# Ebb Delta Development at a “New” Old Inlet, Shark River Inlet, NJ

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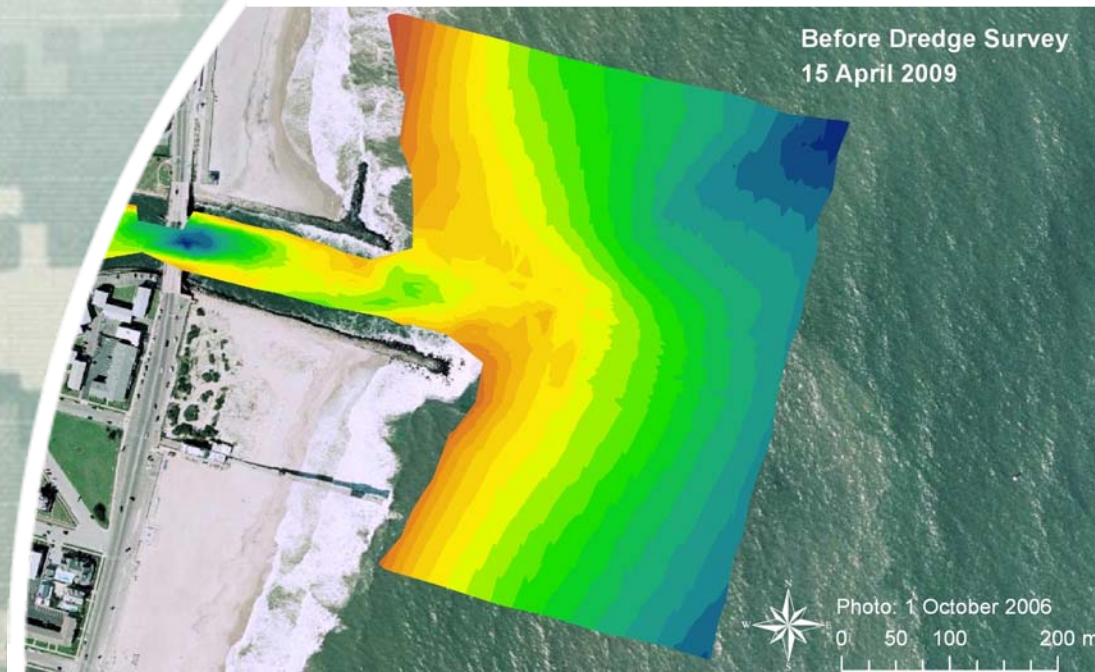
December 2, 2009




US Army Corps of Engineers

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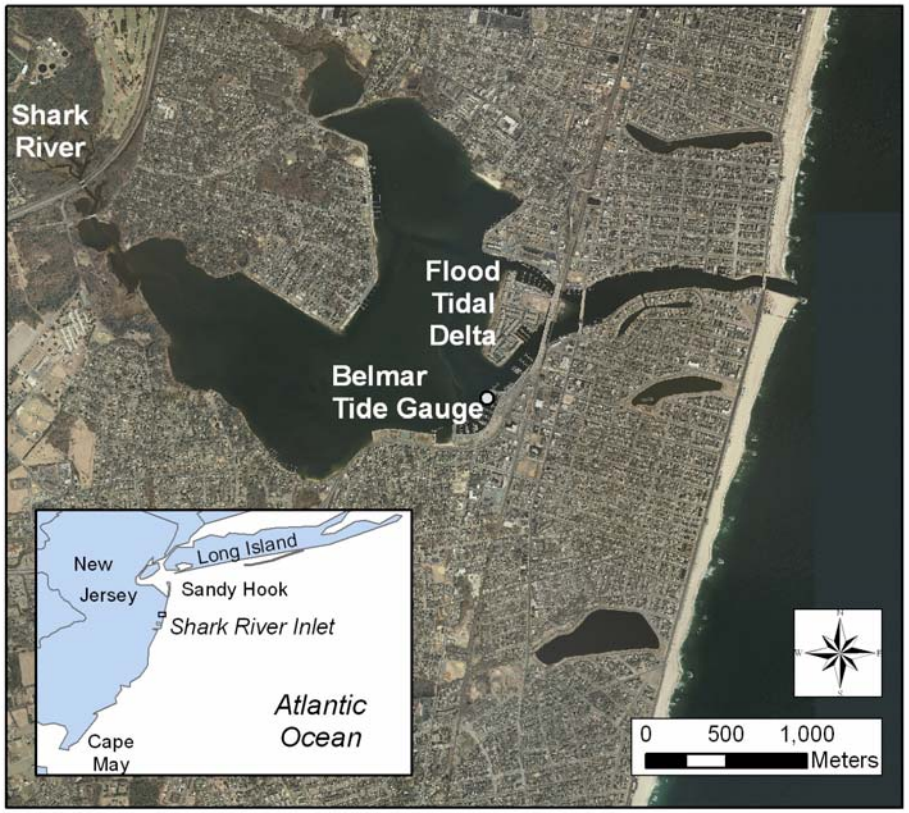
# Introduction




- Federally maintained; southernmost inlet NAN maintained
- Northernmost inlet on NJ coast; Atlantic Highland region (bluffs, historically steep nearshore)
- Small estuary; narrow inlet, small width:depth ratio; wave-dominated
- Densely structured coast
  - Short north jetty with spur; longer south jetty
  - Groins recently notched (2000)

# What is Unique about Shark River Inlet?

- Deep-draft channel maintained to 18 ft MLW (5.5 m), 150 ft (45 m) across
- Historically efficient with little dredging necessary (every 7-10 years)
- 1997 & 2000 Beach Erosion Control Project (nourishment) added 2.3 million $m^3$ to north and 2.3 million $m^3$ to the south of Shark River Inlet
  - Nourished a severely sediment-starved system
  - District planned for increase of dredging interval of every 2-3 years
- CIRP also anticipated the increase in dredging, but did not anticipate the formation of an ebb shoal

# Littoral Processes

- Angas 1960
  - Up-drift (south) jetty impoundment
  - 1958-59 Sand Bypassing Project
    - 105,000 $m^3$ of the 172,000 $m^3$ projected in the first winter
- USACE 2006
  - 153,000 $m^3$/year - net potential transport to north
  - 700,000 $m^3$/year - potential gross transport
- Others: USACE 1954, Caldwell 1956, Johnson 1956
- Beck & Kraus 2009
  - 180,000 $m^3$/year – average net potential transport to north

# Dredging History

- NAN increases condition survey interval following shoaling reports around north and south jetty tips

| Date | Survey Type | Date | Survey Type |
|---|---|---|---|
| 1-Jan-1995 | Condition | 23-May-2006 | Condition |
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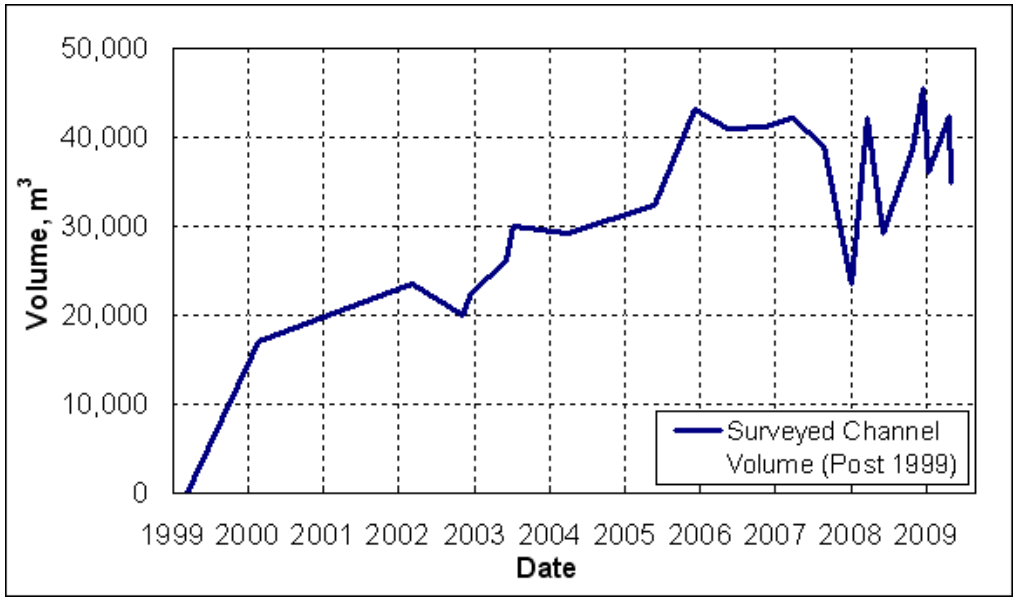
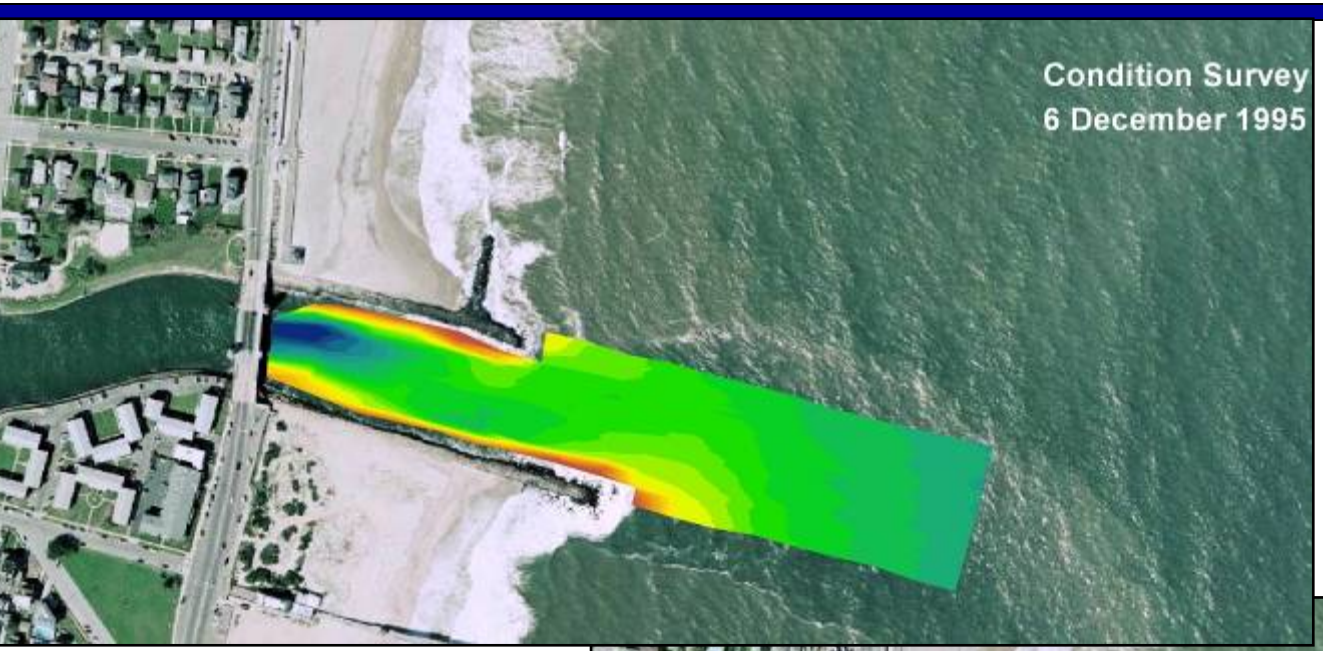
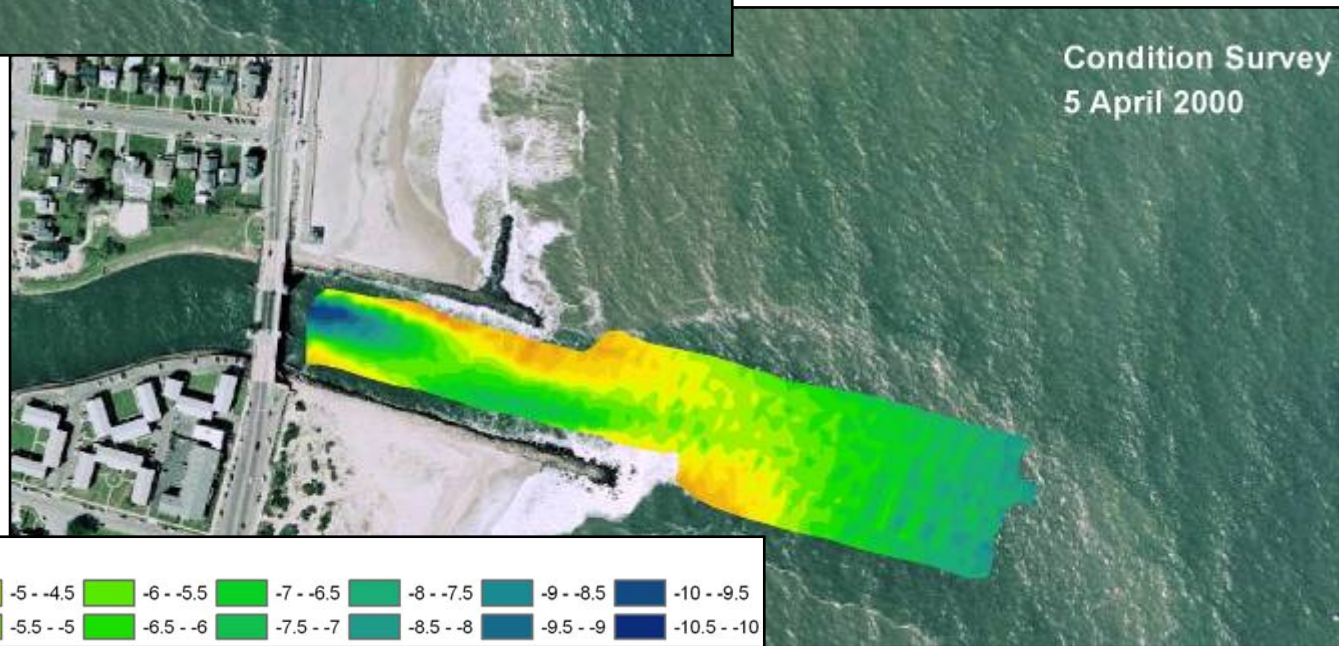



- Volume is largely being controlled by frequent emergency dredging

# 1995 & 2000 Ebb Delta Formation




NAN
Survey

Elevation, MLW (m)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -1 - -0.5 | -2 - -1.5 | -3 - -2.5 | -4 - -3.5 | -5 - -4.5 | -6 - -5.5 | -7 - -6.5 | -8 - -7.5 | -9 - -8.5 | -10 - -9.5 |
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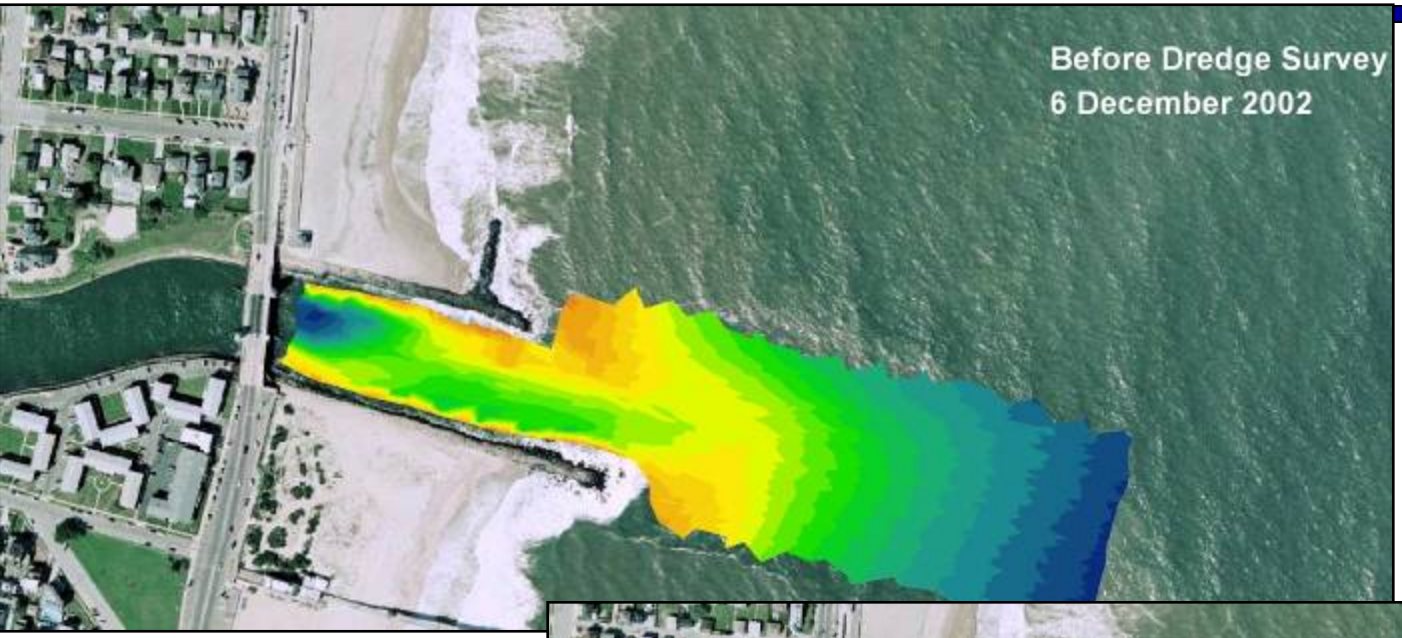
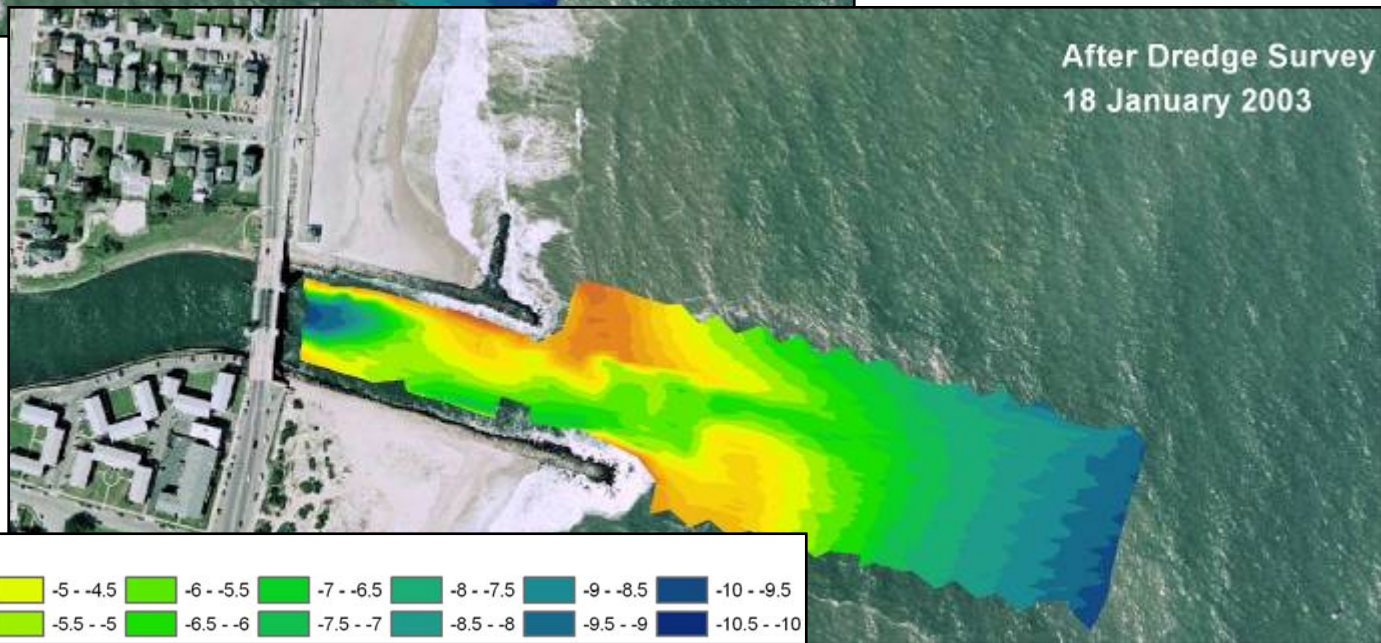
# 2002 & 2003 Ebb Delta Formation

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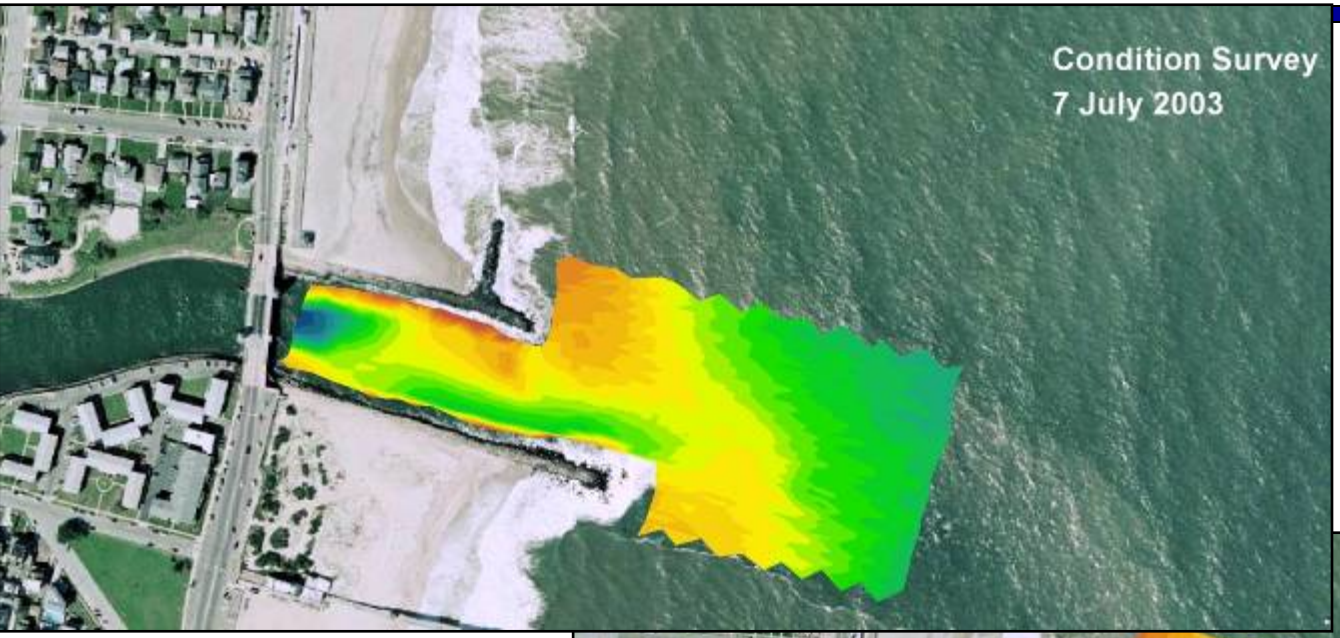
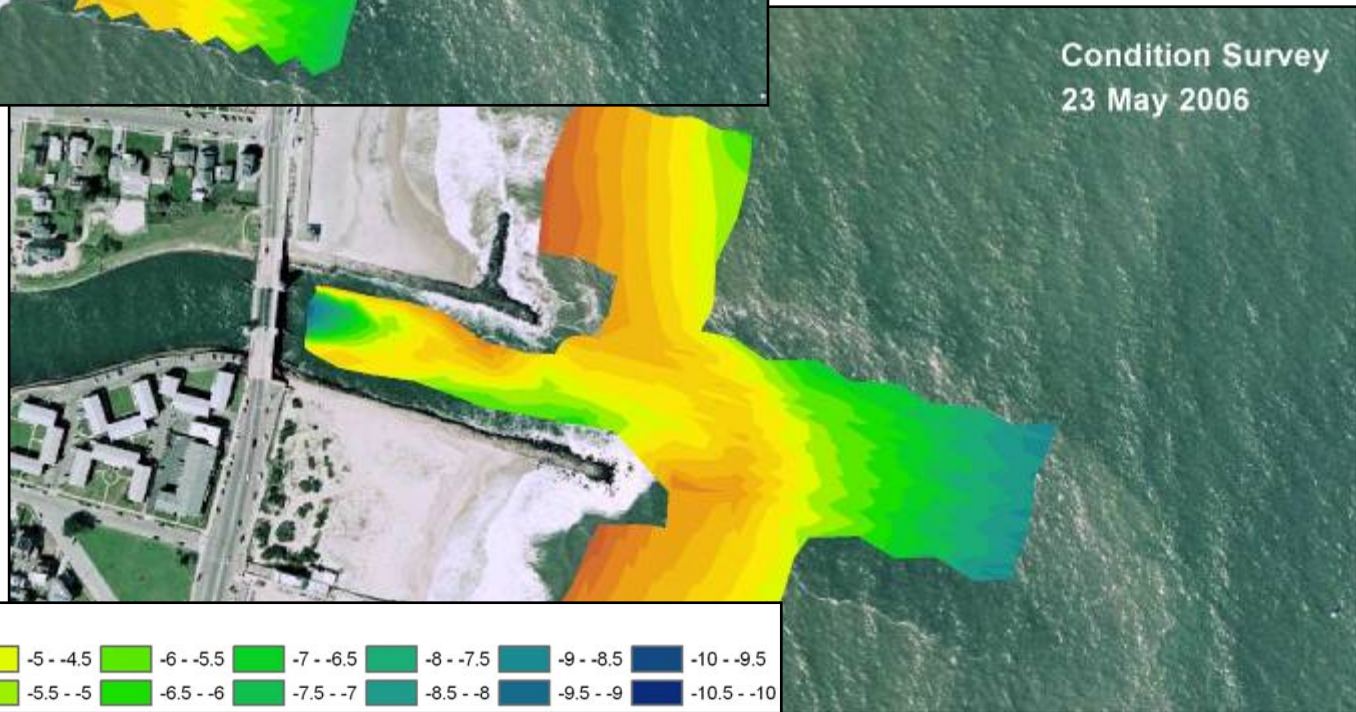
# 2003 & 2006 Ebb Delta Formation

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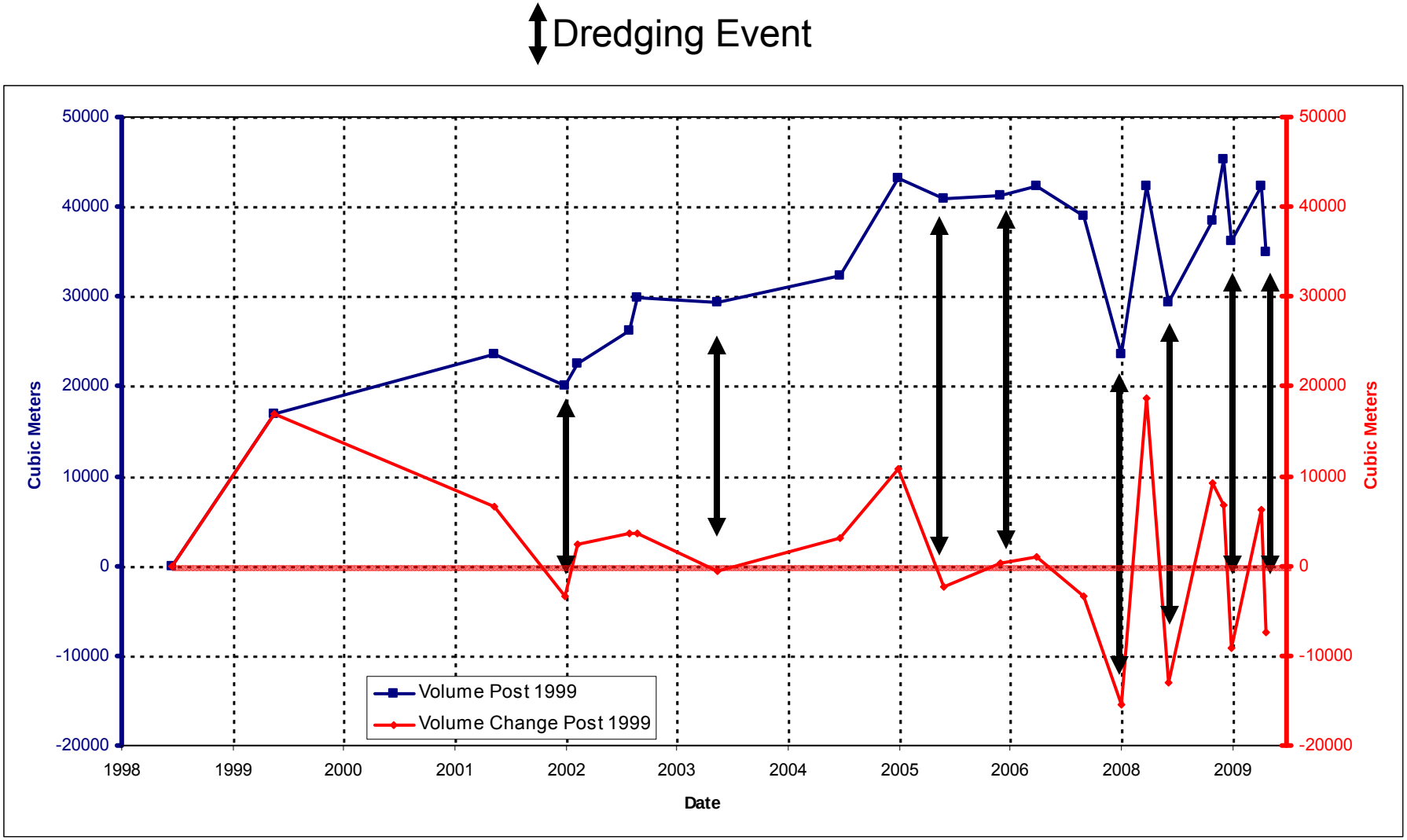
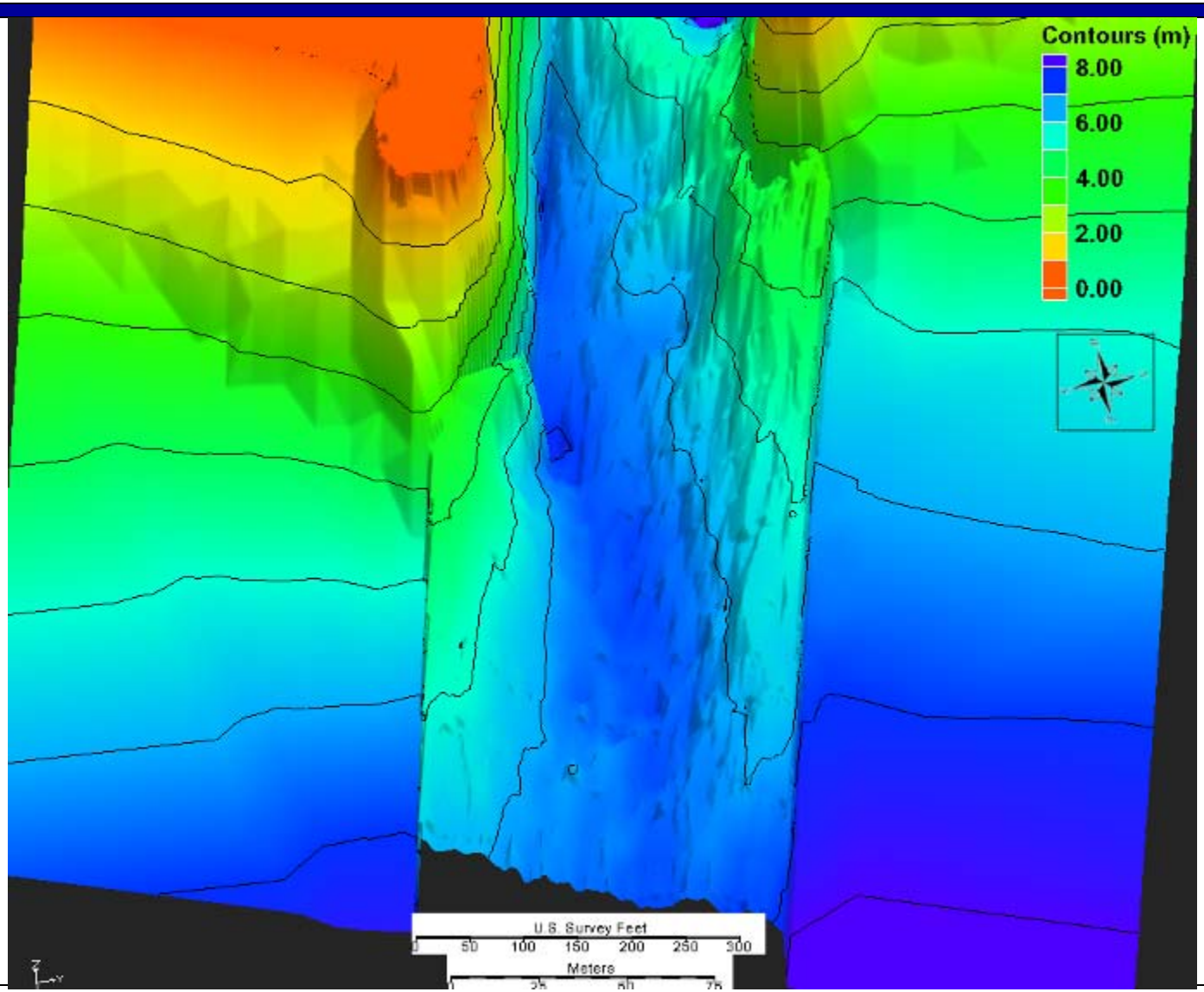
# Volume & Volume Change Post 1999

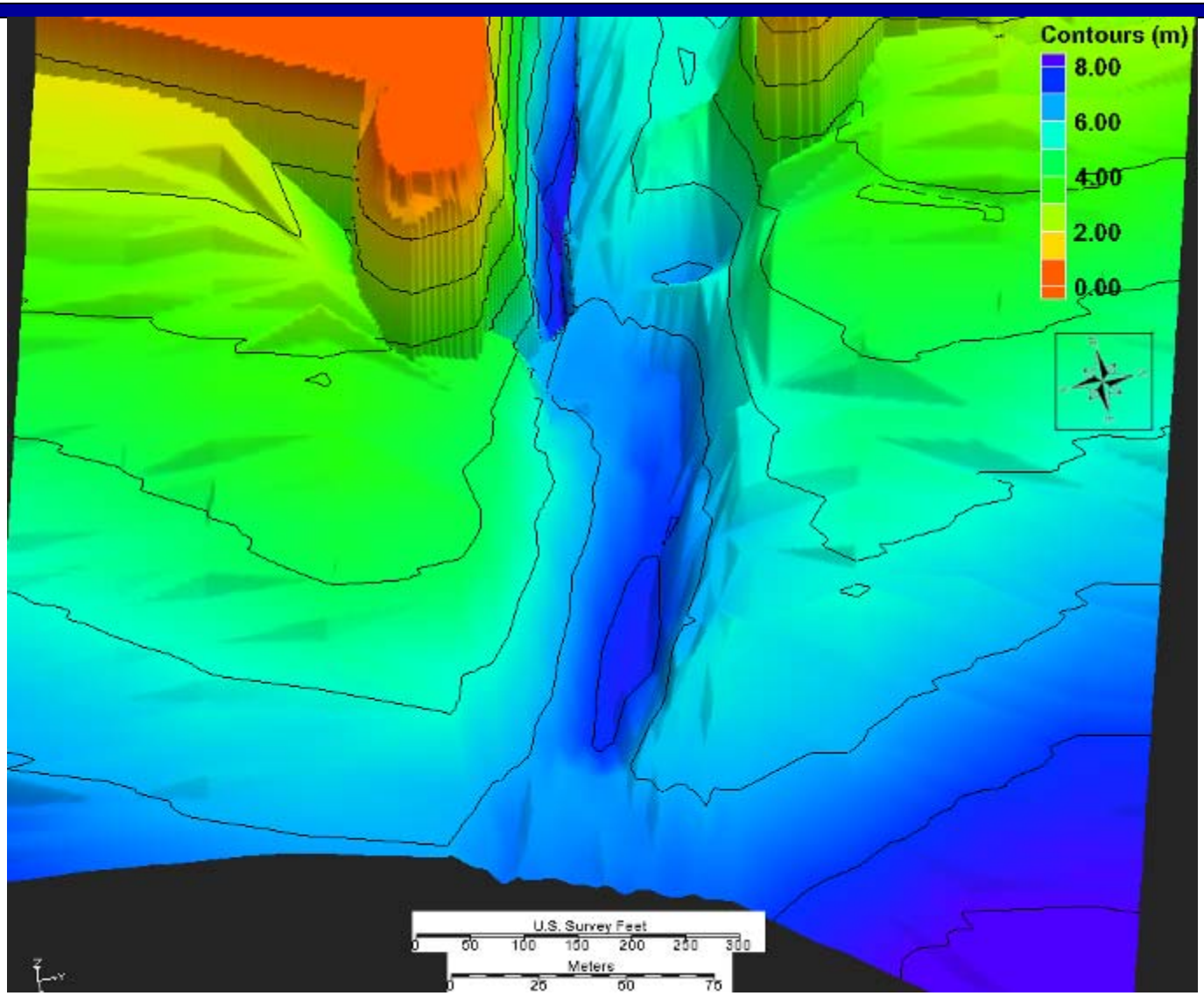


# January 08 – After Dredging



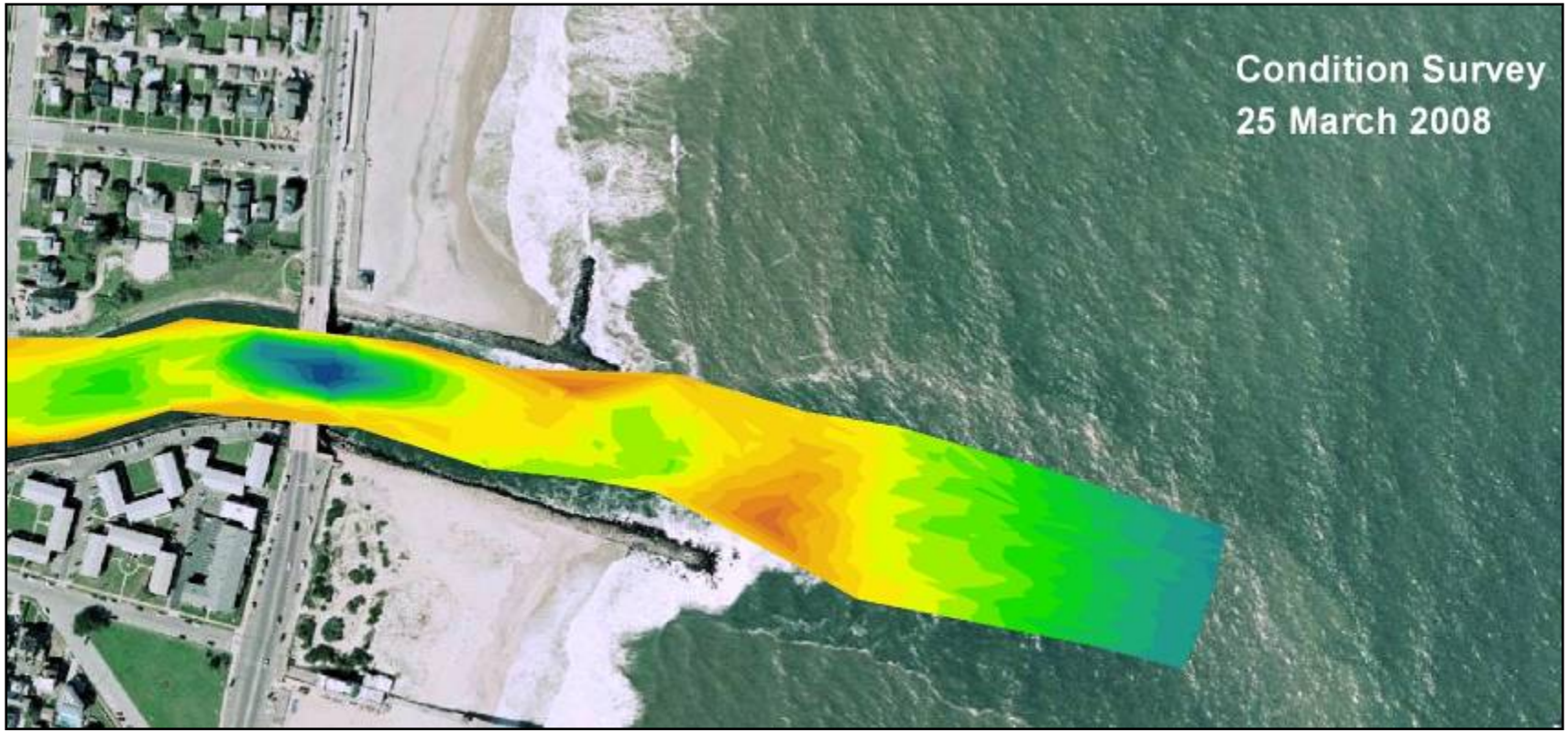

NAN Survey

# June 08 – After Dredging




NAN Survey

# 2008 & 2009 Ebb Delta Formation

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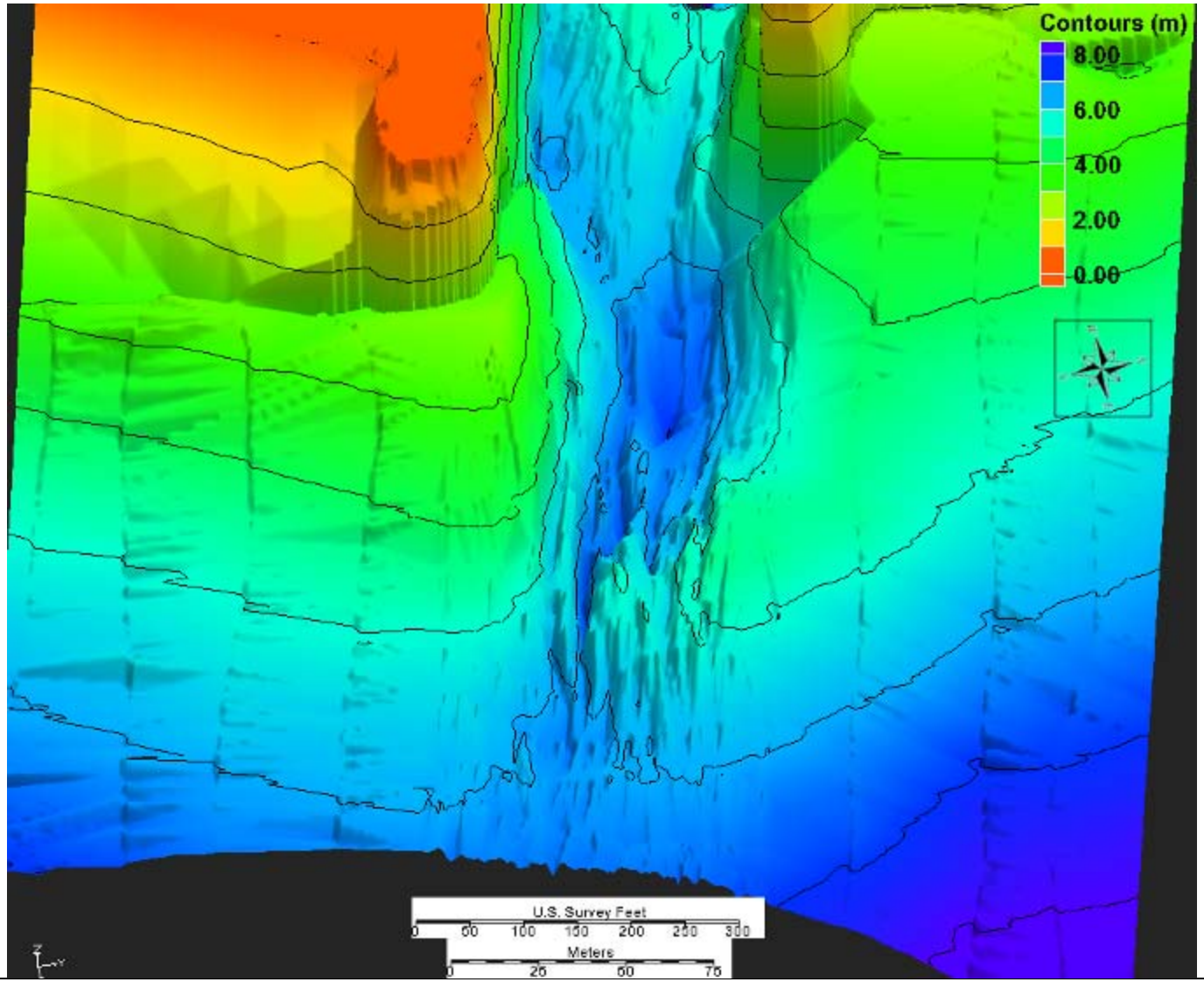
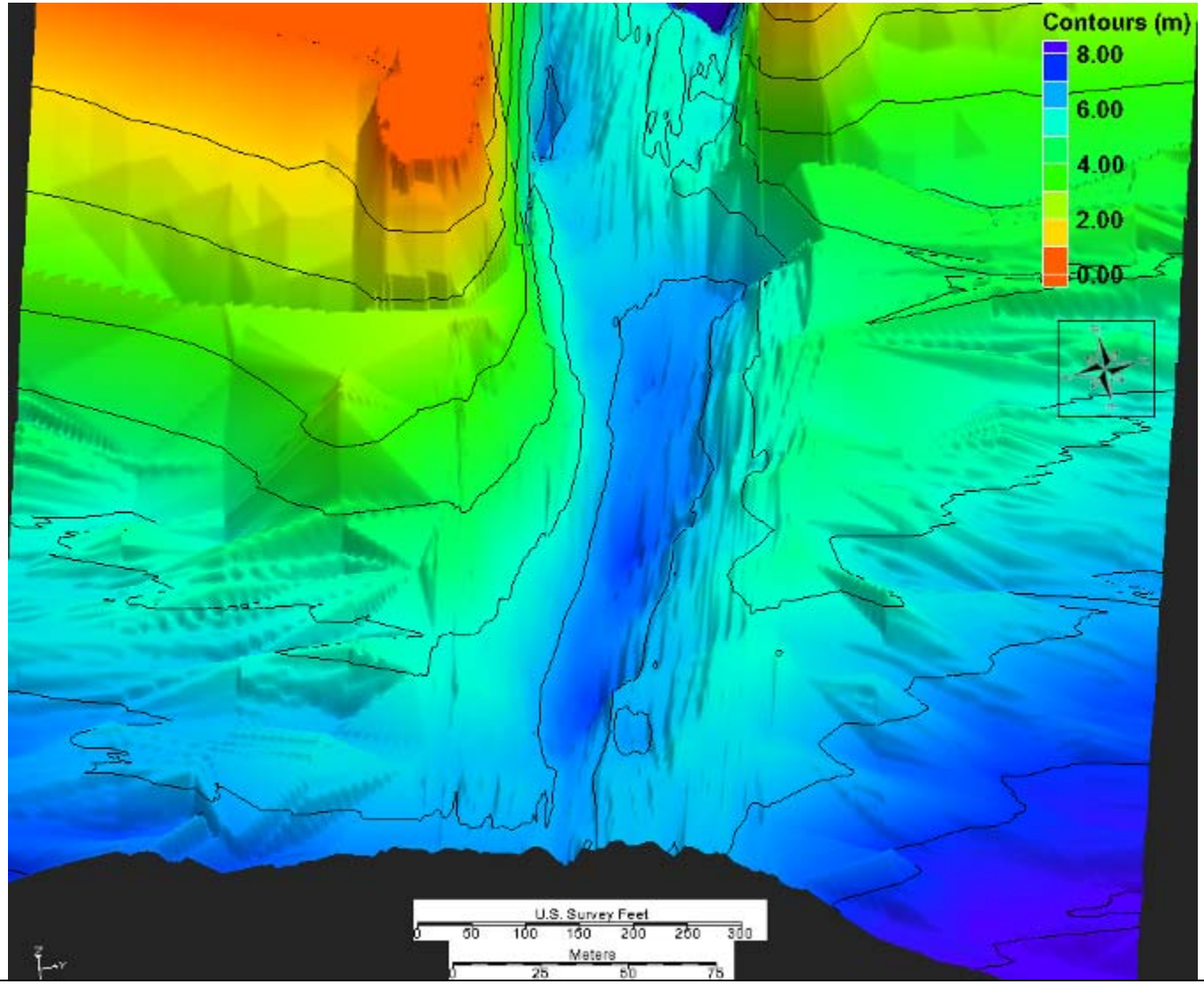
NAN Survey

# January 09 – After Dredging



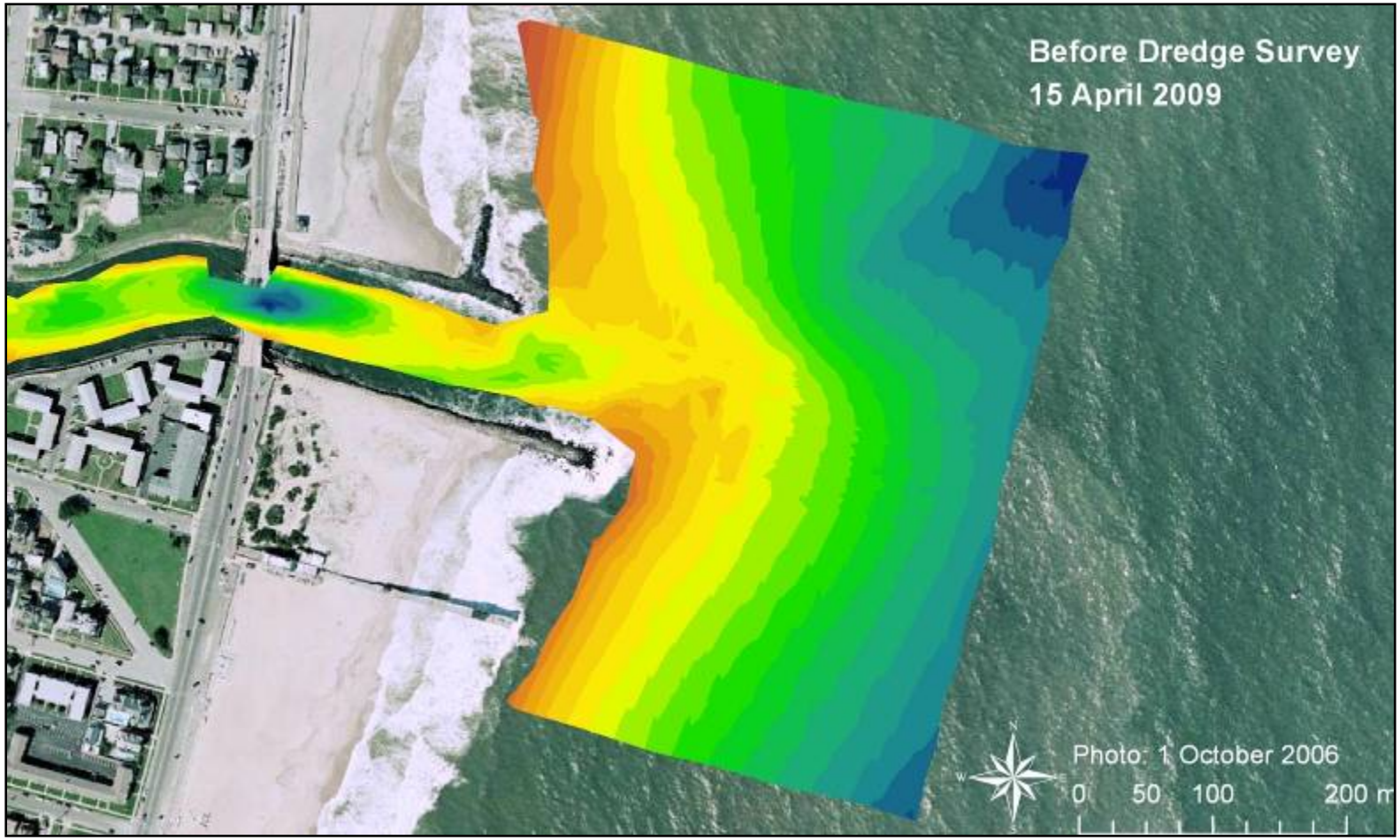

NAN Survey

# May 09 – After Dredging




NAN Survey

# 2008 & 2009

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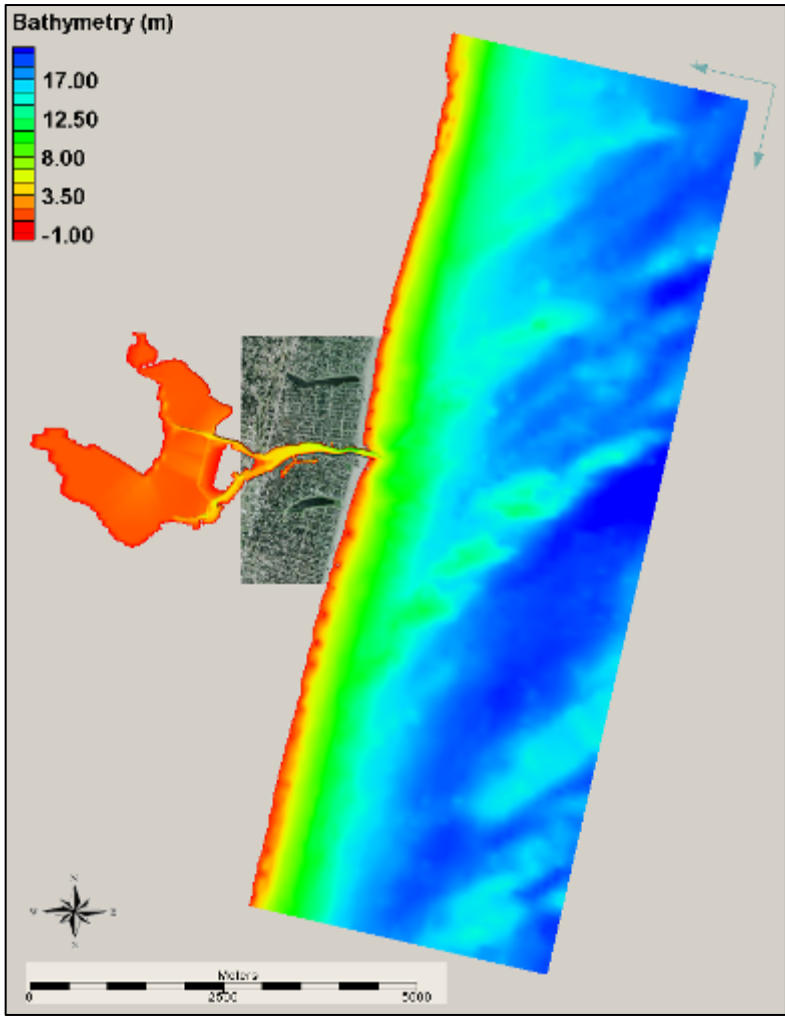
NAN Survey

# Shark River Inlet Simulation

- CMS – Implicit solution
  - Short term to calibrate to dredging data (shorter cycle of 4-6 months)
  - Long term to test several alternatives
    - Generate ebb delta; dredging configuration (widen channel); jetty-tip shoaling under dominant wave direction
- Sediment Transport Parameters
  - Sediment Grain Size ($D_{50}$) – 0.20 to 0.30 mm
    - Variable $D_{50}$
    - Choose 0.26 for constant grain size (Kraus and Gravens, 1988)
  - Transport Coefficients – 1.0 (goal)
  - Constant Total Load Adaptation Length Method
  - Total Load Adaptation Length
    - Tested several lengths
    - 1 m best represented morphology change

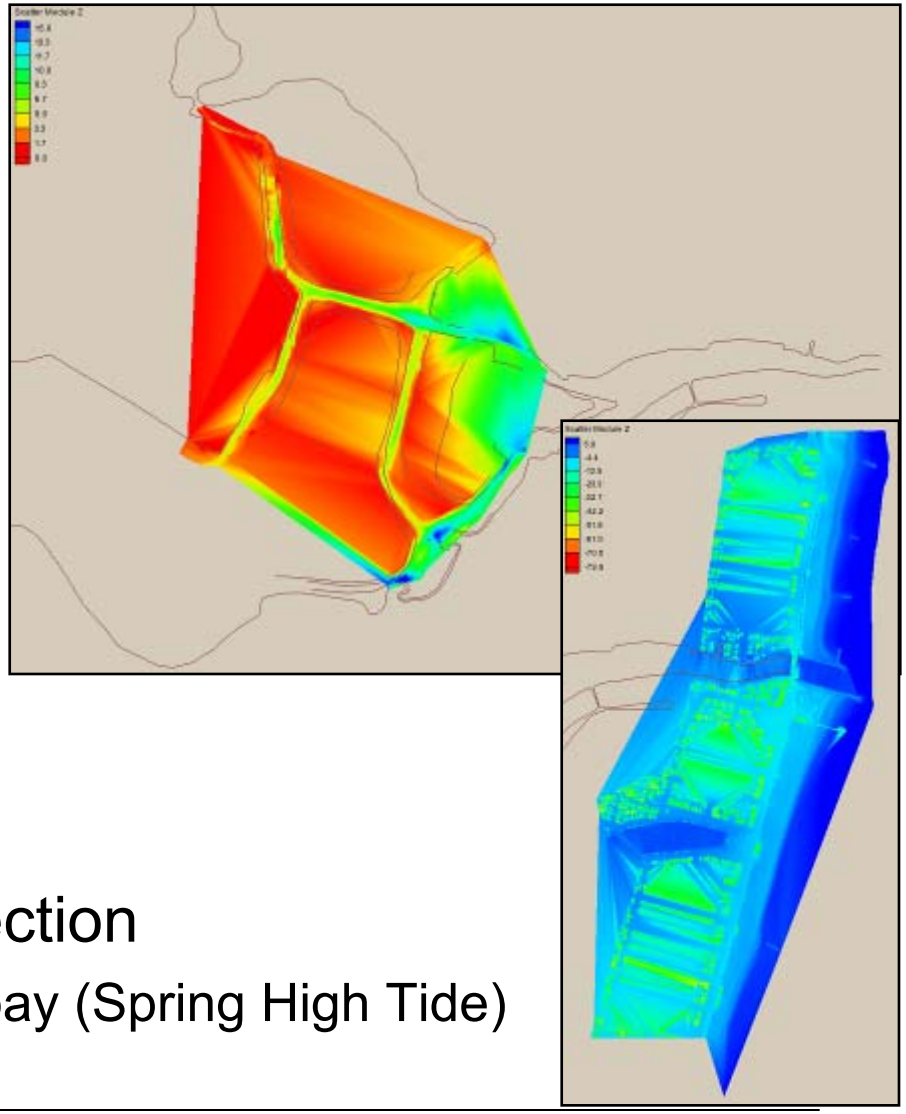
# Defining the Modeling Domain

- Small estuary
- Channels accurately represented
  - At least 10-15 cells across inlet
- Cover at least 1-2 km of coastline
  - Resolve groin “circulation cells”
  - Lateral boundaries at relatively unstructured stretch
- Ocean boundary
  - 3 or 4 times the ebb jet distance
  - Resolve the shallow transverse shoals; not too shallow on the edge



# Bathymetric Datasets

- Limited bay bathymetry
- NOAA – Offshore datasets
- LIDAR – Shoreline and nearshore (important for structure resolution)
- Channel
  - NJ State maintains north channel and north bay channel
  - Federally maintained entrance and south channel (15 years)
- NAN-supported field data collection
  - Included bathymetry of the backbay (Spring High Tide)



# Different Channel Configurations

- 15 Year Record of Bathymetry

| Date | Survey Type | Date | Survey Type |
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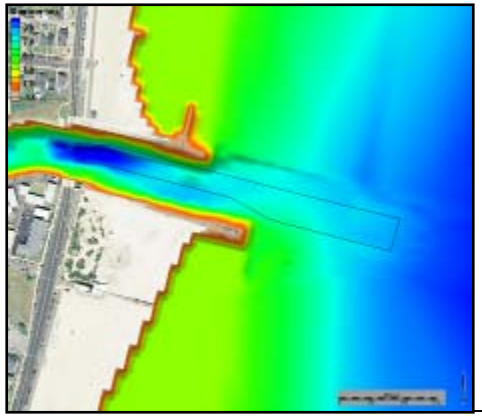
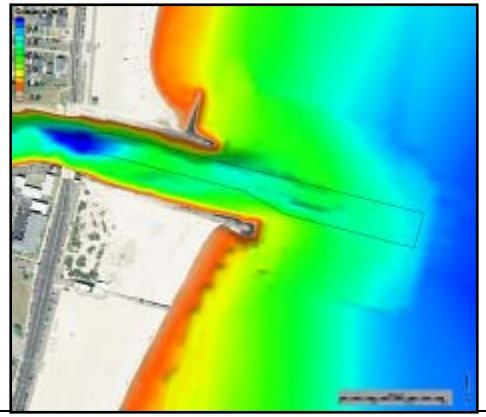
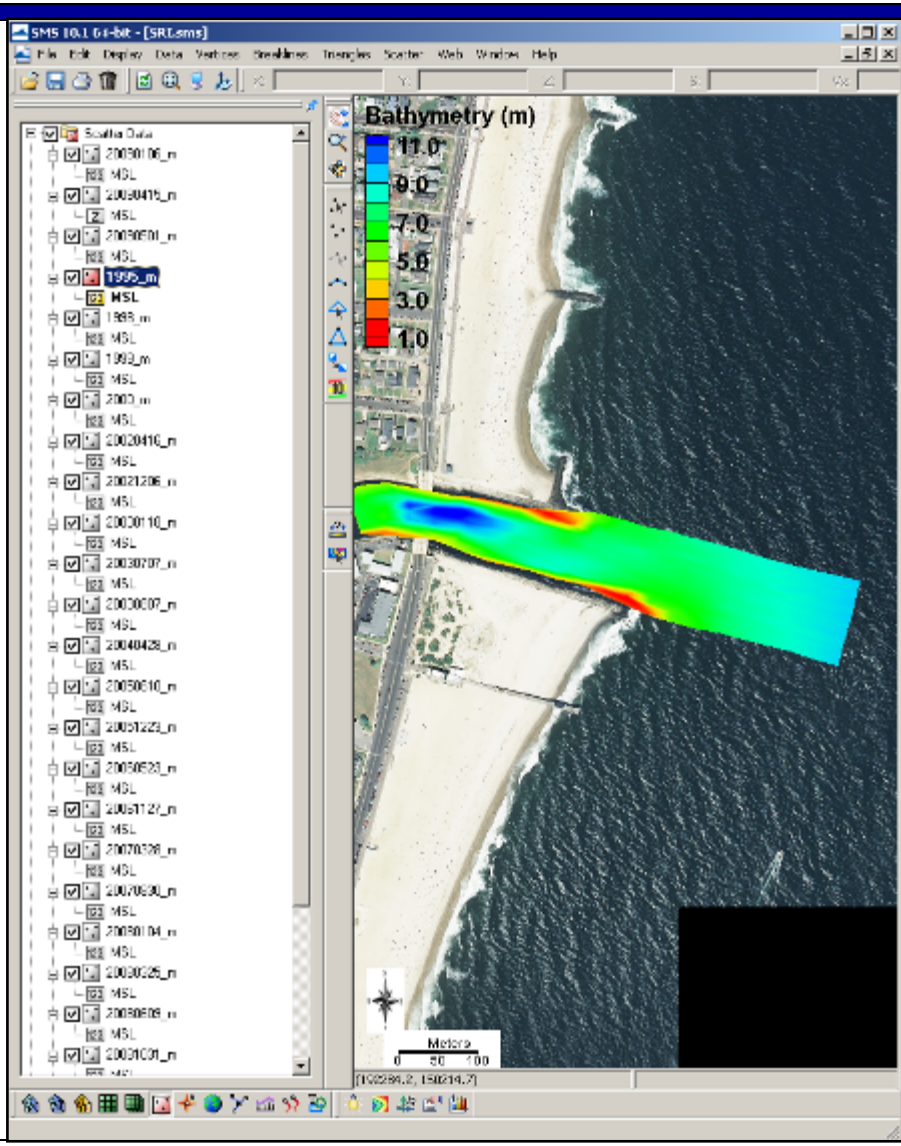
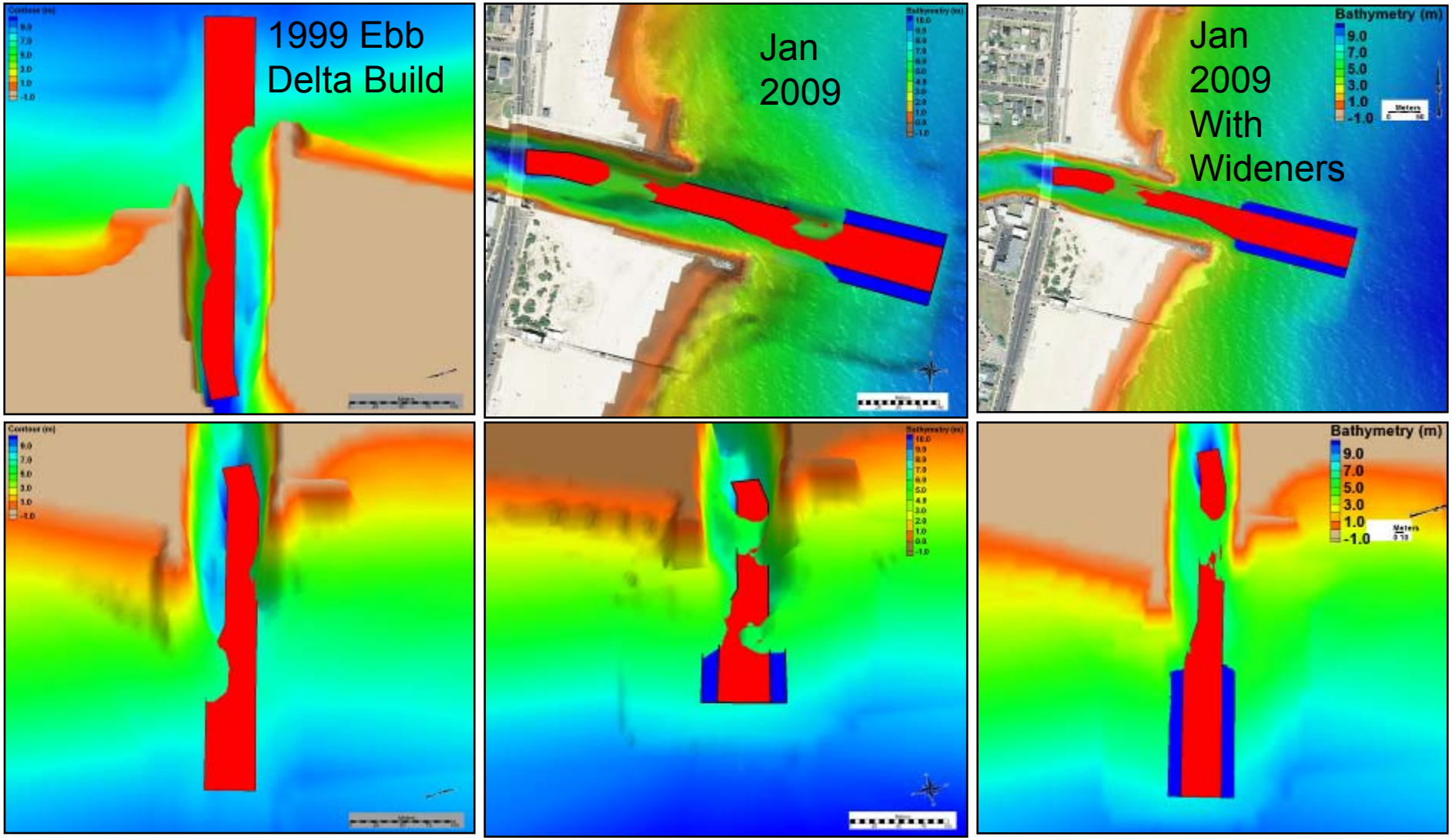


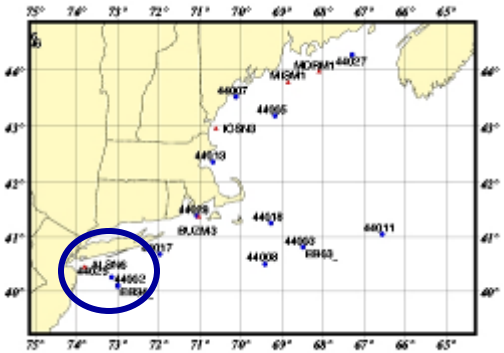




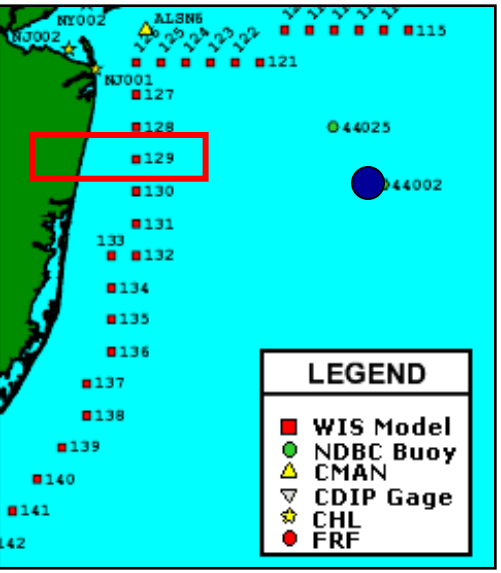
# Selected Alternatives

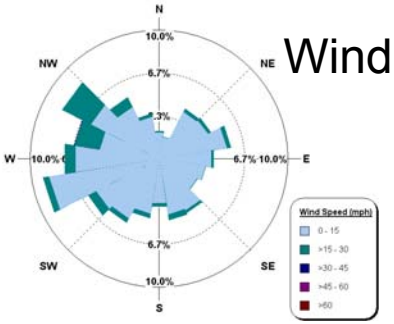


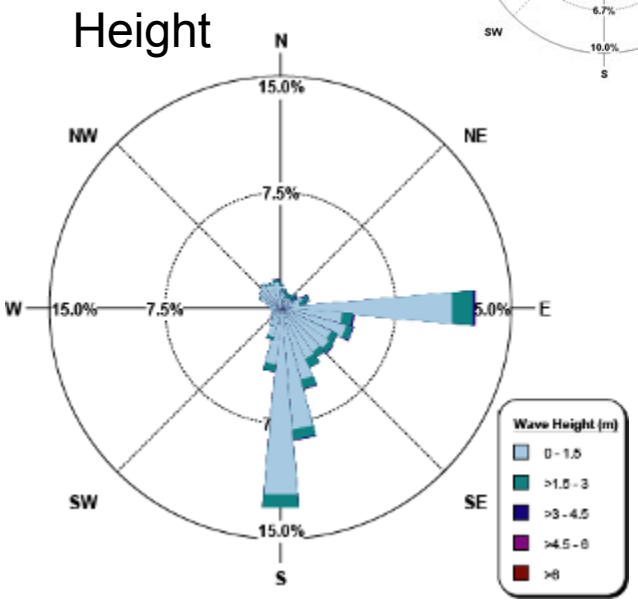
# Waves

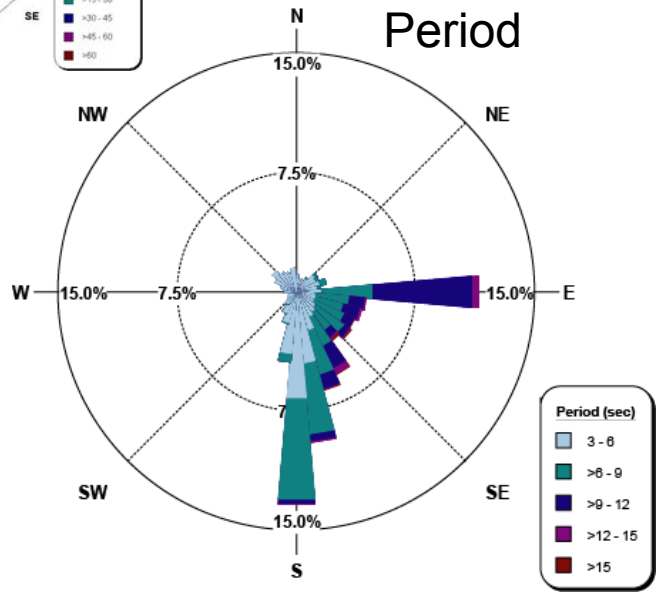


- NOAA Buoy
- Wave Information Study (WIS)

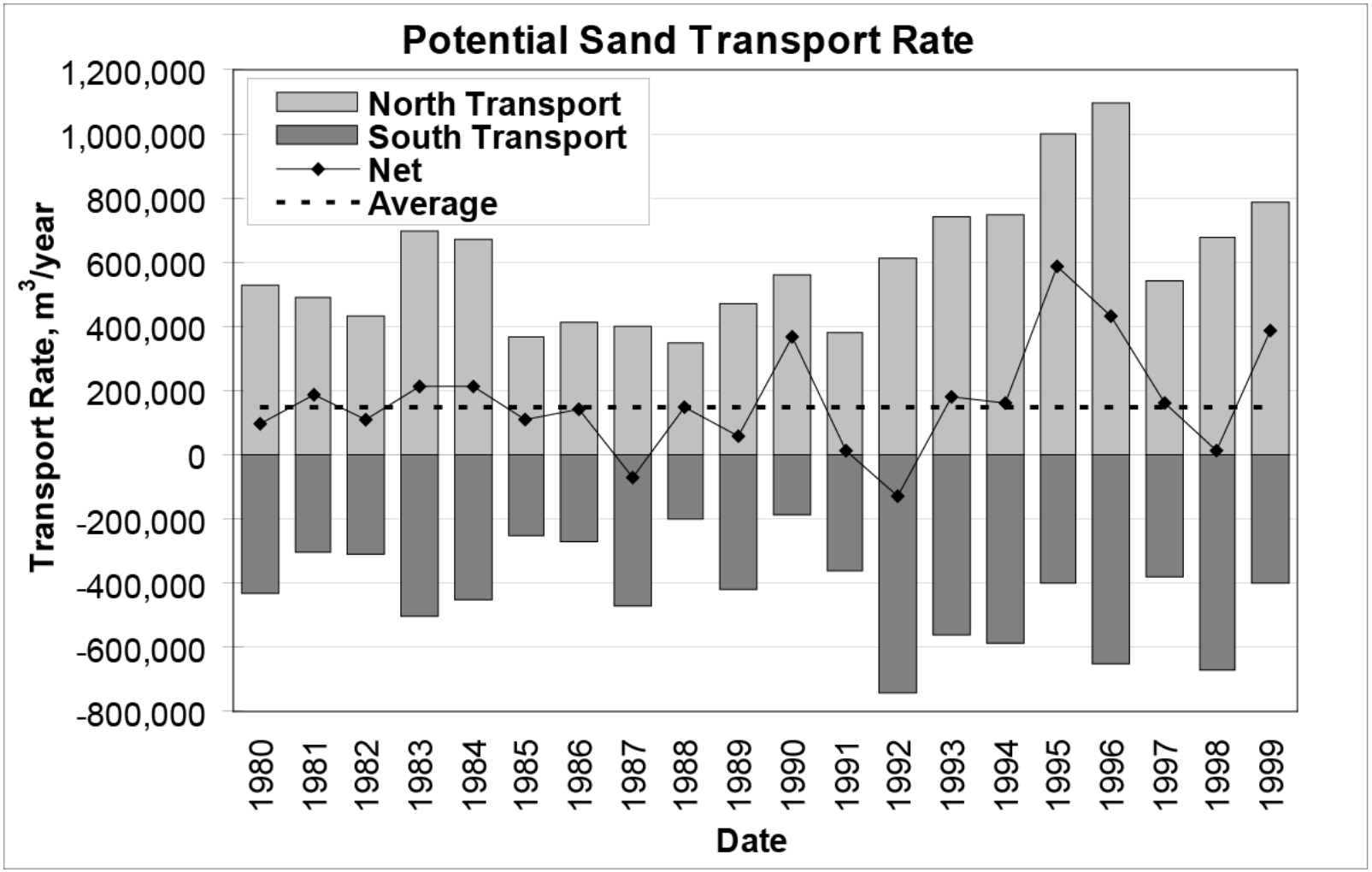


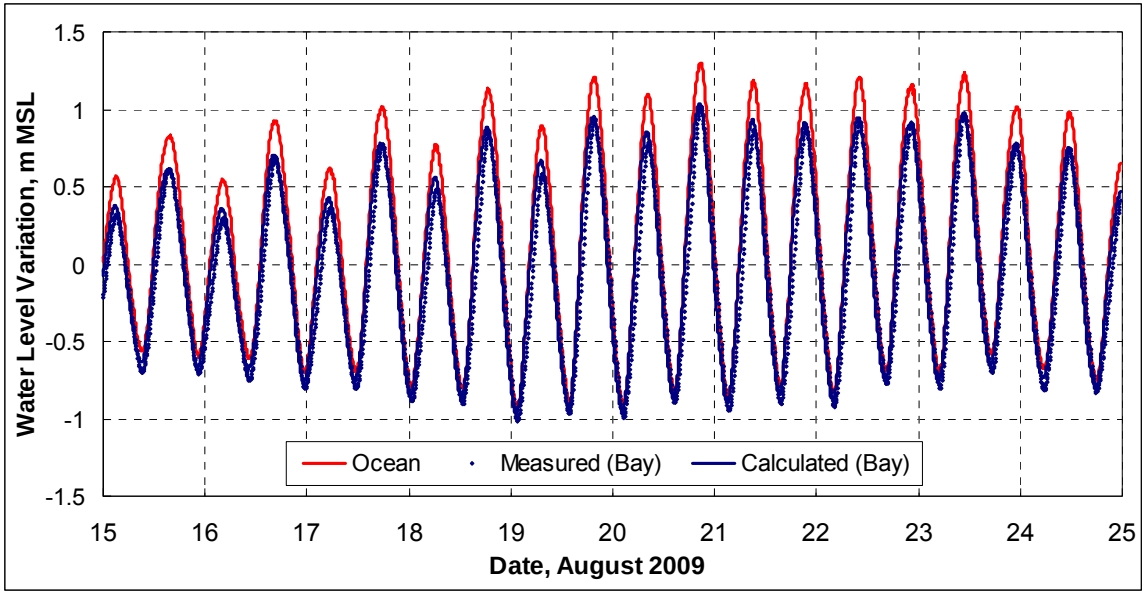



# Sediment Transport (WIS Waves)



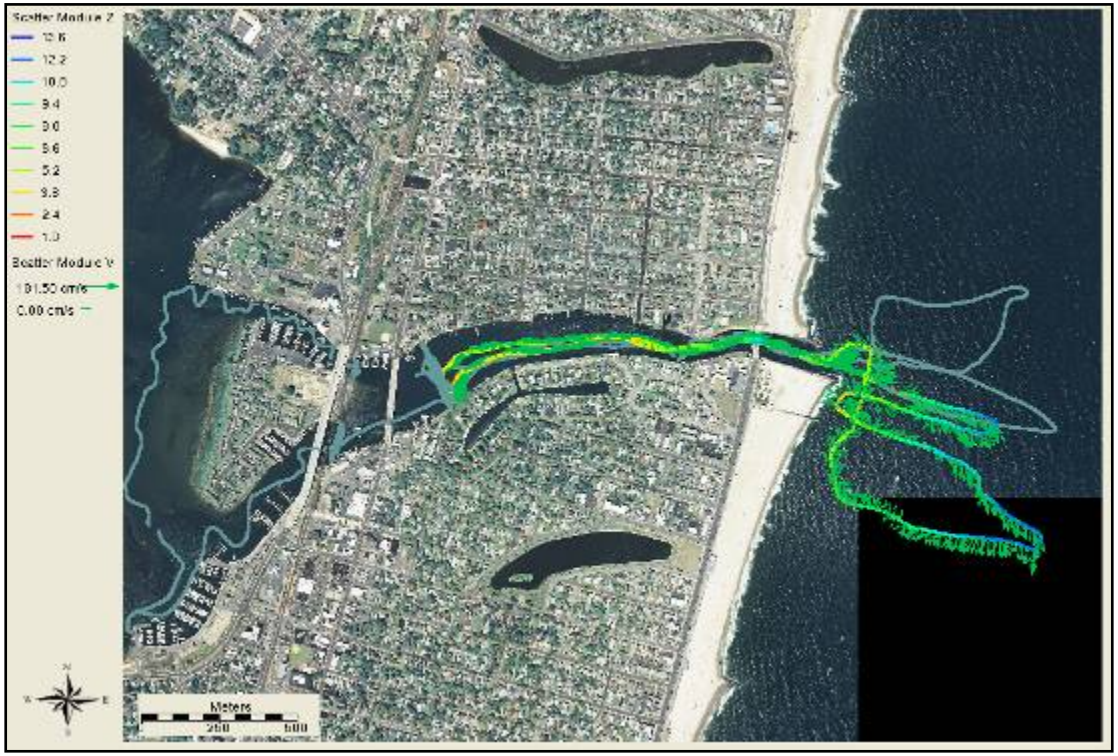
# Tide

- Forcing data from Sandy Hook gauge
  - Ocean gauge (located on pier)
- Belmar tide gauge (bay)
  - Tidal benchmark
  - Field measurements set to this gauge



# Field Measurements

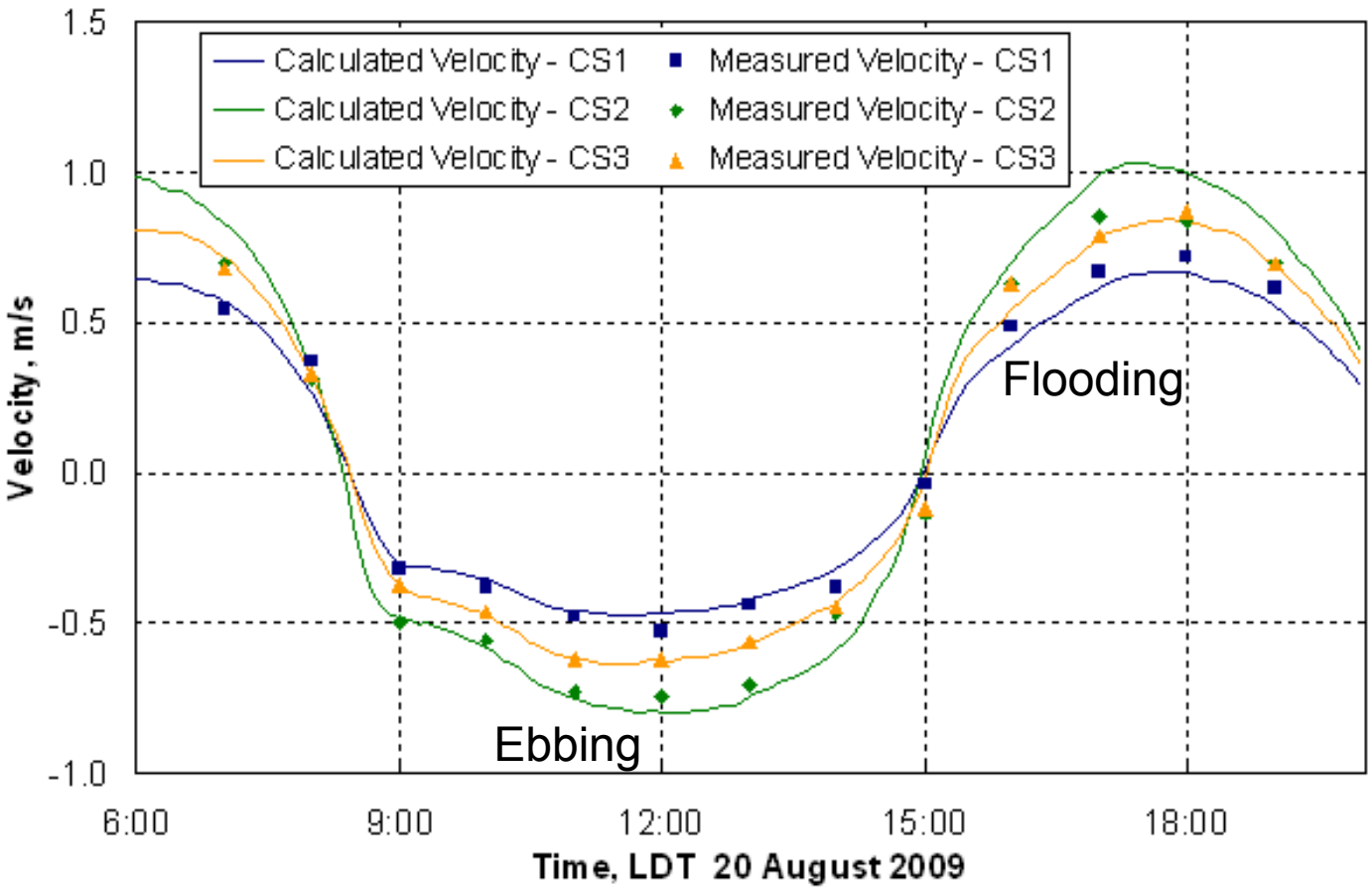
- Down-looking ADCP Measurements (20 August 2009)
  - Cross-sections – 3 locations per hour

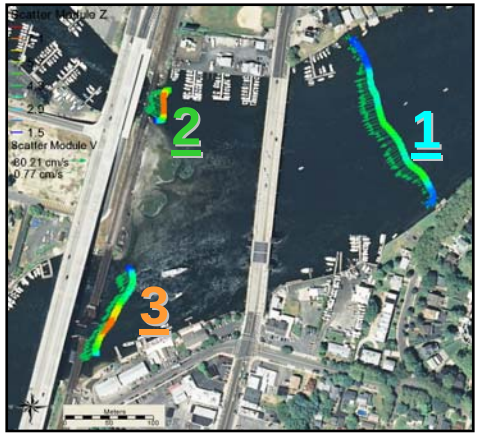



Flooding Tide

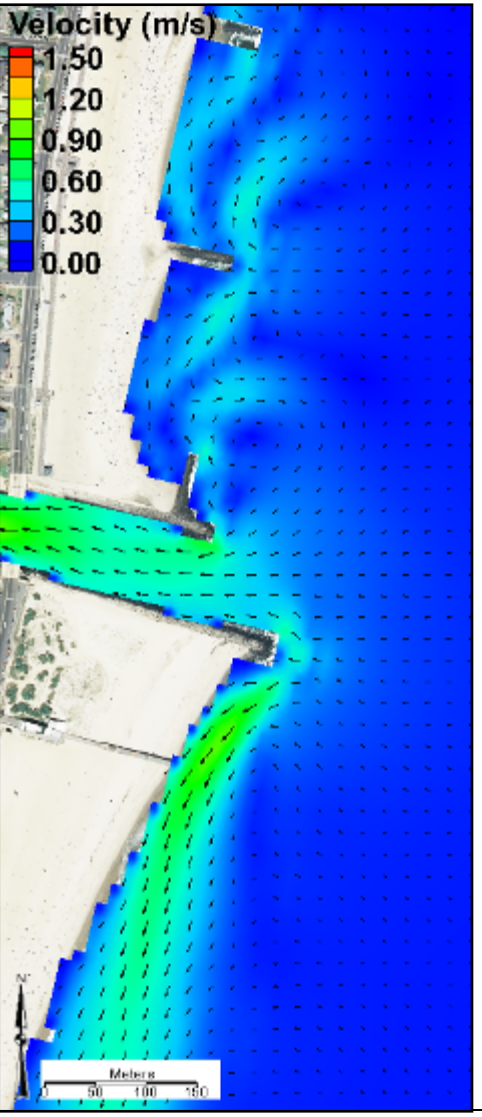
Ebbing Tide

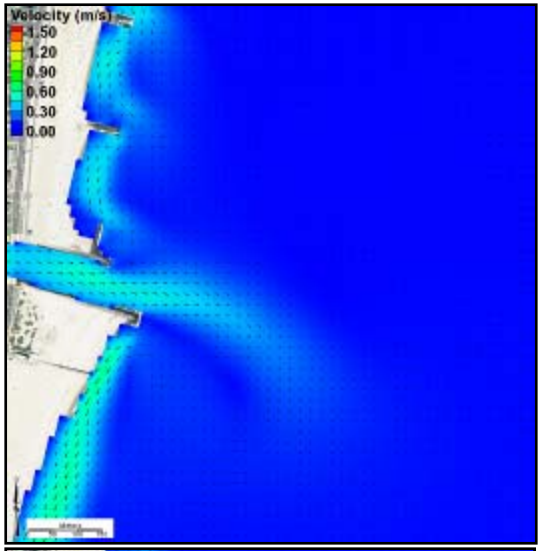
# Current Velocity

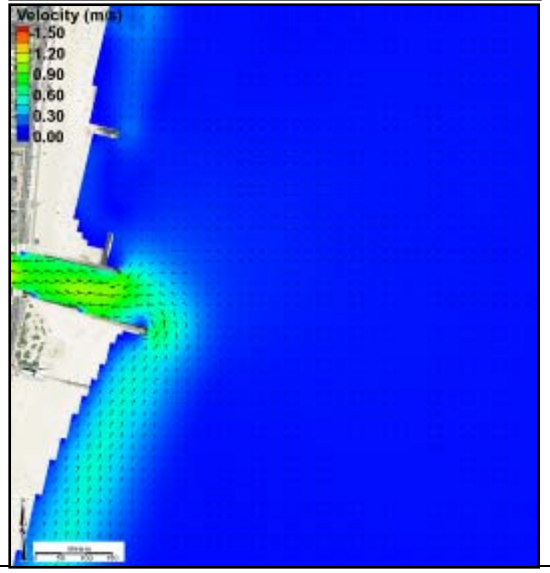


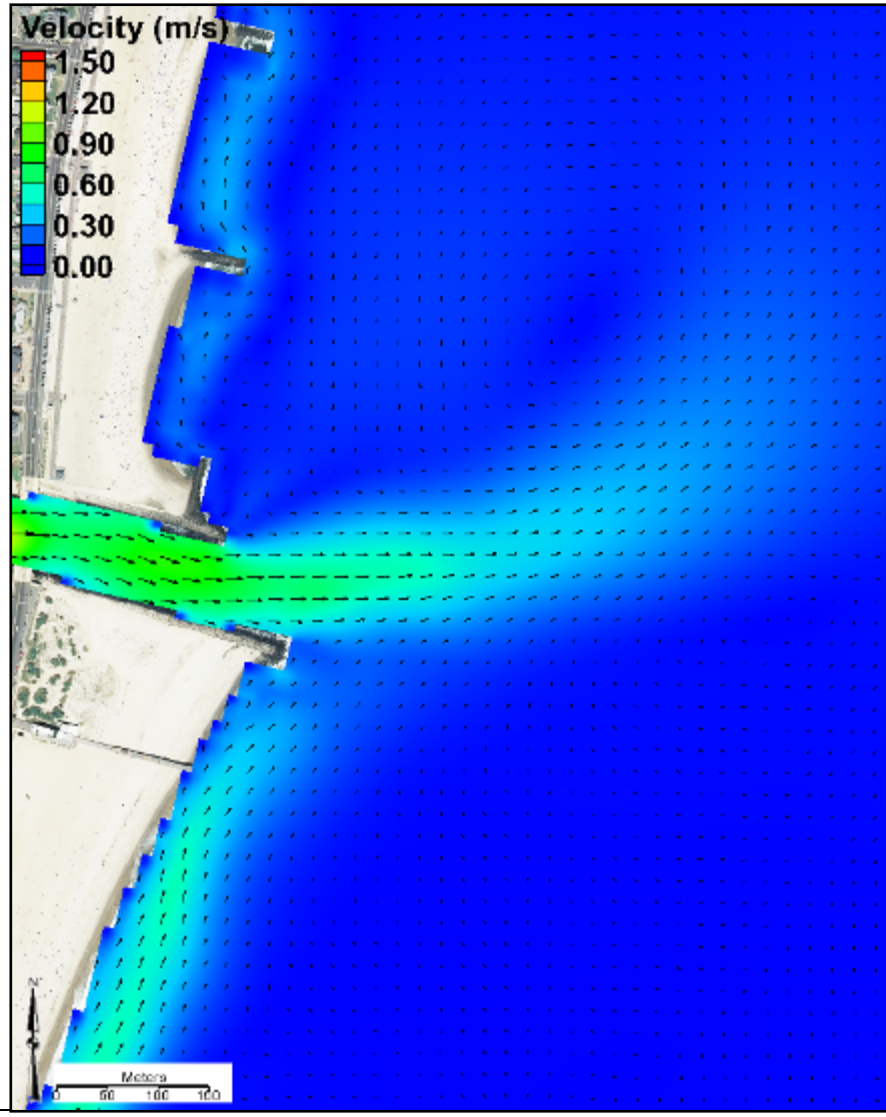



# CMS – Calculated Channel & Longshore Current

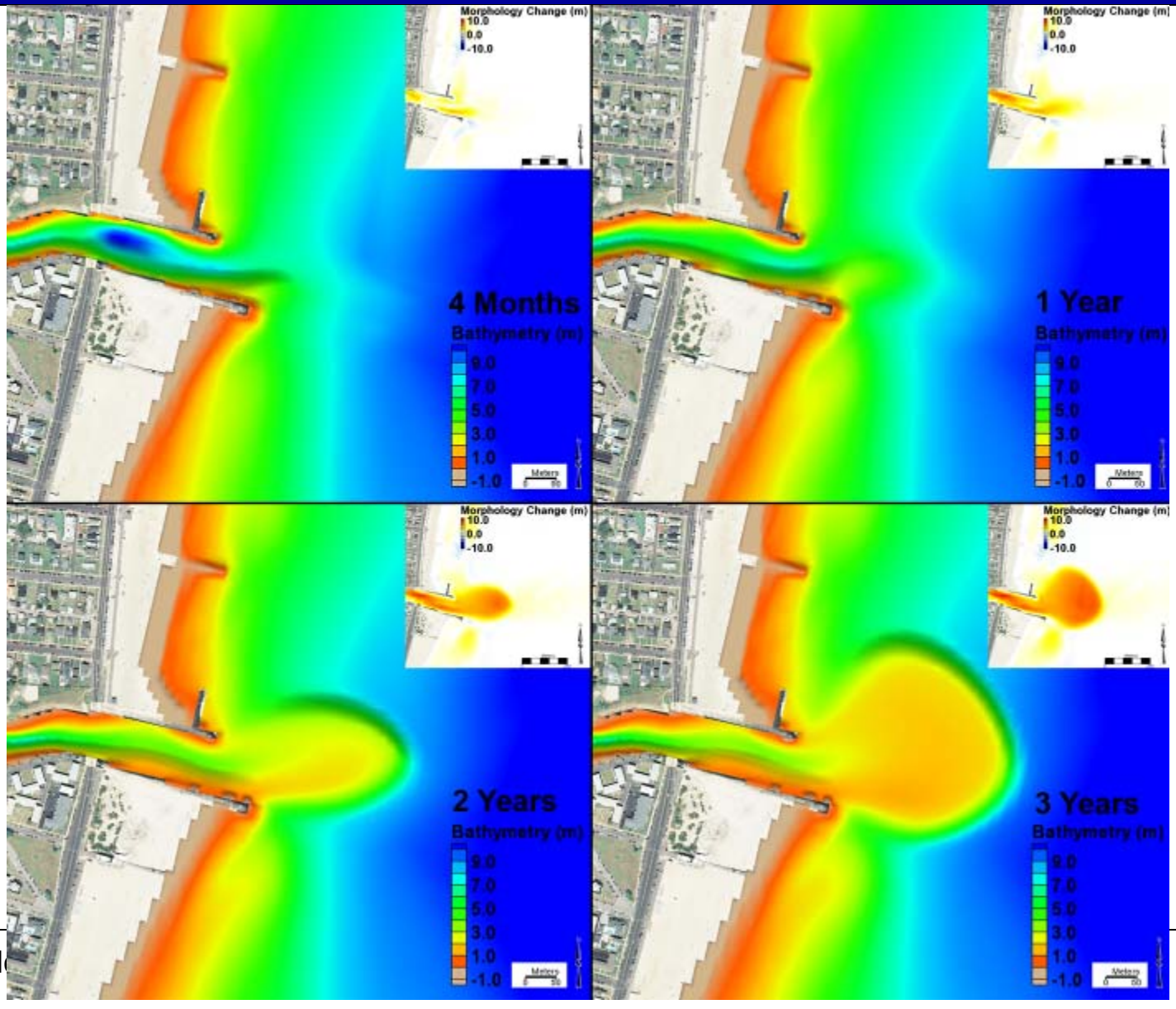


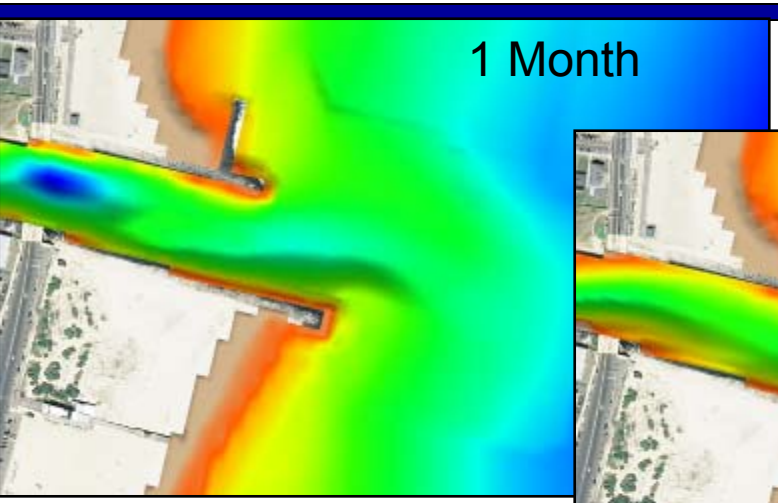



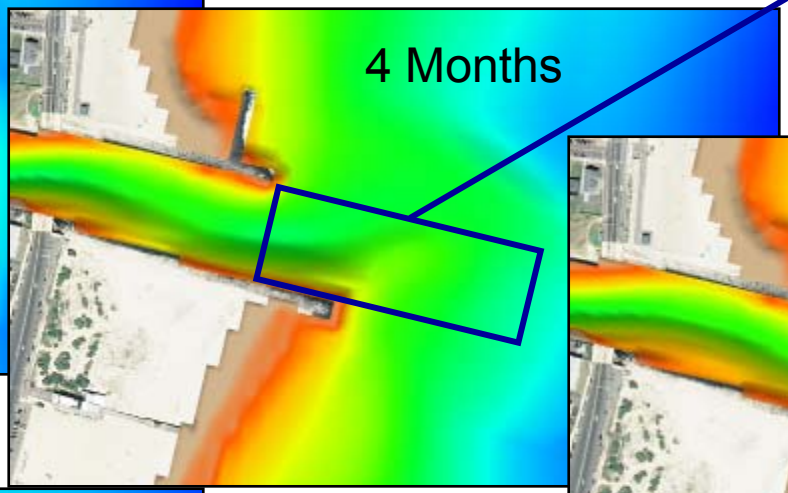



# Predicted Ebb Tidal Delta (3 years)

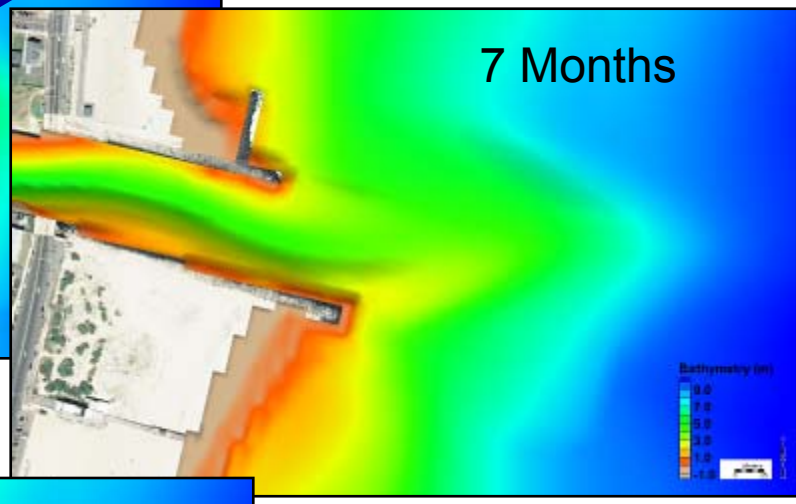


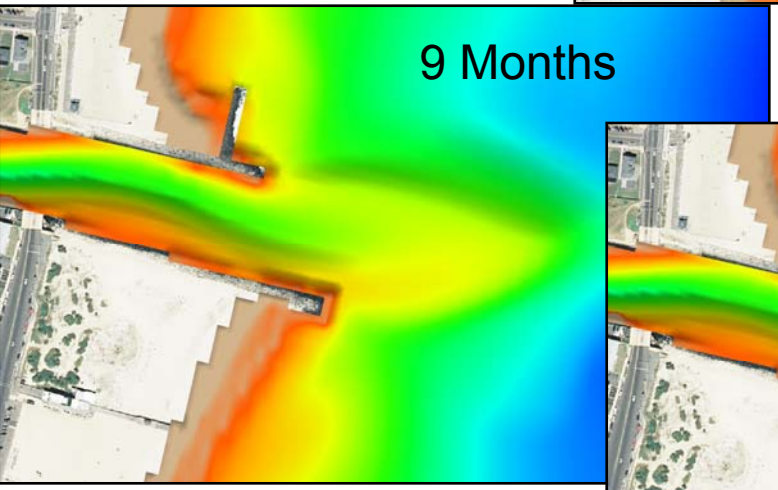
# Jan 09 Post-Dredge (no widener)

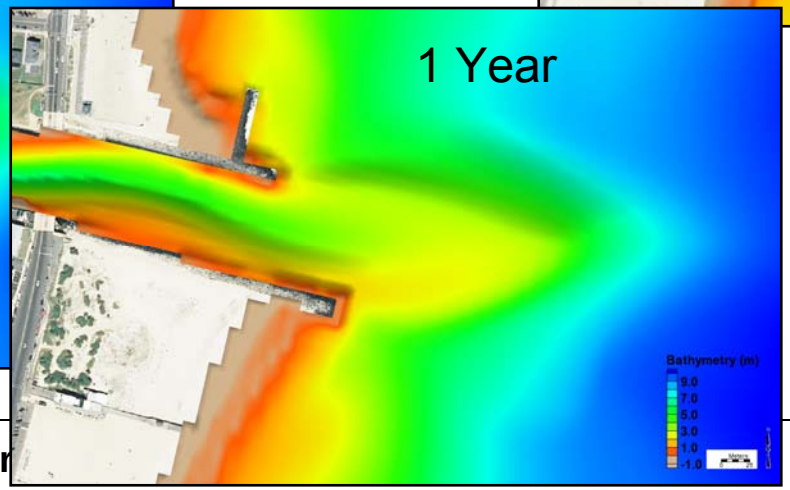


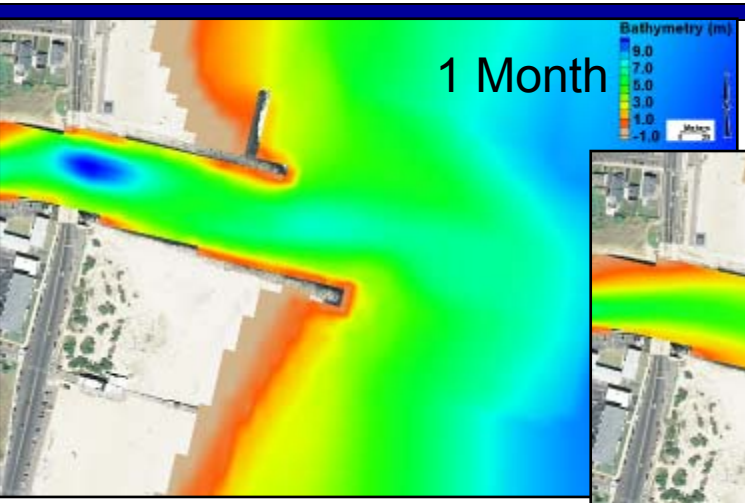

**Consistent with volume removed during the next dredging (~10k m³)**

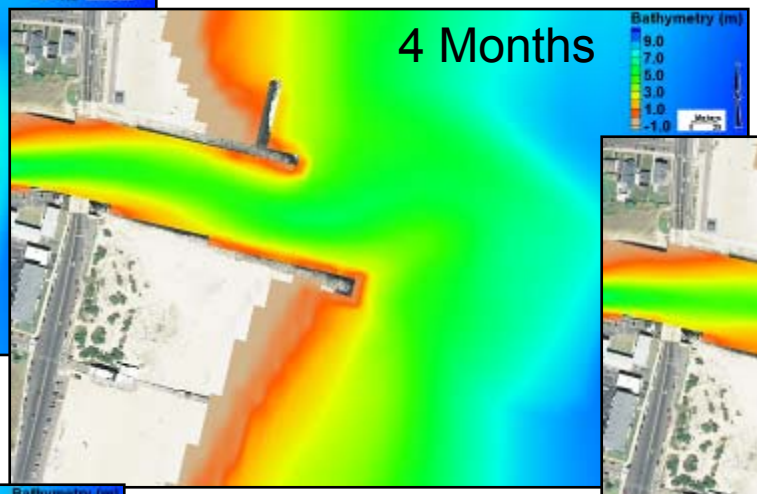


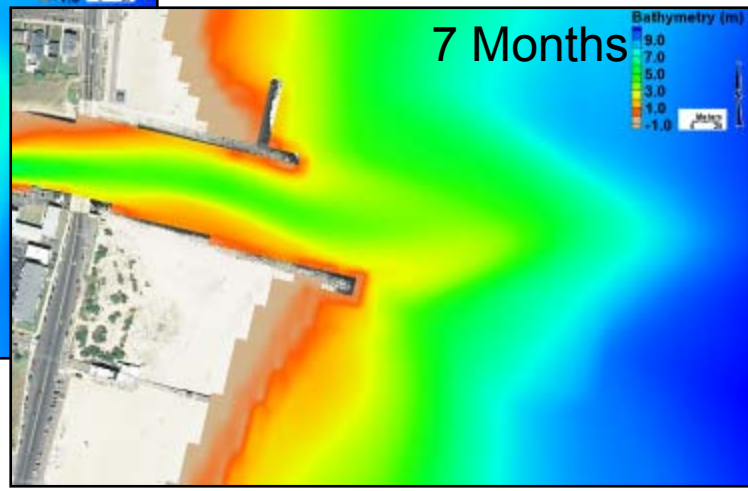



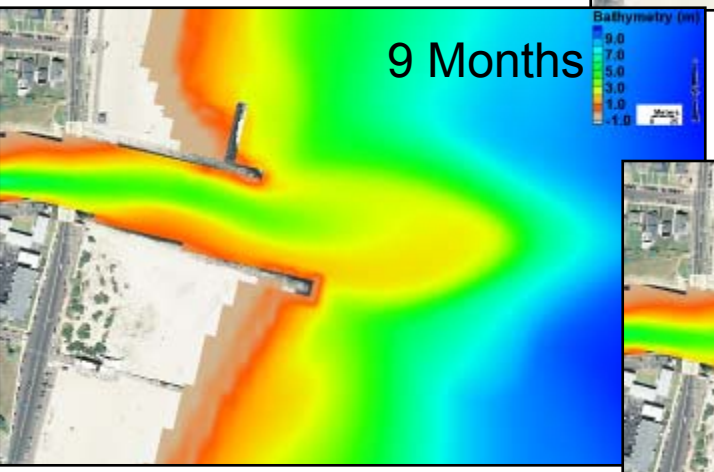



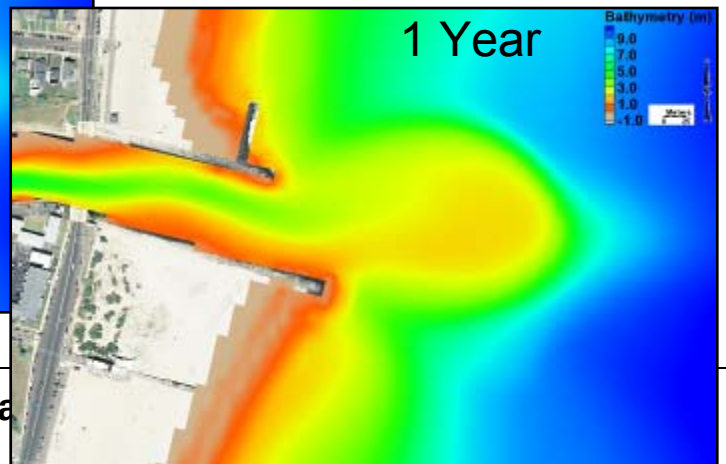
# Jan 09 Post-Dredge (with widener)



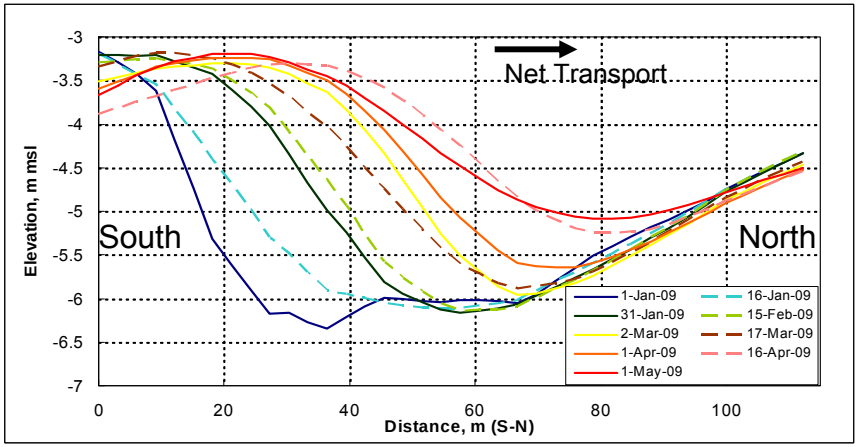



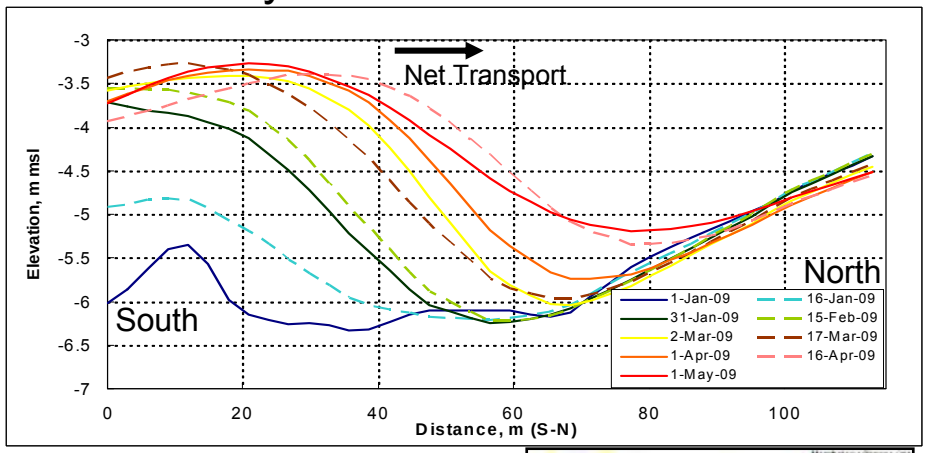



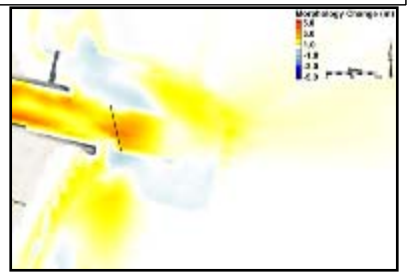
# Channel Infilling

## January 09 – Post Dredging

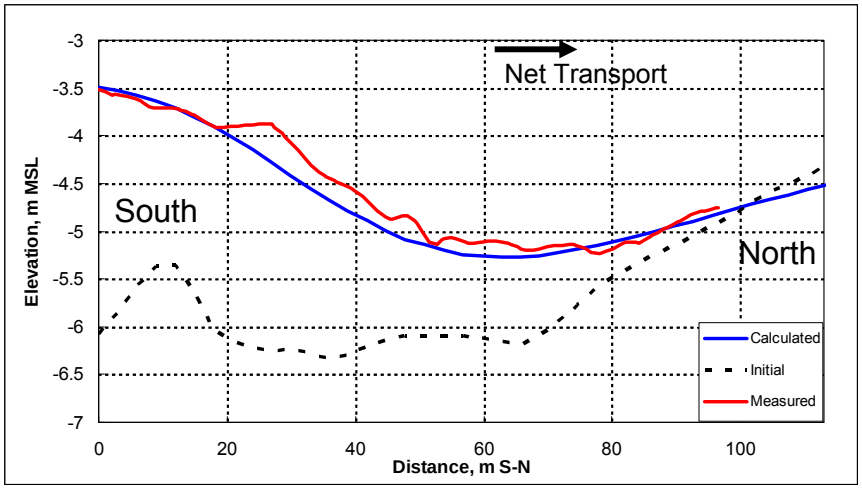



## January 09 – Widened Channel



## Results of 4 months of simulation



# Summary

- CMS calculations of circulation patterns and magnitudes agree with measurements
- Morphology change agrees with expected trends
  - Jetty tip shoals; ebb delta shape (wave-dominated, Atlantic coast type); dominant shoaling along the south jetty
- Short-term simulations calculate sedimentation volume within order of magnitude (uncertainty in wave input)
- NET captured channel infilling and development of shallow south jetty tip shoal
- 1-year simulation takes 30 hrs to complete on a PC
- Next steps:
  - Engineering options (jetty extension, orientation change)
  - Nourishment impact
  - Long-term (decade) calculations