along the inlet channel and no tracer is found the north or south of the inlet.
- Sediment mapping feature in the CMS shows its promising performance in simulating sediment tracer tracking and helping identify sediment transport pathways.
- Sediment tracer pathways analyzed and obtained in the study only correspond to the specific forcing conditions during the selected simulation period and the results might vary for different wave, hydrodynamic, atmospheric, and environmental forcing.

Thank You!