TWO-DIMENSIONAL MORPHOLOGIC MODELING CASE STUDY

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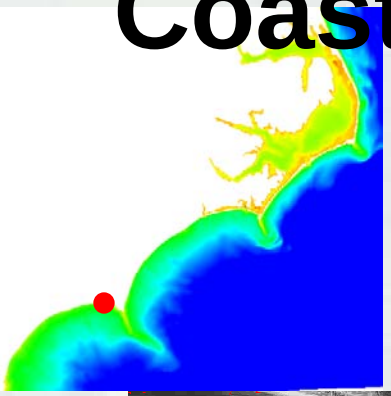
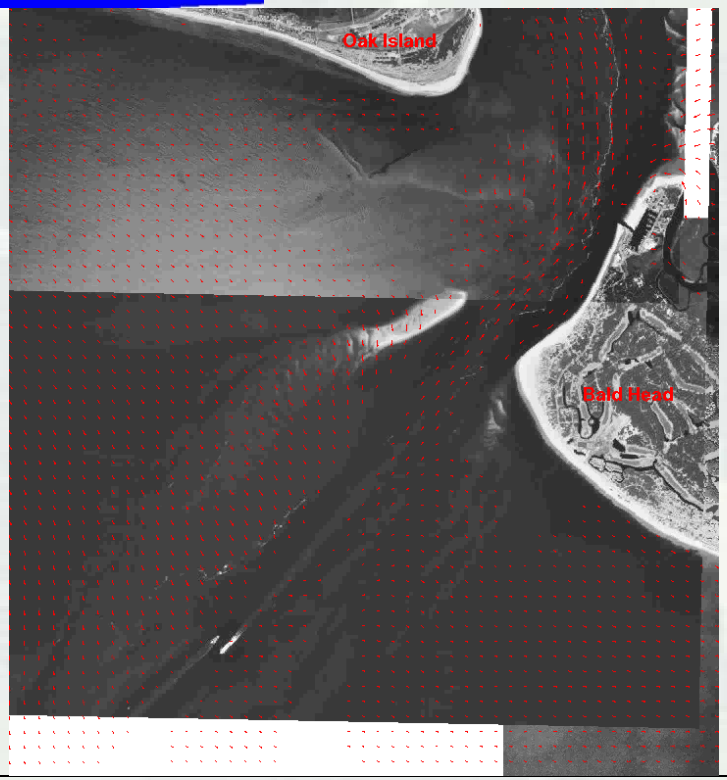
October, 2010

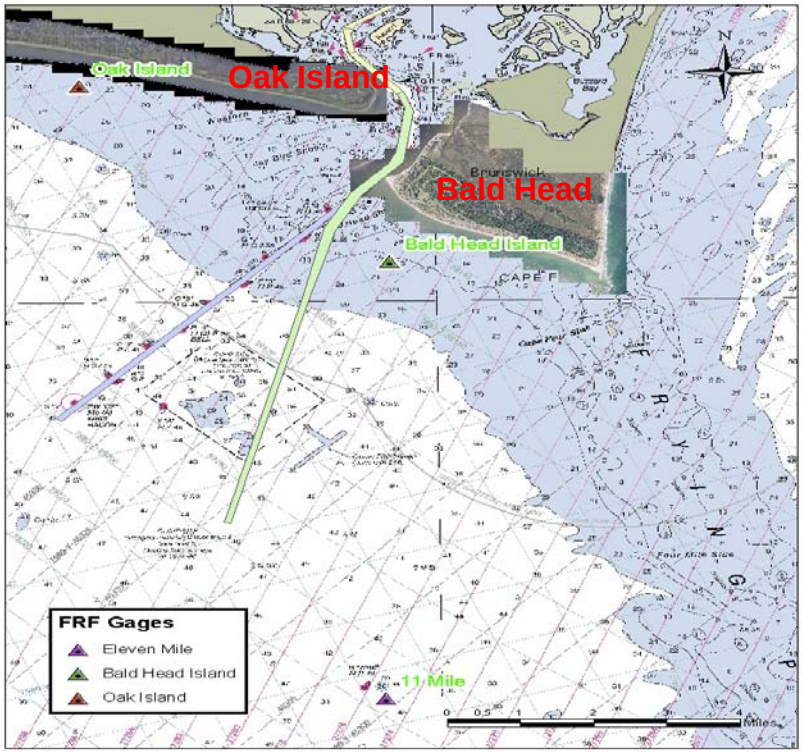
US Army Corps of Engineers
BUILDING STRONG®

Coastal Modeling System (CMS)



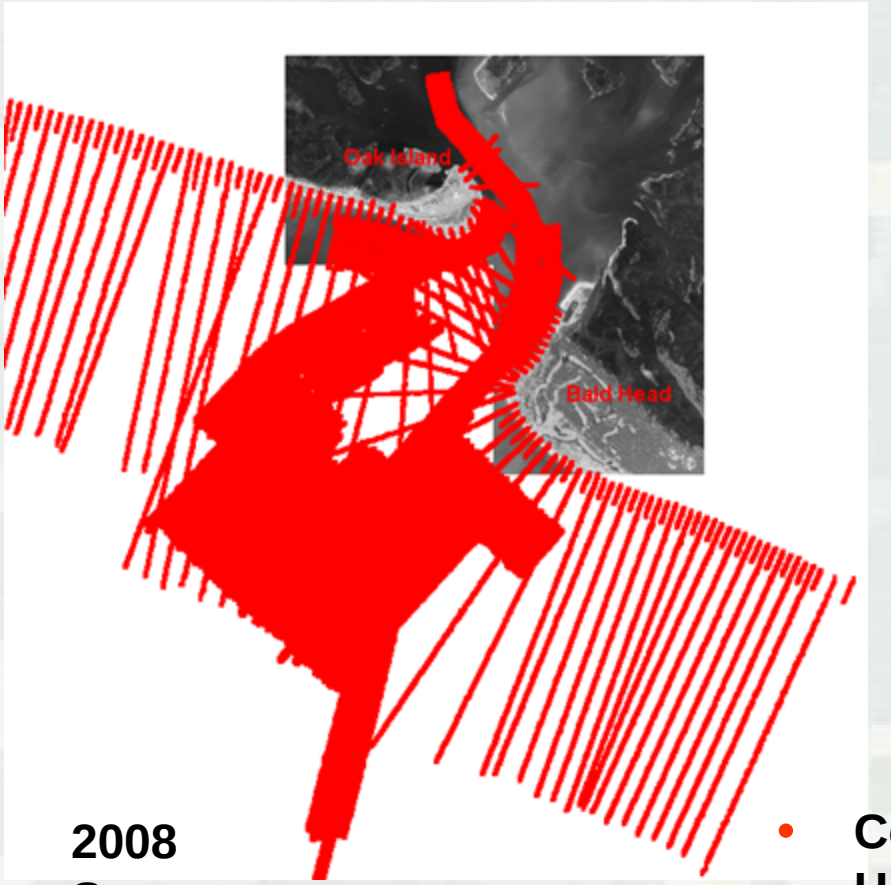
Cape Fear Inlet, NC



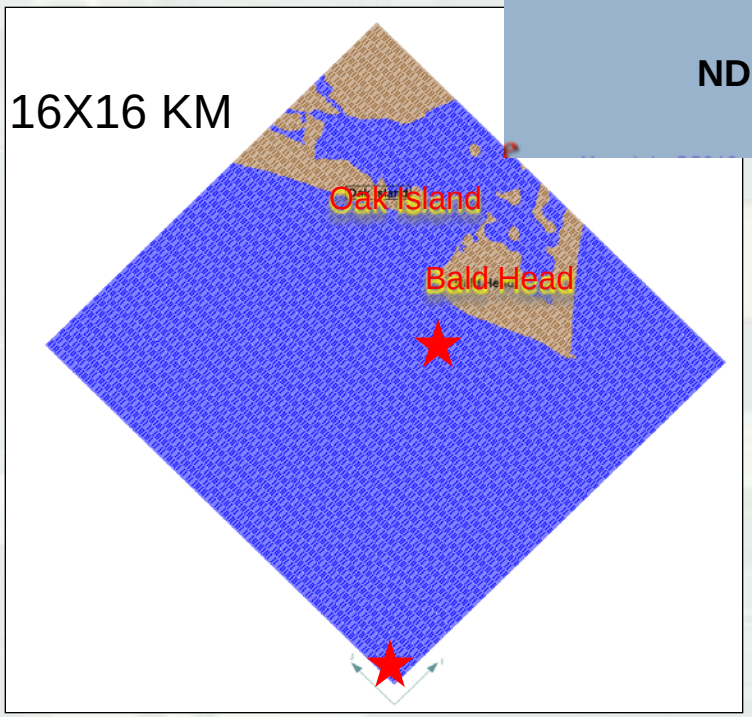


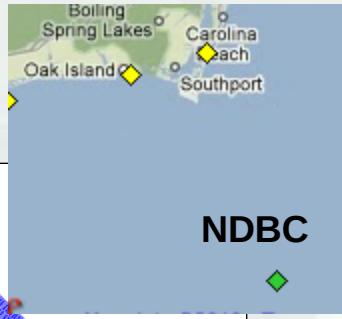
- Wilmington Harbor Monitoring Program
- Three ADCP gauges

CMS-WAVE Model



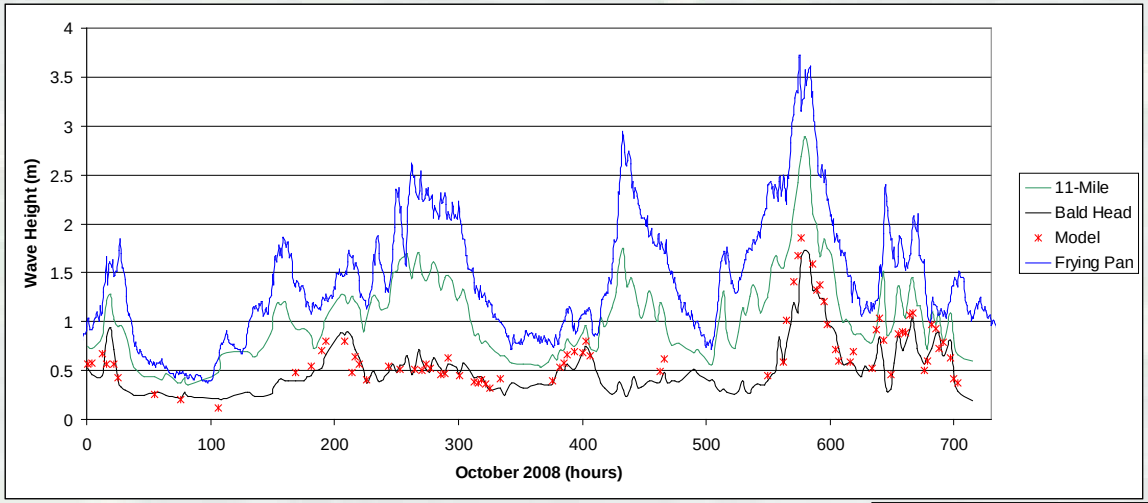
2008 Survey



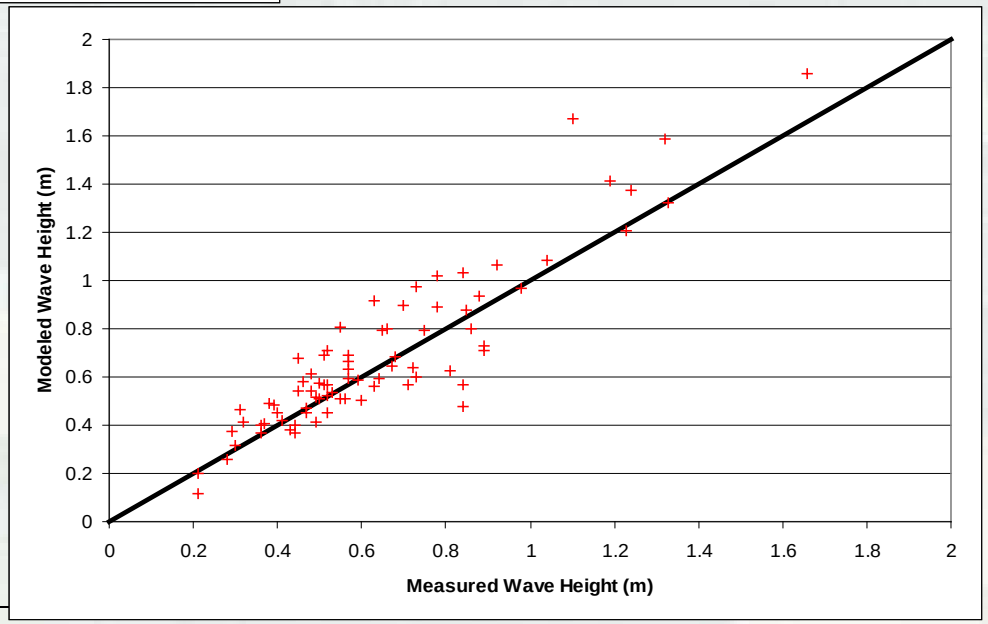


- Complete time series at 11-Mile and Bald Head gauges simultaneously
- October 2008
- Tune model parameters

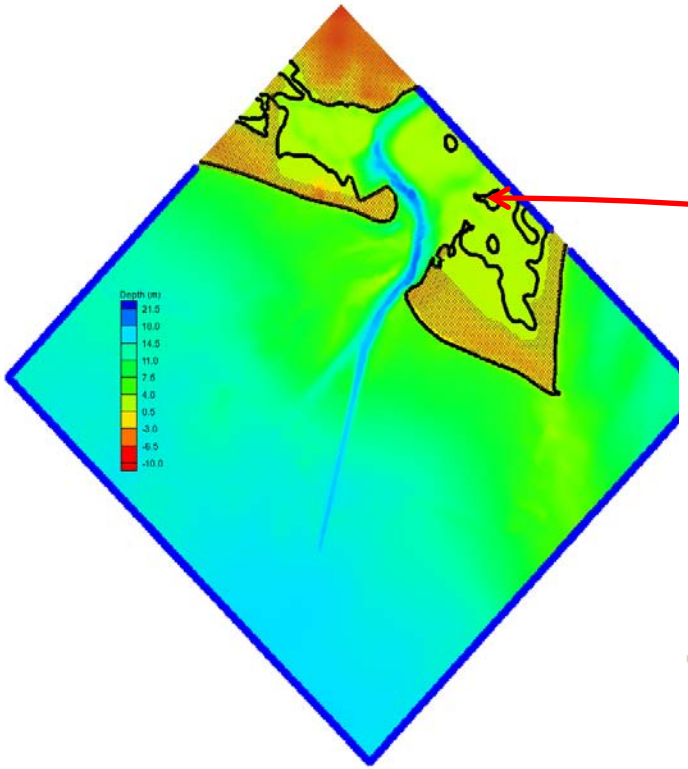
CMS-WAVE Model

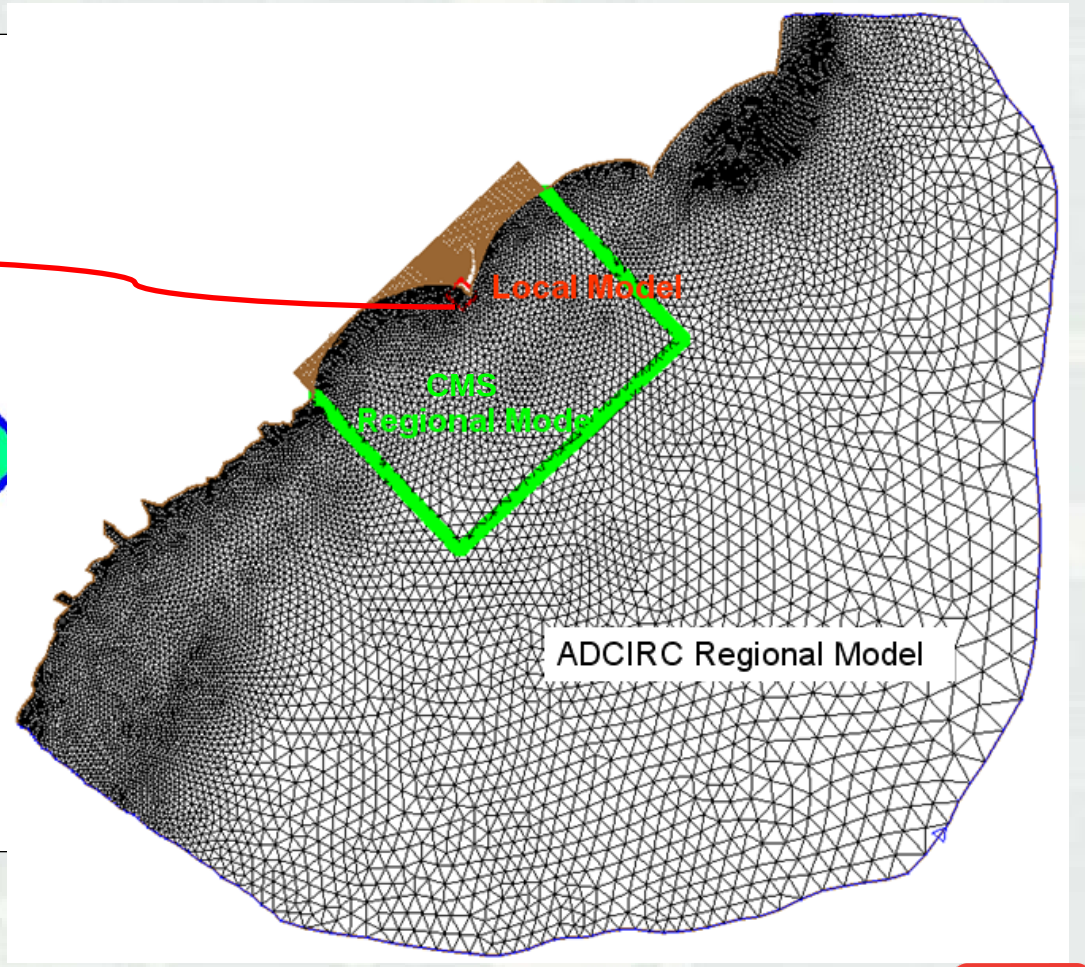


- **Wave height RMS = 0.14 m**
- **Wave height Model Performance Index (MPI) = 0.75**



CMS-FLOW Model

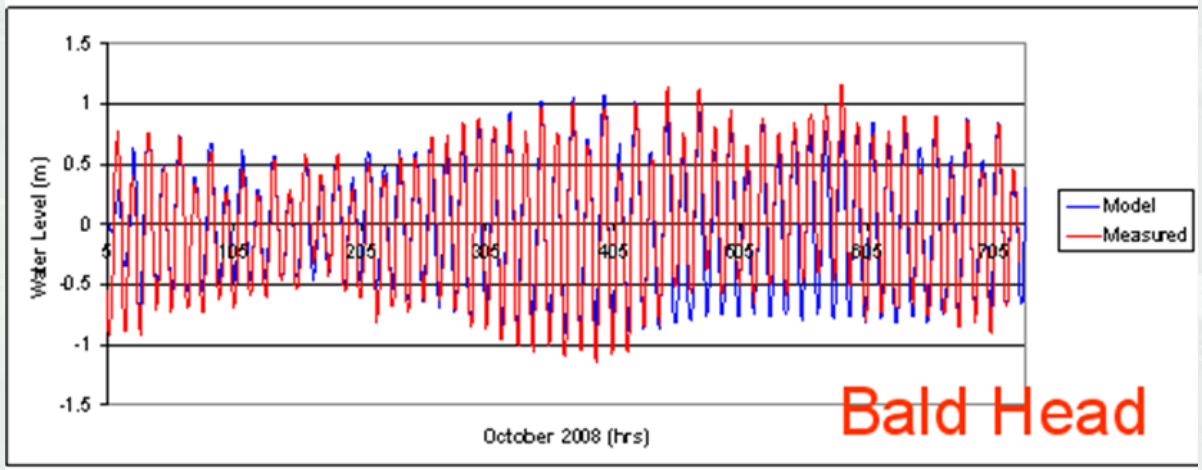


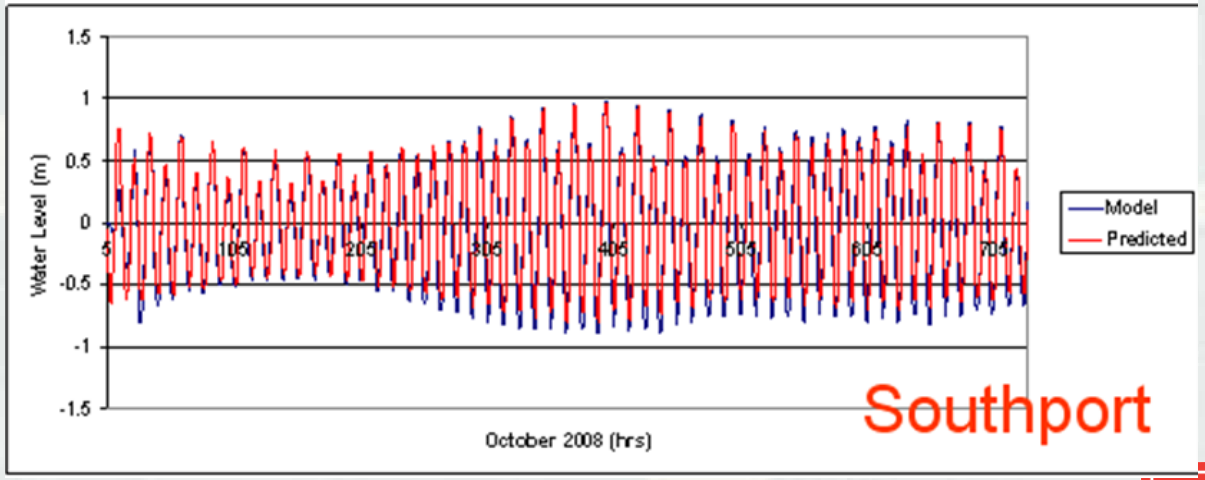


- ADCIRC regional model
- Nesting approach
- Manning

CMS-FLOW Model

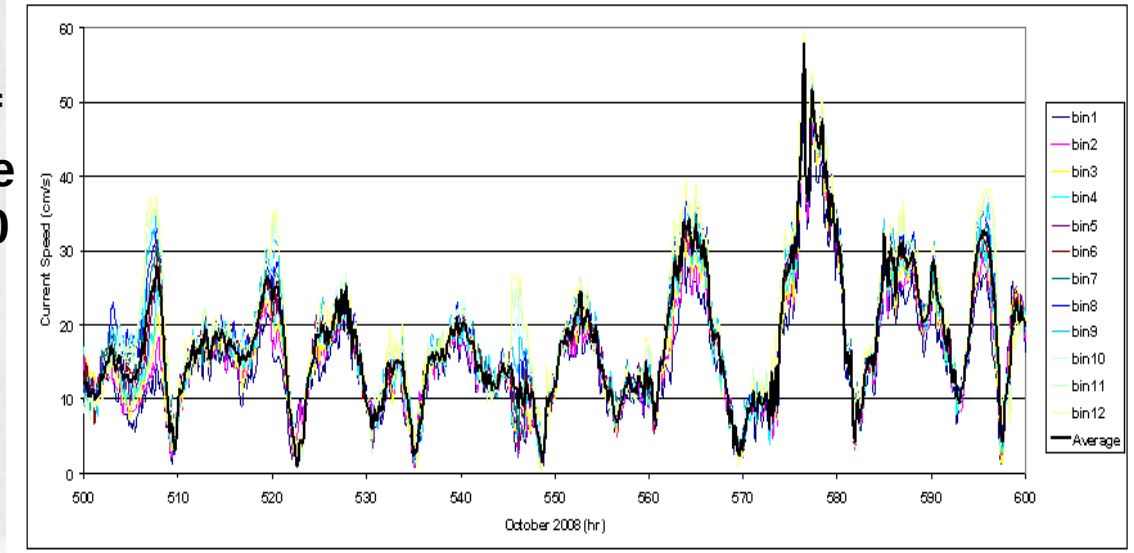
Percent Error:
Bald Head = 7
Southport = 6.7

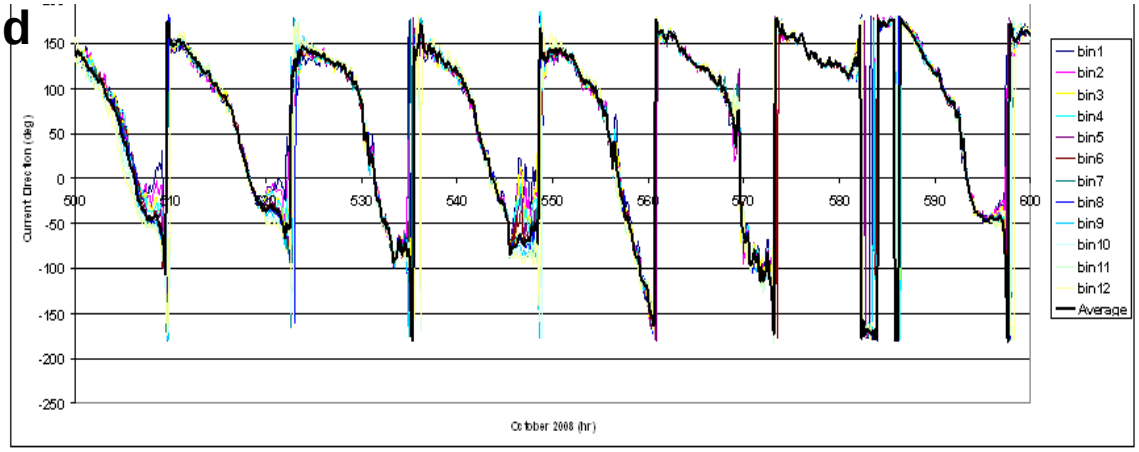




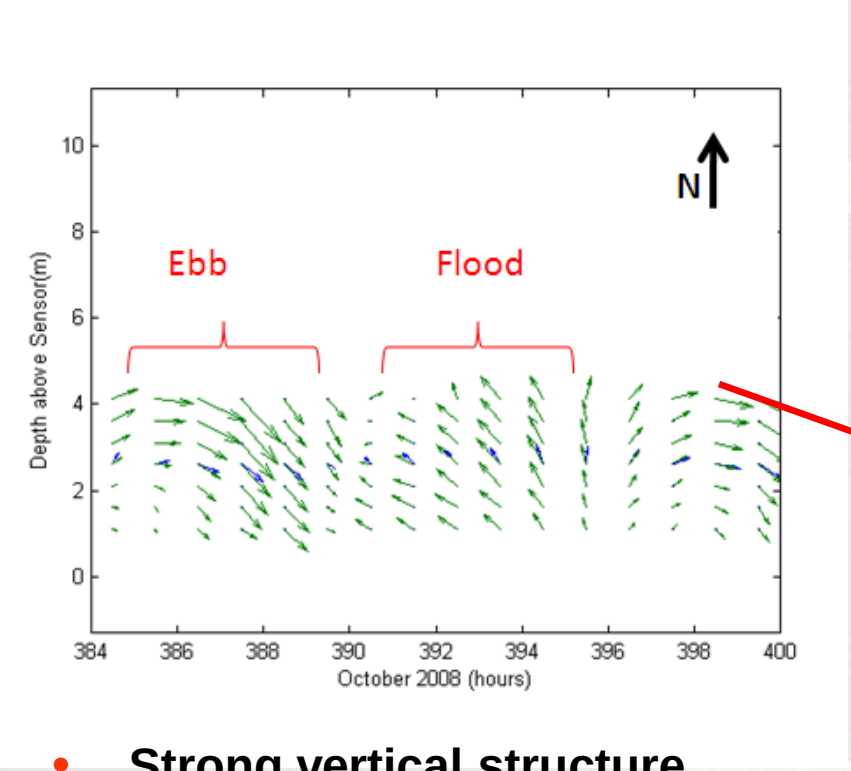
Measured Current Data at Bald Head

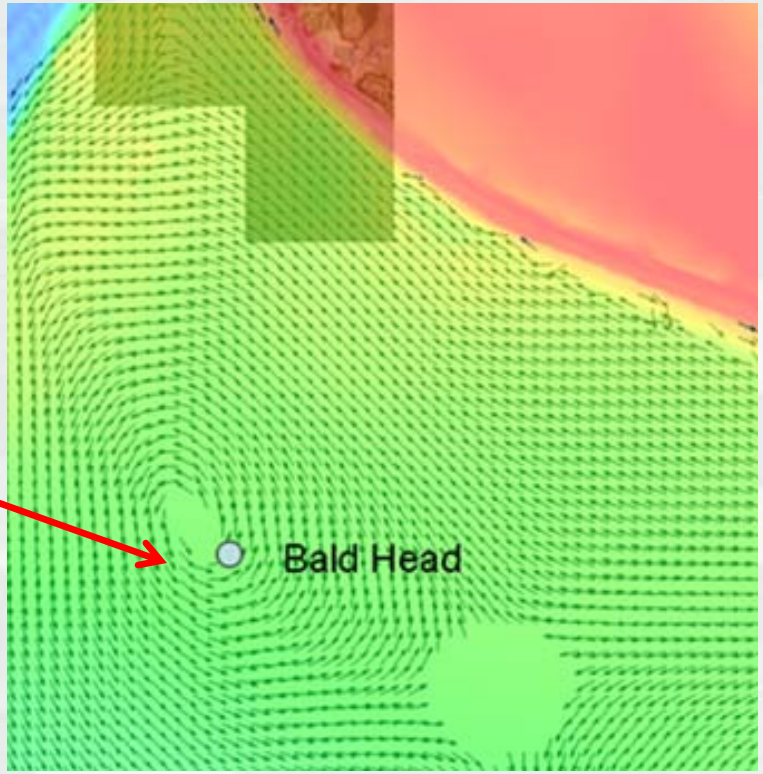
- Vertical distribution of current throughout the water column every 10 minutes
- Velocity profile was divided into 32 bins
- Stratification during flood and ebb peaks
- More fluctuation around the predominant direction during ebb tide than during flood tide





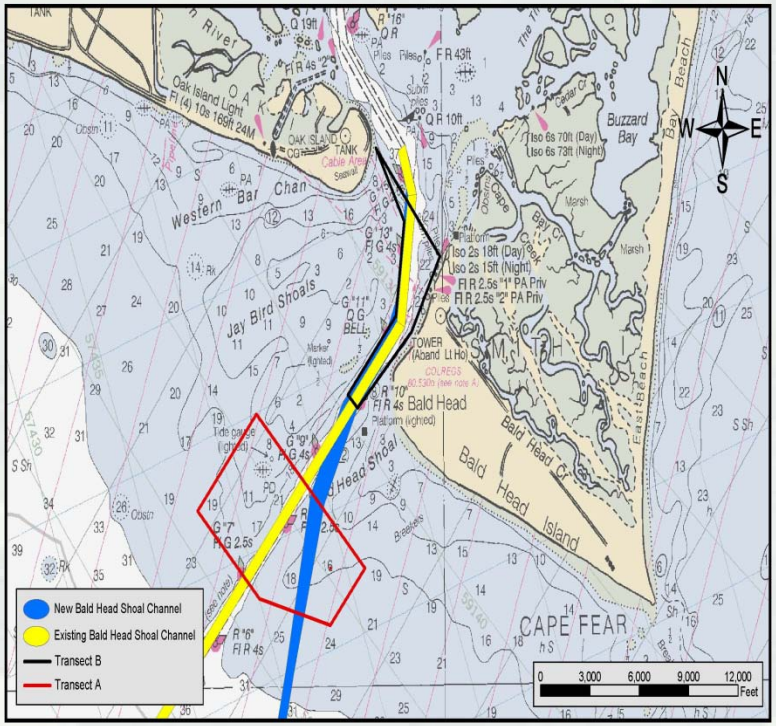
CMS-FLOW Model

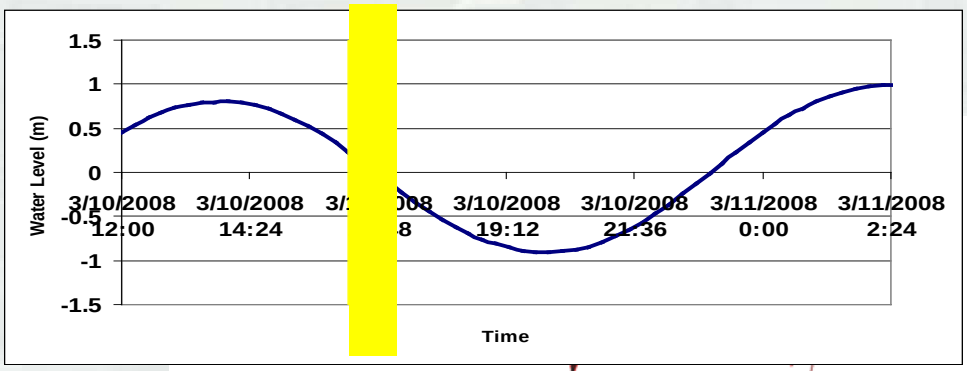


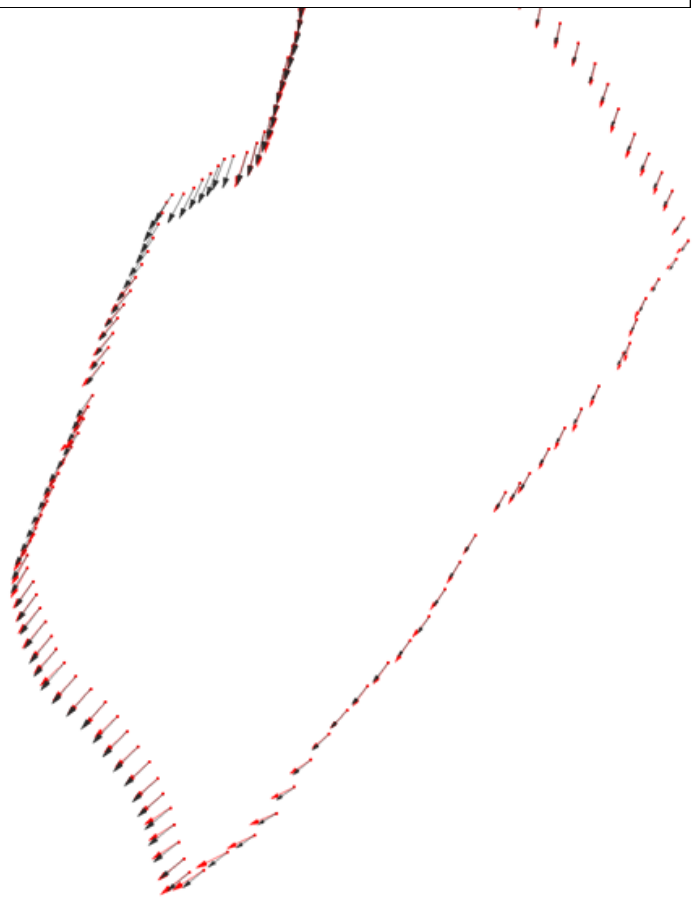


- Strong vertical structure
- Eddy formation at Bald Head shoal
- Eddies are not reproduced accurately with two dimensional models due to the complicated vertical structure associated with eddy formation

Flow Model

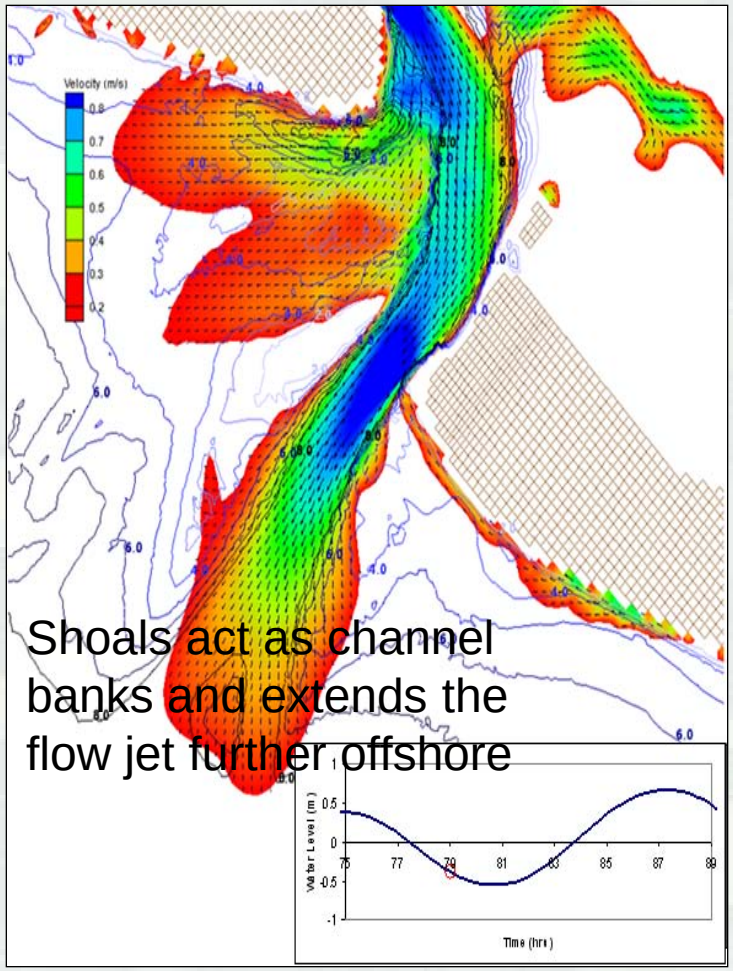




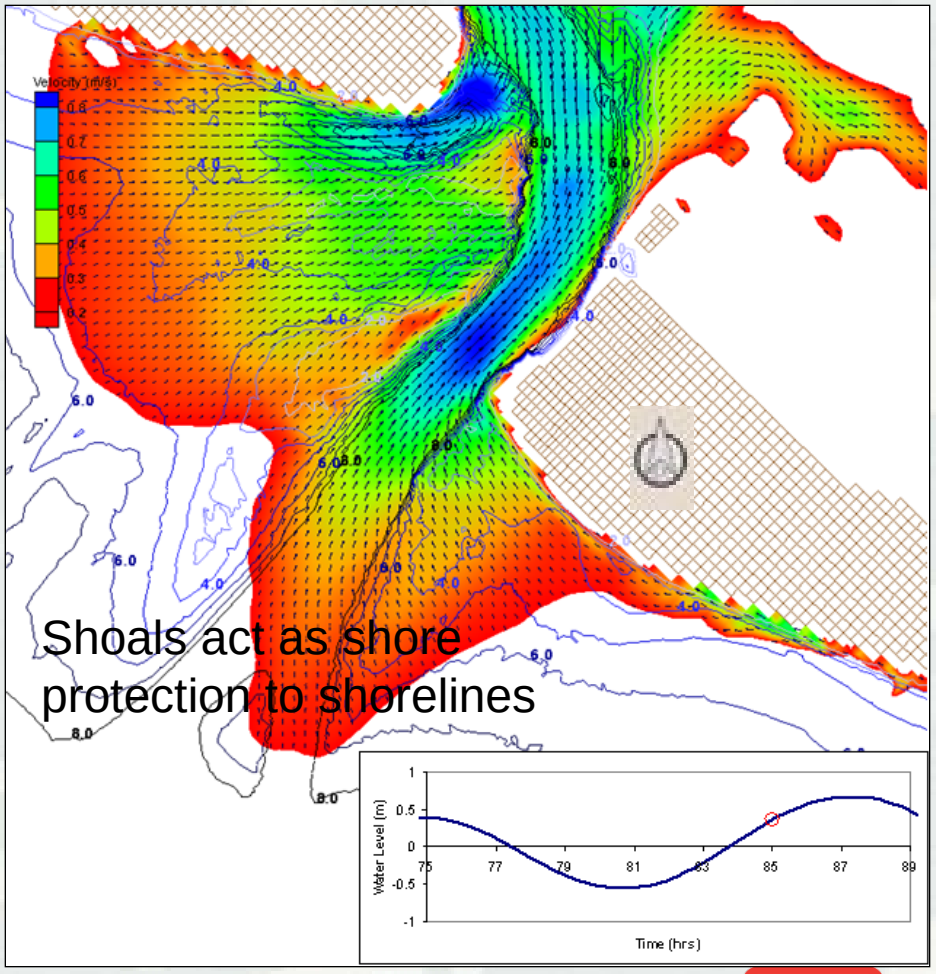


- Currents were measured across the mouth of the inlet near spring tide
- ADCIRC and the regional CMS flow (March 7-10, 2008)
- Modeled data (black vectors) were extracted to match the measuring points in space and time

Flow Patterns



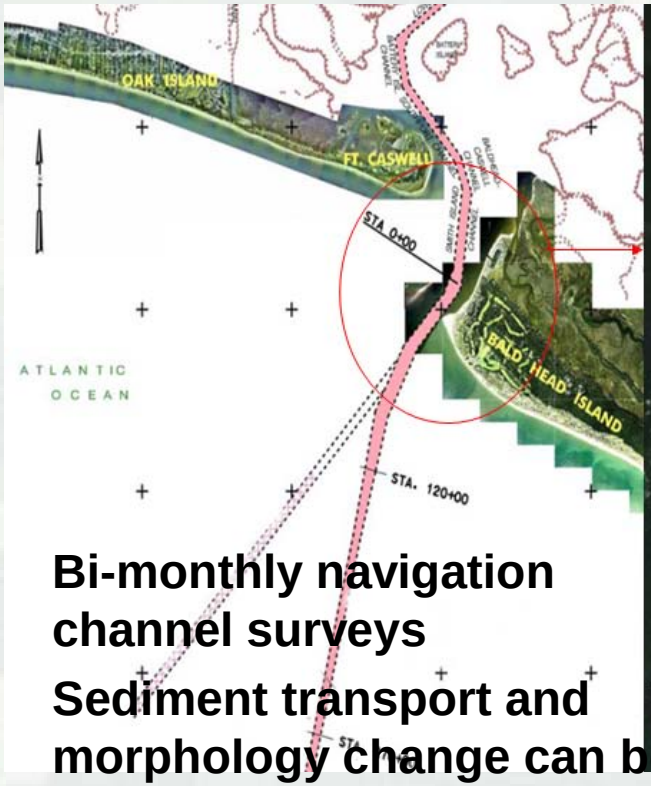
Shoals act as channel banks and extends the flow jet further offshore

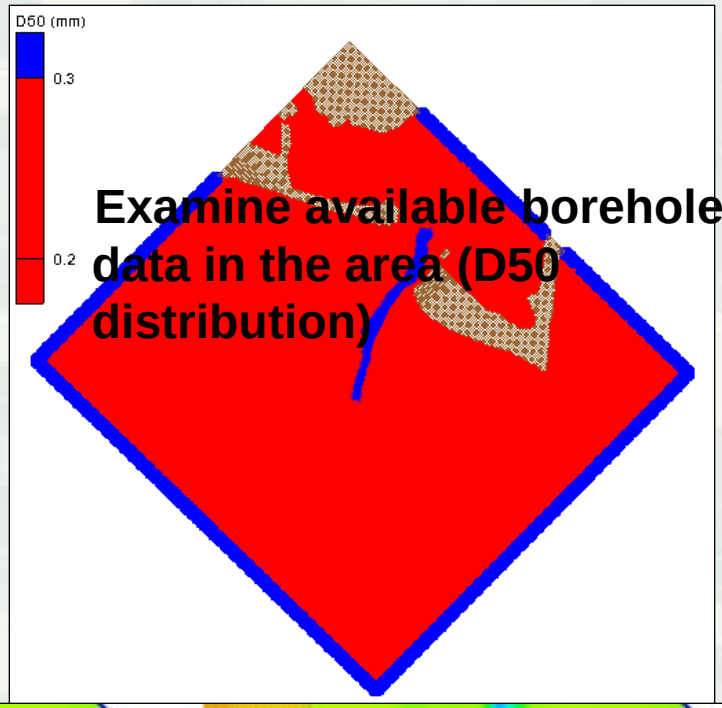


Shoals act as shore protection to shorelines

Principal Wave Direction (SE)

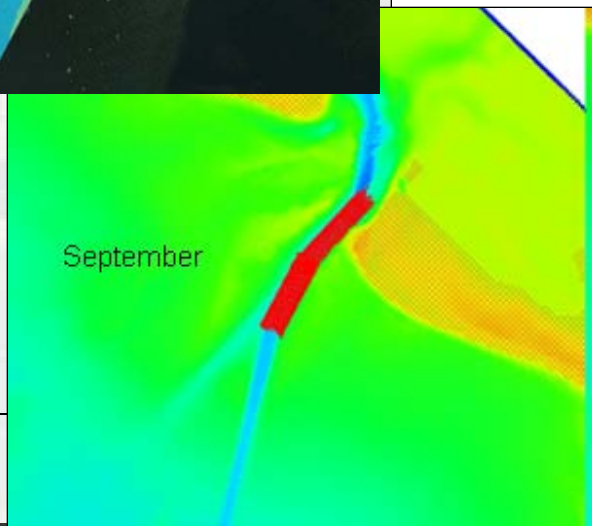
Sediment Model

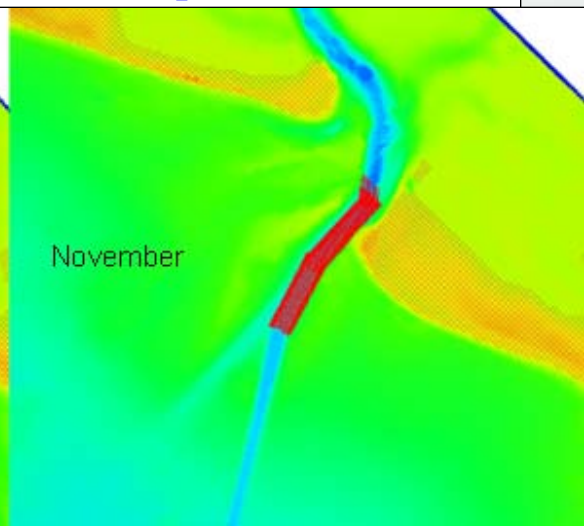




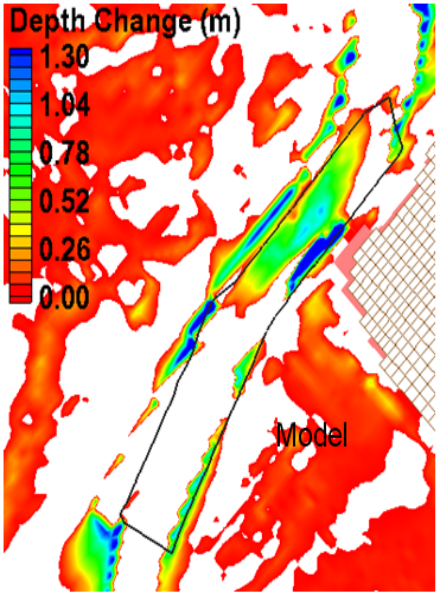
Examine available borehole data in the area (D50 distribution)

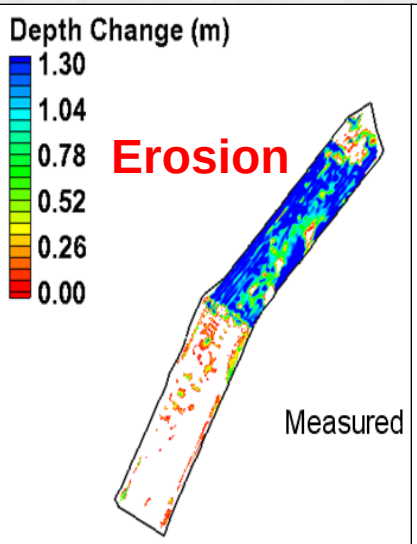
- Bi-monthly navigation channel surveys
- Sediment transport and morphology change can be computed as user-specified option
- Update bathymetry-Nesting approach-Steering Module
- Explicit CMS code

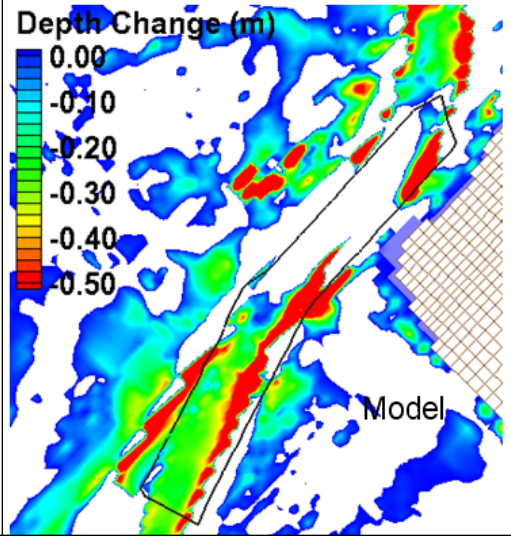


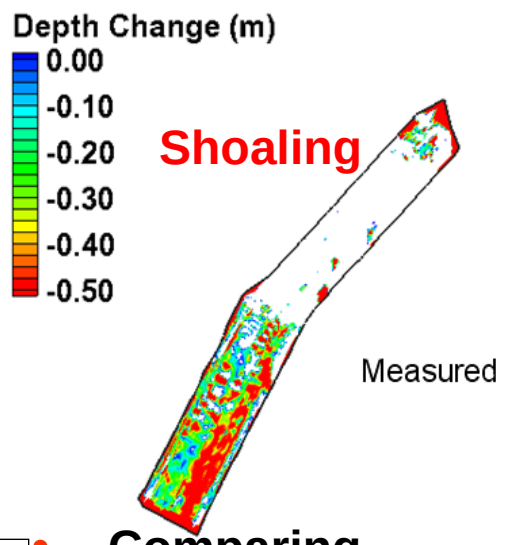


Morphology Change



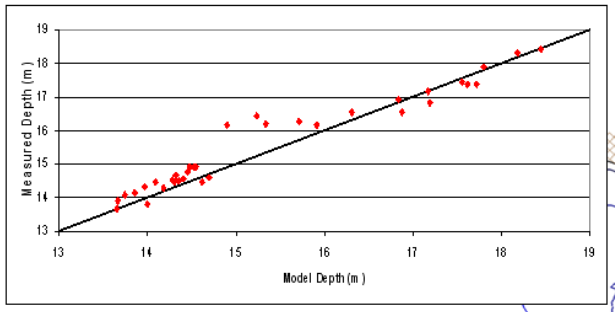


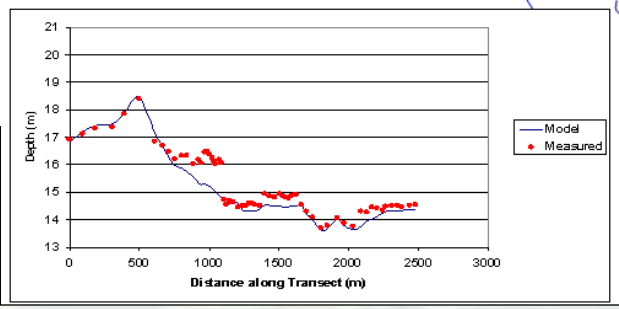


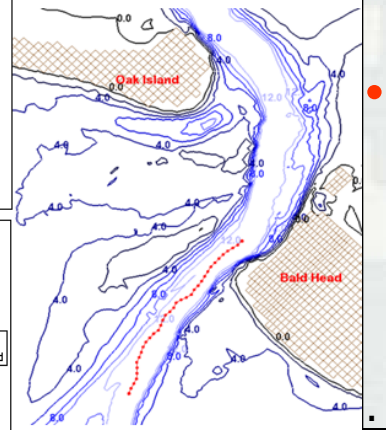


The Brier Skill Score (BSS) was used to evaluate the model performance as it provided an objective measure for model skill.

$$BSS = 1 - \frac{\overline{(Zm - Zc)^2}}{\overline{(Z0 - Zm)^2}} = .79$$



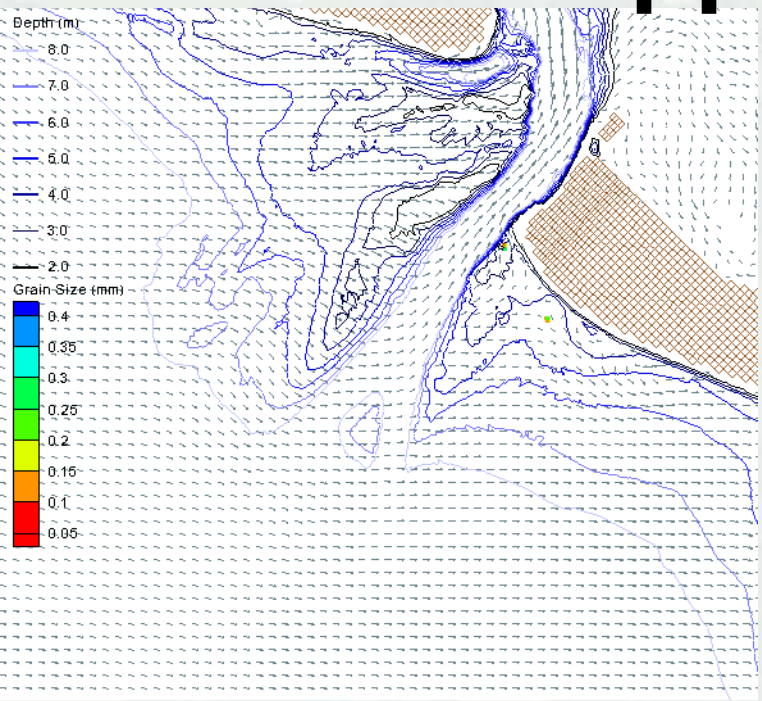


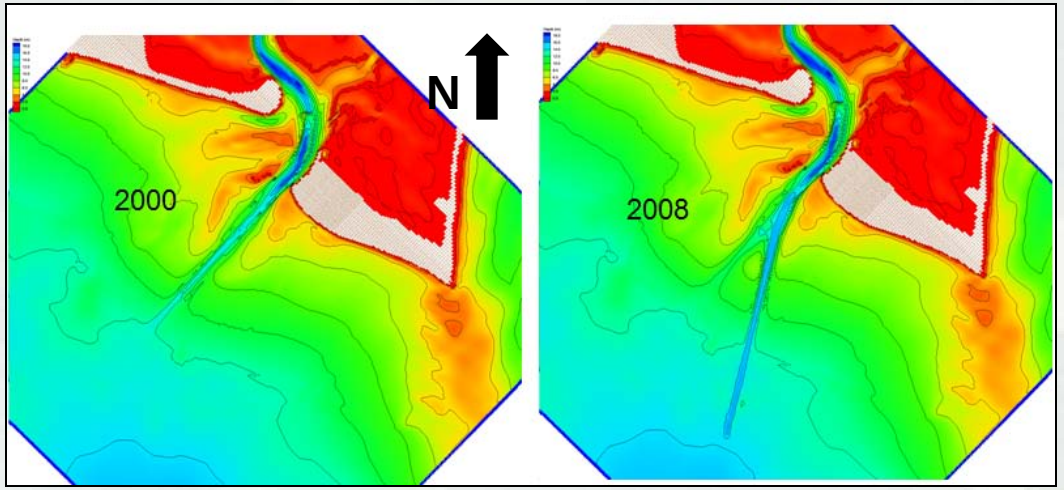


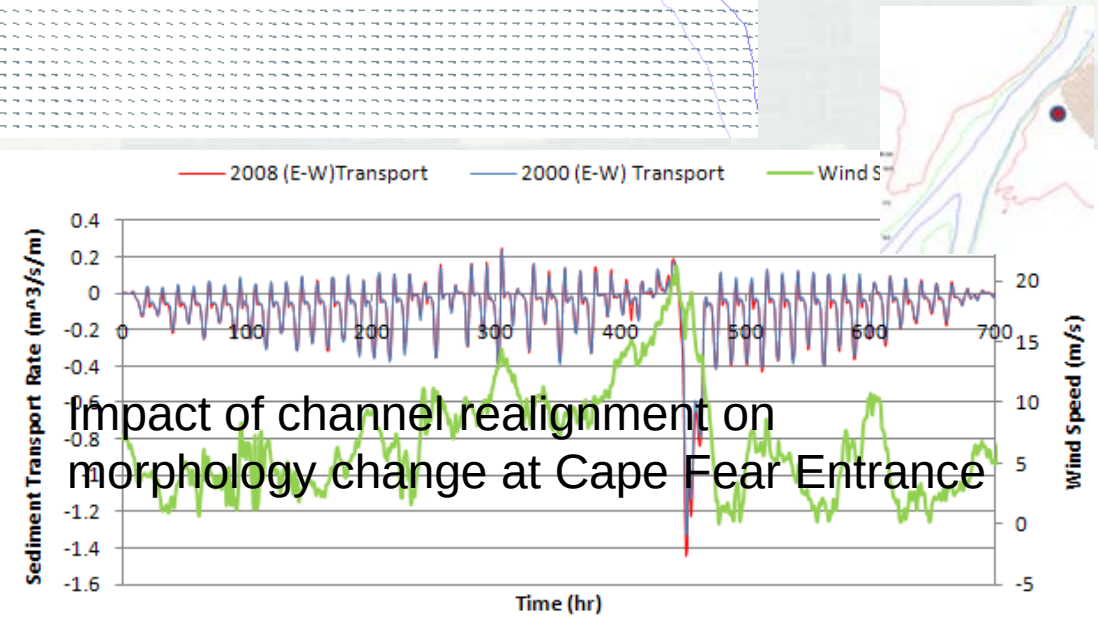
- Comparing morphology change is difficult
- Increase resolution and resolve banks (telescoping)

Applications

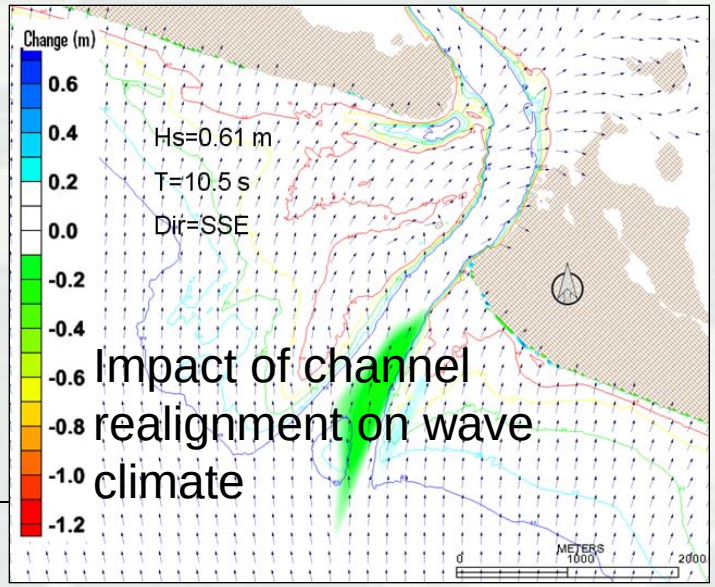
Visualize potential sediment particles pathway (PTM)







Impact of channel realignment on morphology change at Cape Fear Entrance



Impact of channel realignment on wave climate

THANK YOU