

Modeling and Evaluation of Sand Transport Pathways around an Inlet Navigation Channel



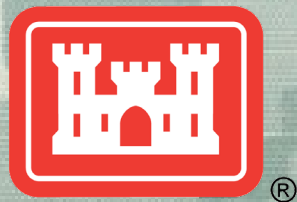
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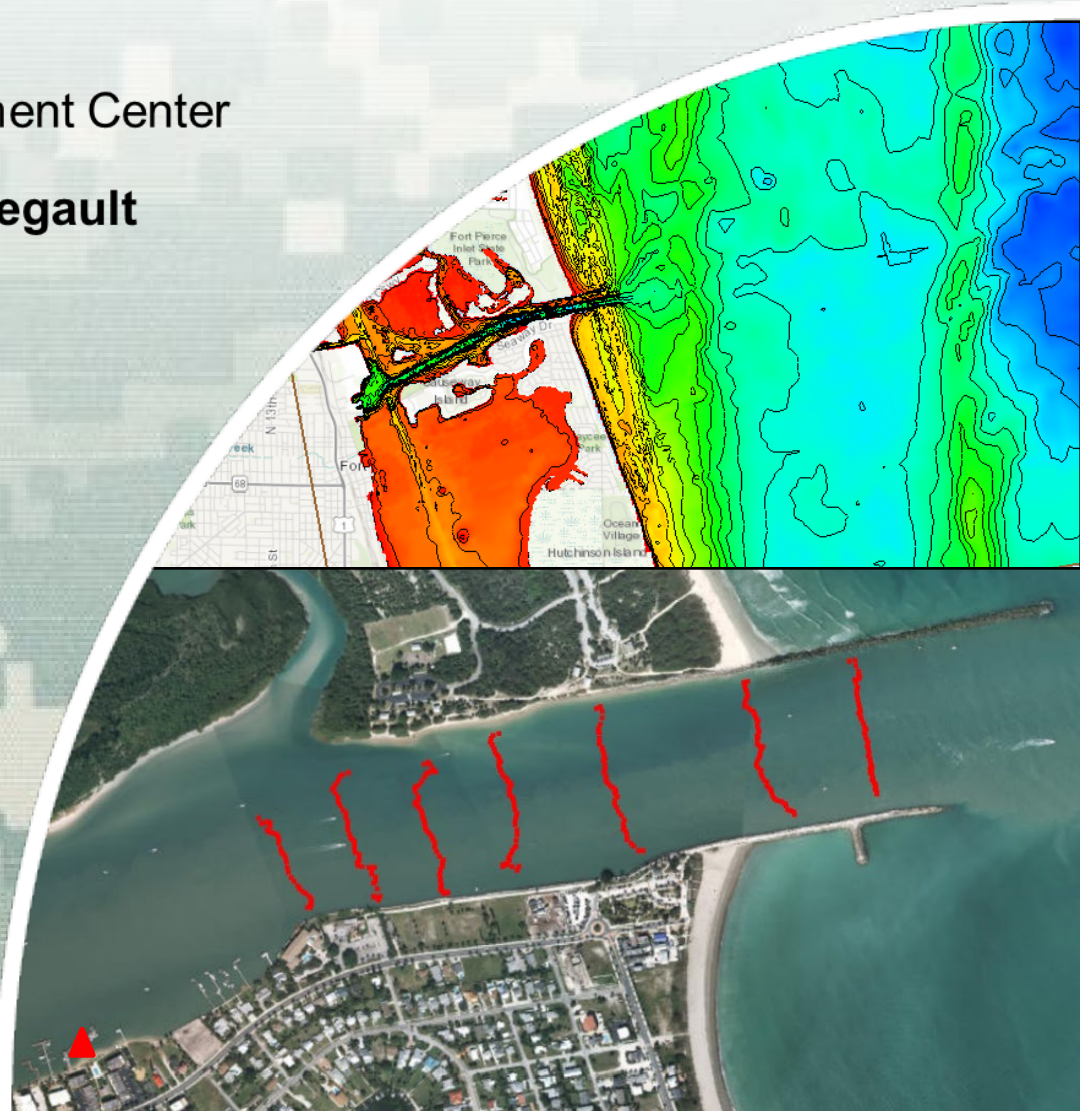
Kevin C. Hodgens and Kelly R. Legault

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9th ICSE
Taipei, Taiwan
06 November, 2018



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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**

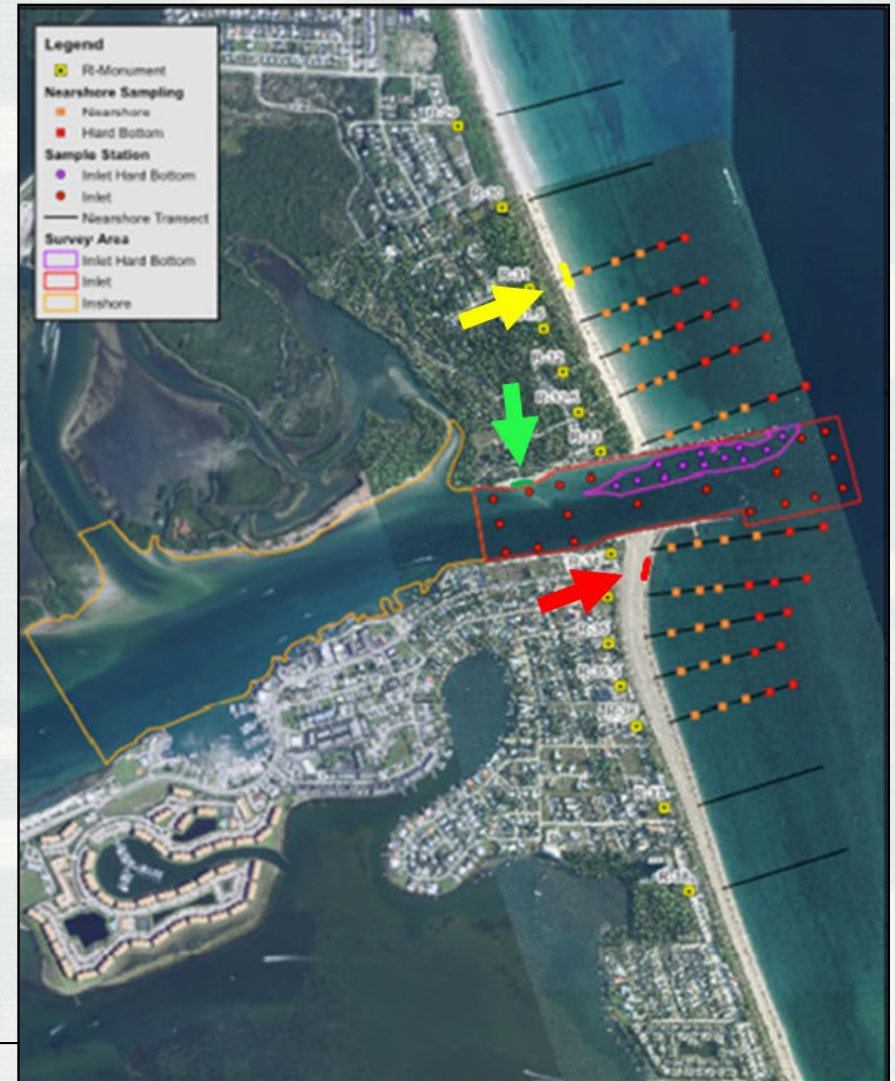
Red tracer (250 kg)

Yellow tracer (250 kg)

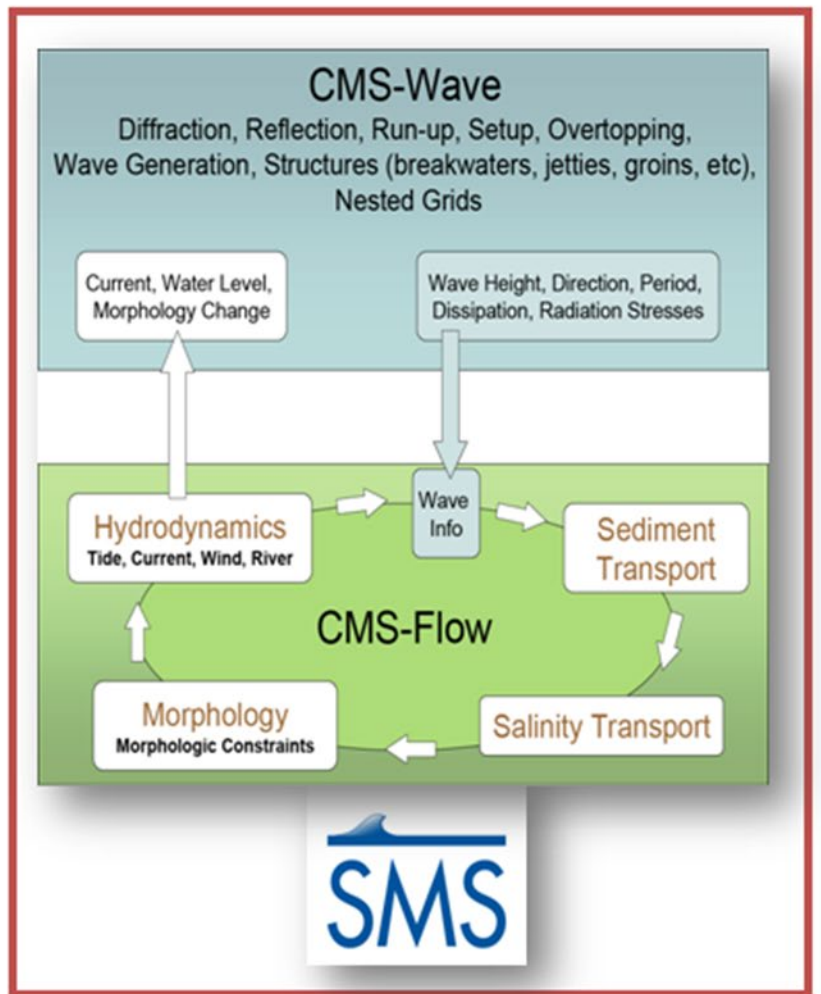
Green tracer (200 kg)

- **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)

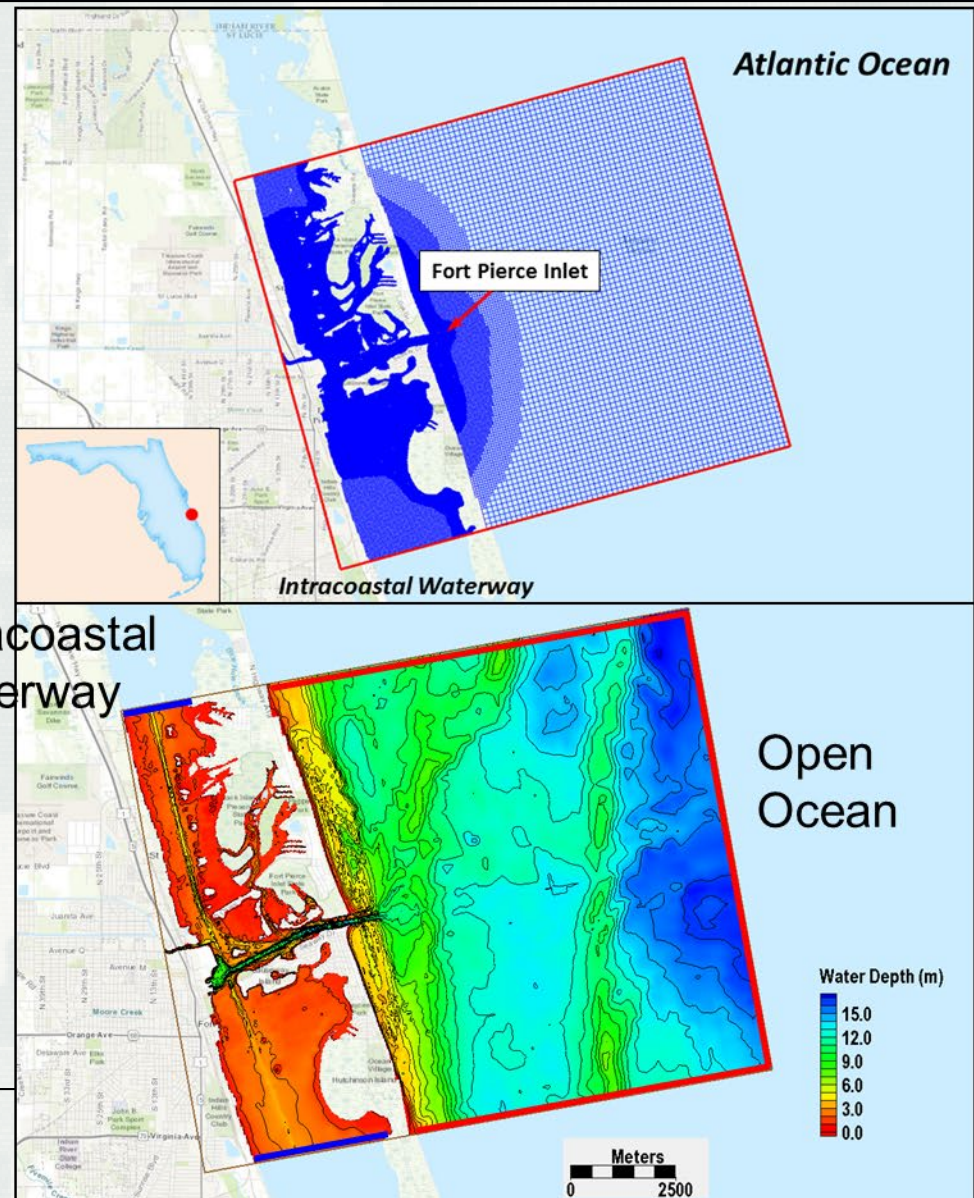


- CMS-Flow: Two-dimensional (2D) finite-volume model and calculate hydrodynamics, sediment transport
- CMS-Wave: 2D spectral wave transformation model, simulate important wave processes, including diffraction, refraction, reflection, wave breaking and dissipation mechanisms ...
- Coupled system for waves, 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
- Simulation Periods:
 - ~ May – Jun, 2008 (validation)
 - ~ Mar – May, 2016 (sed mapping)



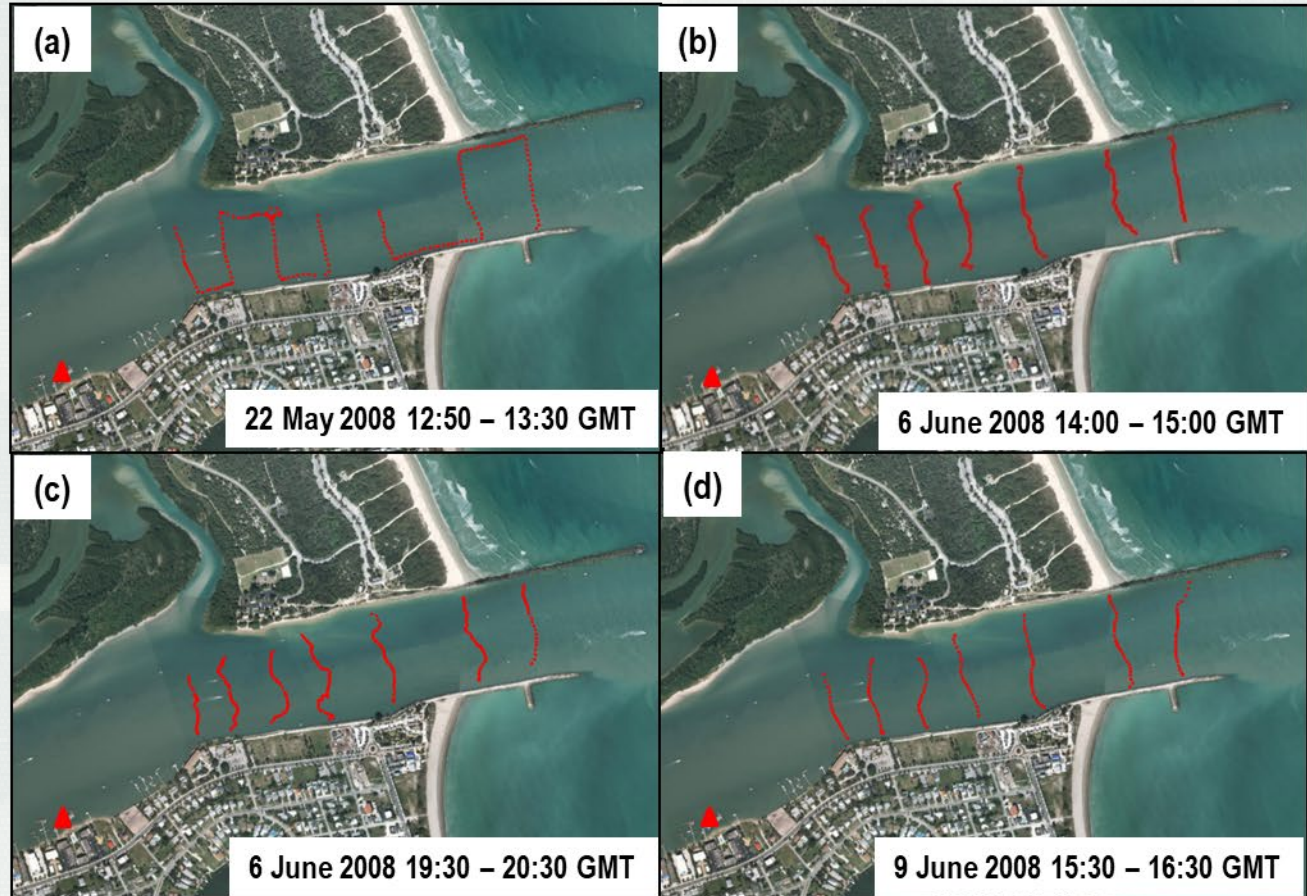
Model Calibration/Validation

Water Surface
Elevation Gage (time
series)

- May-June 2008

Current Measurements

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



Water Surface Elevation and Current

Water Surface Elevation

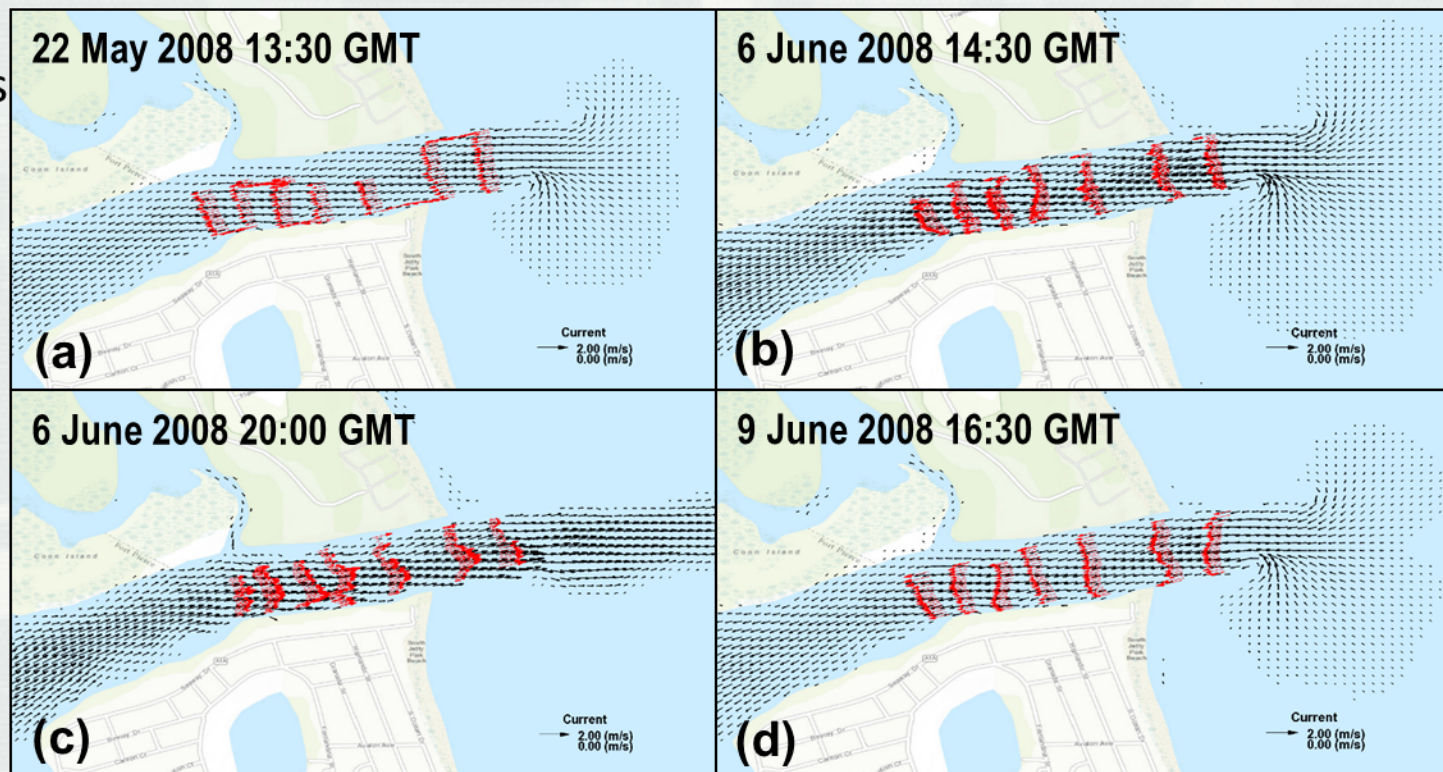
RMSE = 5.7 cm/s

CC = 0.992

RRMSE = 5.2%

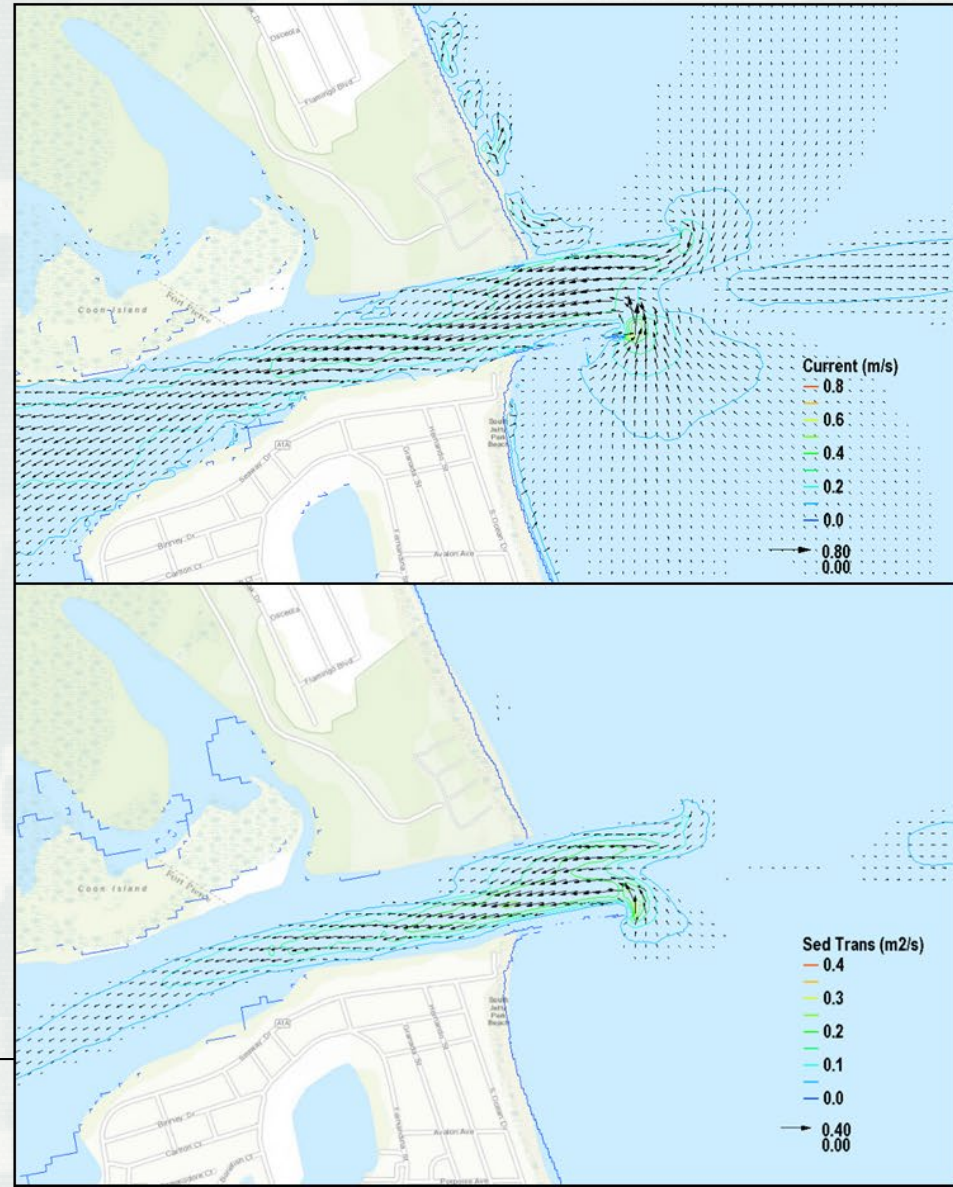
Peak Ebb/Flood Current

> 2.0 m/sec



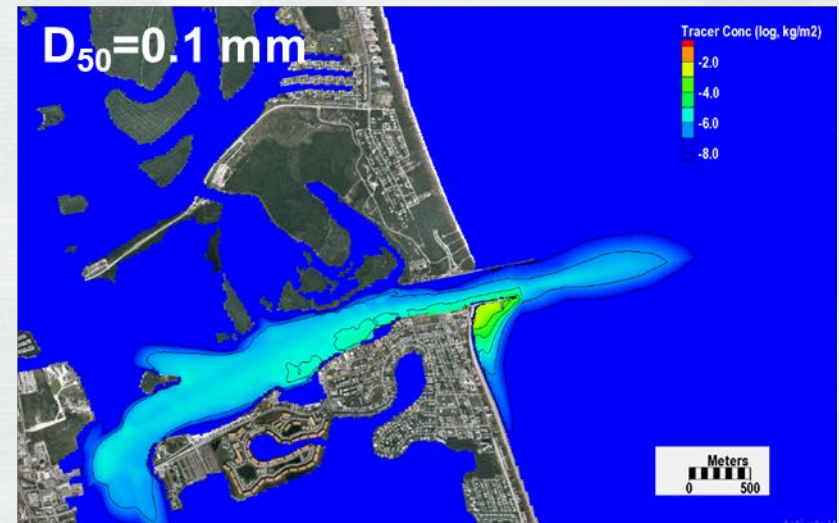
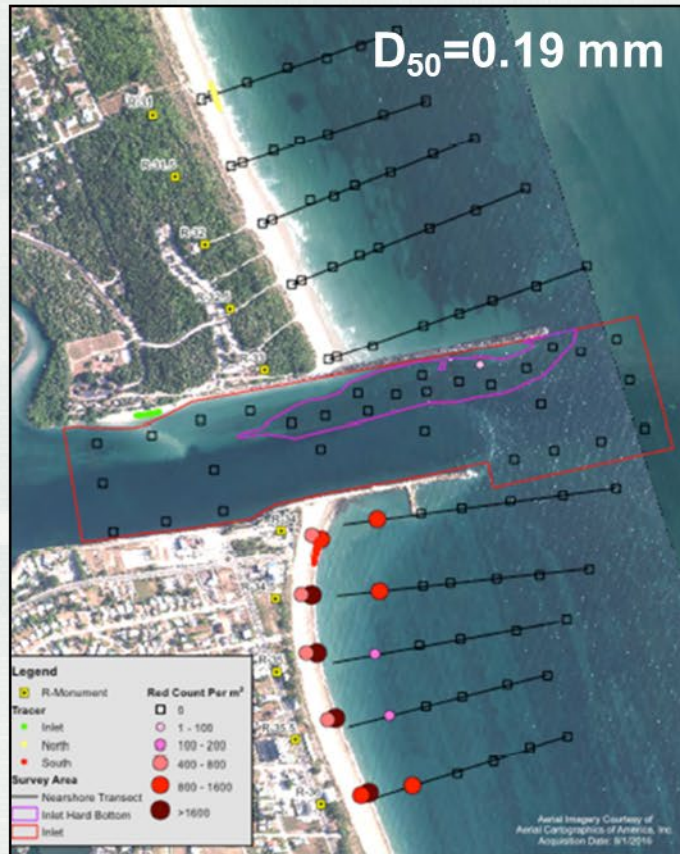
Current and Sediment Transport

- 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 through the inlet ~ 0.4 m/sec



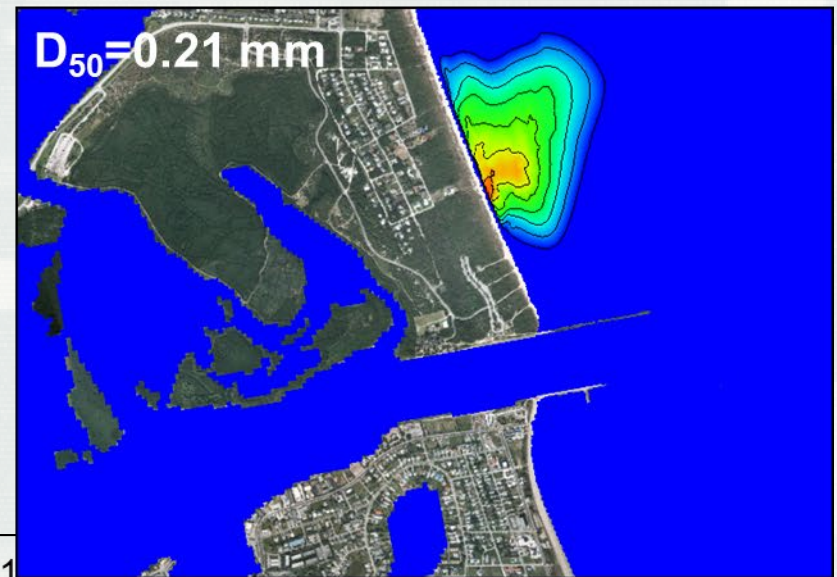
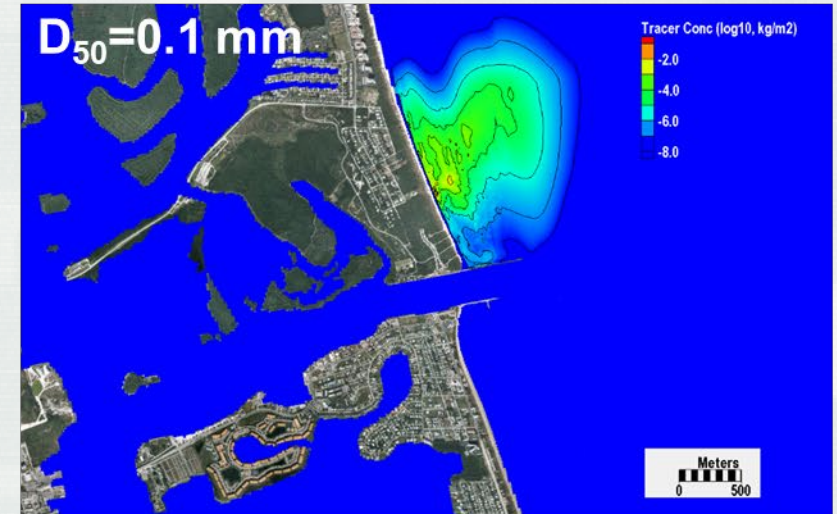
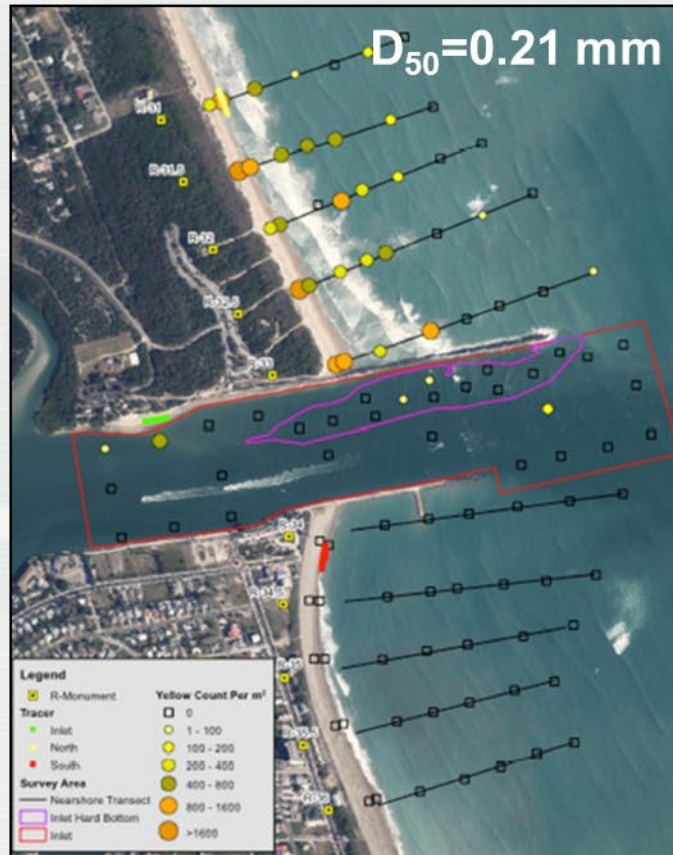
Sediment Tracer Distribution

- Red sand tracer



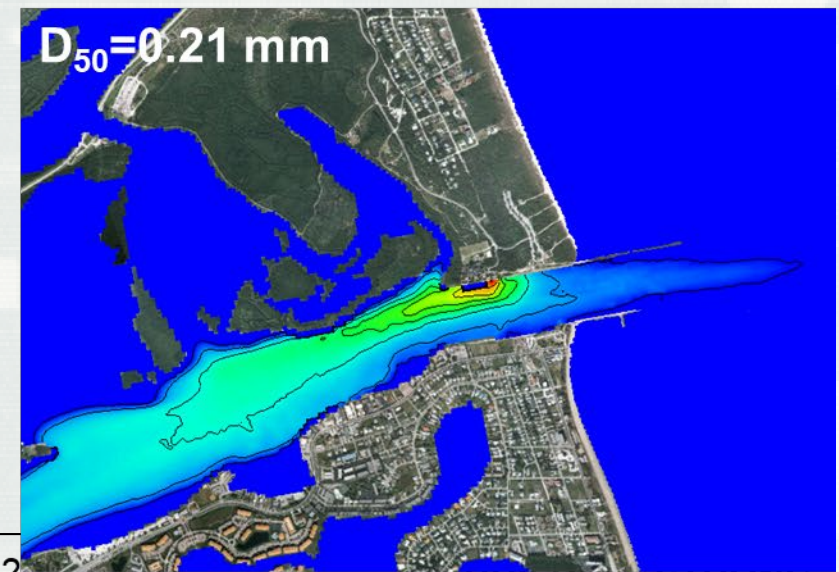
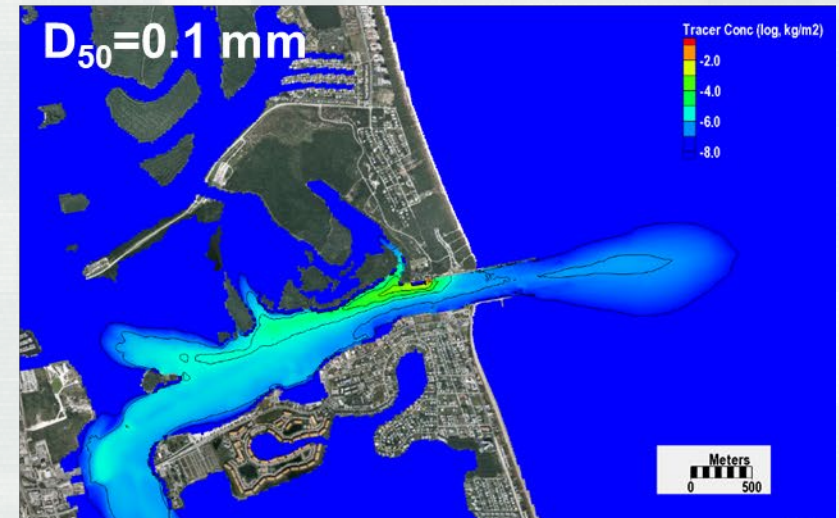
Sediment Tracer Distribution

- 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 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. Further validation needs to be conducted for different wave, hydrodynamic, atmospheric, and environmental forcing



Thank You!



Questions?



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