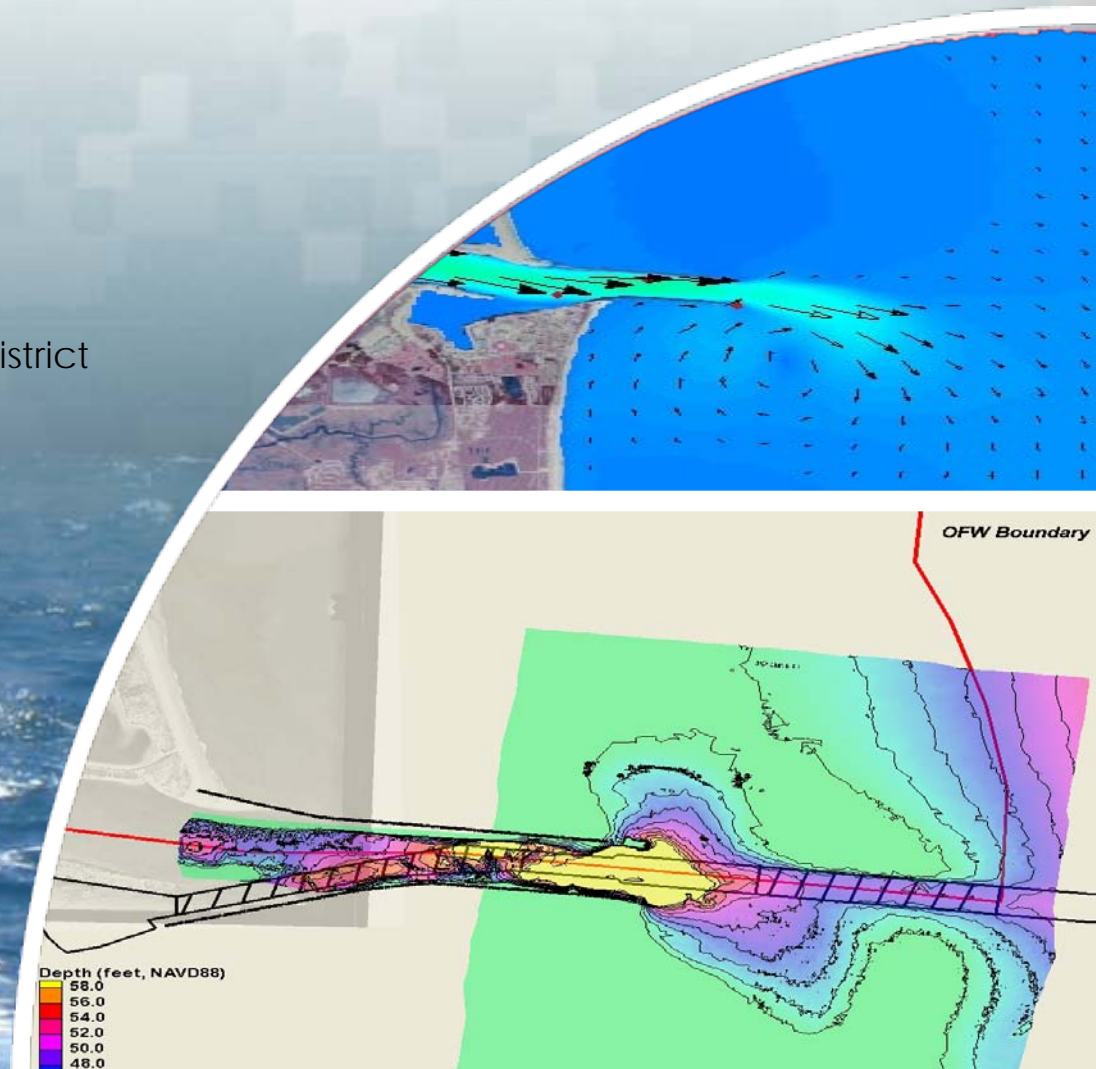# Regional Sediment Management – Application of a Coastal Model at the St. Johns River Entrance
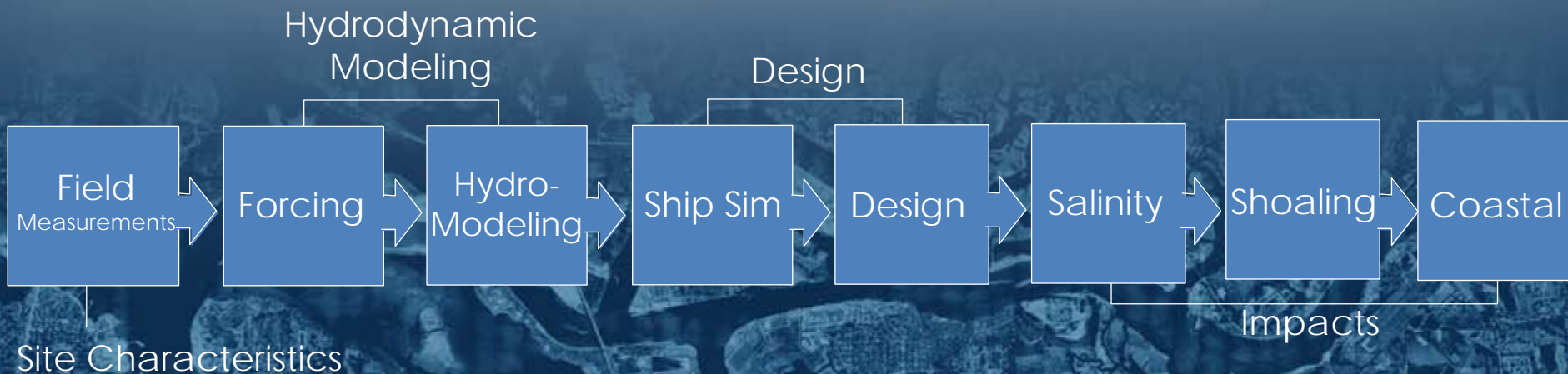
Steven Bratos
Senior Coastal Engineer

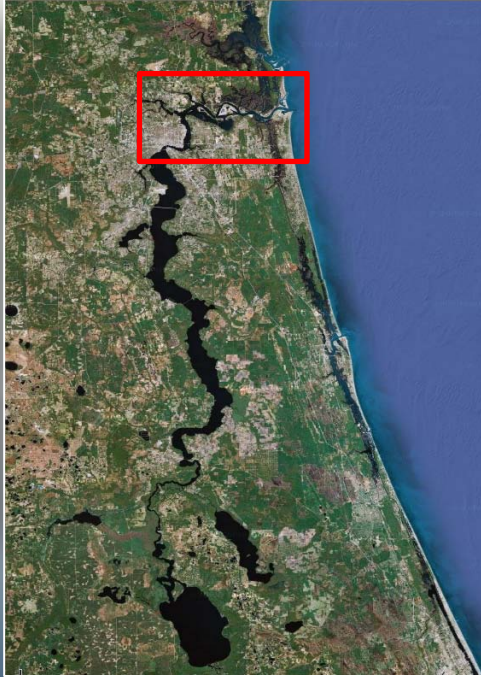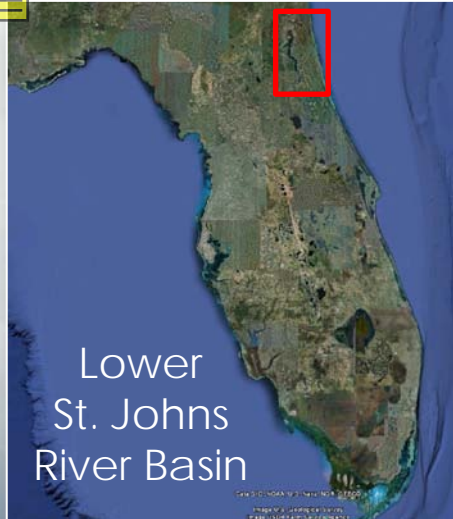U.S. Army Corps of Engineers – Jacksonville District

February 11, 2011

Depth (feet, NAVD88)
- 58.0
- 56.0
- 54.0
- 52.0
- 50.0
- 48.0

OFW Boundary

Presentation Outline

- Jacksonville Harbor Project Background
- Project vs Regional View
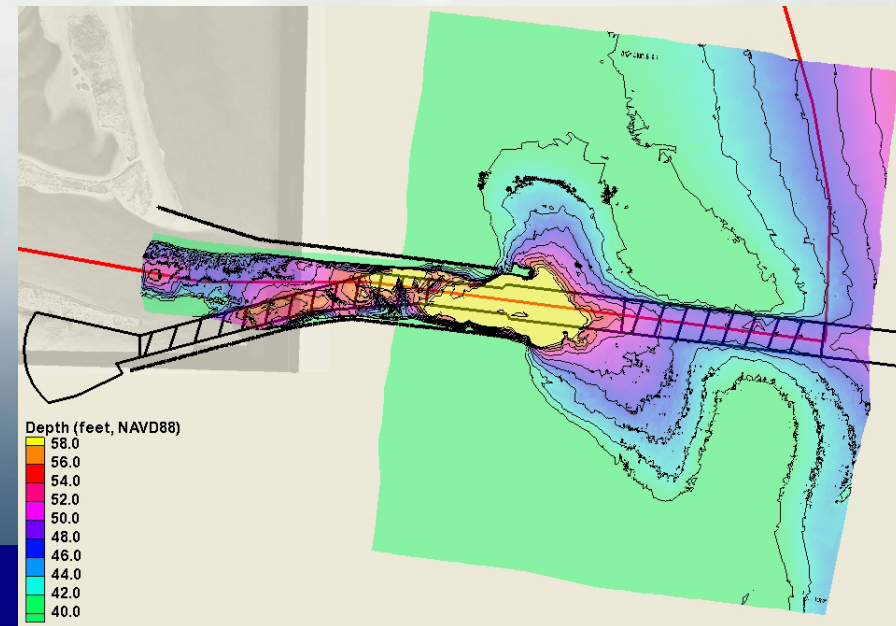- Coastal System Approach
- Summary & Conclusion

Hydrodynamic
Modeling

Design

Field Measurements → Forcing → Hydro-Modeling → Ship Sim → Design → Salinity → Shoaling → Coastal

Site Characteristics

Impacts

Project Location
Jacksonville Harbor Federal Channel

Lower St. Johns River Basin

BARTRAM ISLAND

BLOUNT ISLAND

BUCK ISLAND

MILE POINT

MAYPORT NAVAL STATION

MILL COVE

Jacksonville Harbor – Mayport NS

- Jacksonville Harbor Seg. 1&2
  (14 mi, 6 mi)

- Existing Project Depth – 40 ft, Proposed between 40 & 50 ft

- Mayport NS – Project Depth 50 ft (under constr)

Depth (feet, NAVD88)
58.0
56.0
54.0
52.0
50.0
48.0
46.0
44.0
42.0
40.0

Segment 2
Segment 3
Segment 1
BARTRAM ISLAND
BLOUNT ISLAND
BUCK ISLAND
MILE POINT
MAYPORT NAVAL STATION
MILL COVE
Mill Cove

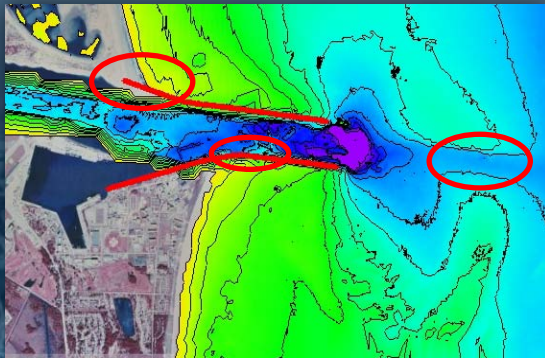JACKSONVILLE HARBOR NAVIGATION STUDY

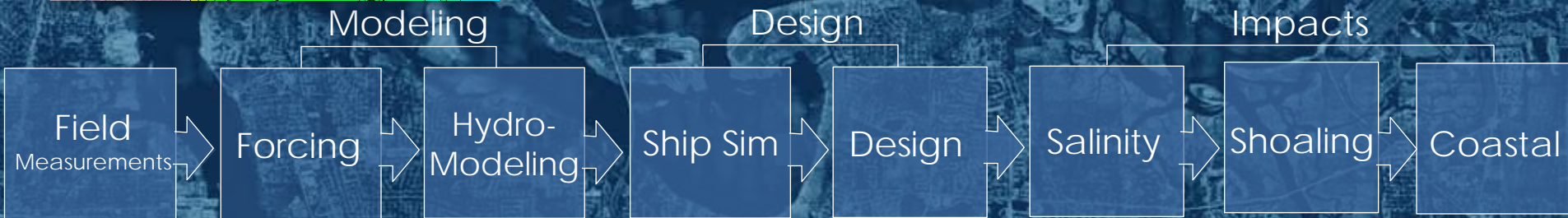# Project & Regional View

PROJECT SCALE

- Channel Shoaling
- Impacts – Adjacent Inlets & Beaches
- Miles
- Years

REGIONAL SCALE

- Manage Sediment per Littoral Processes
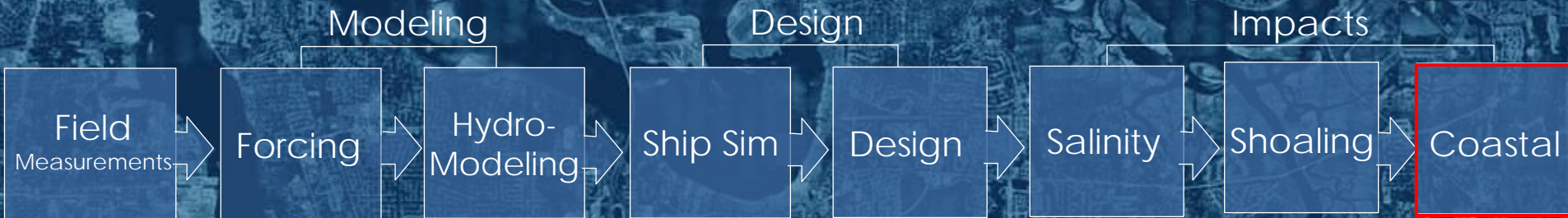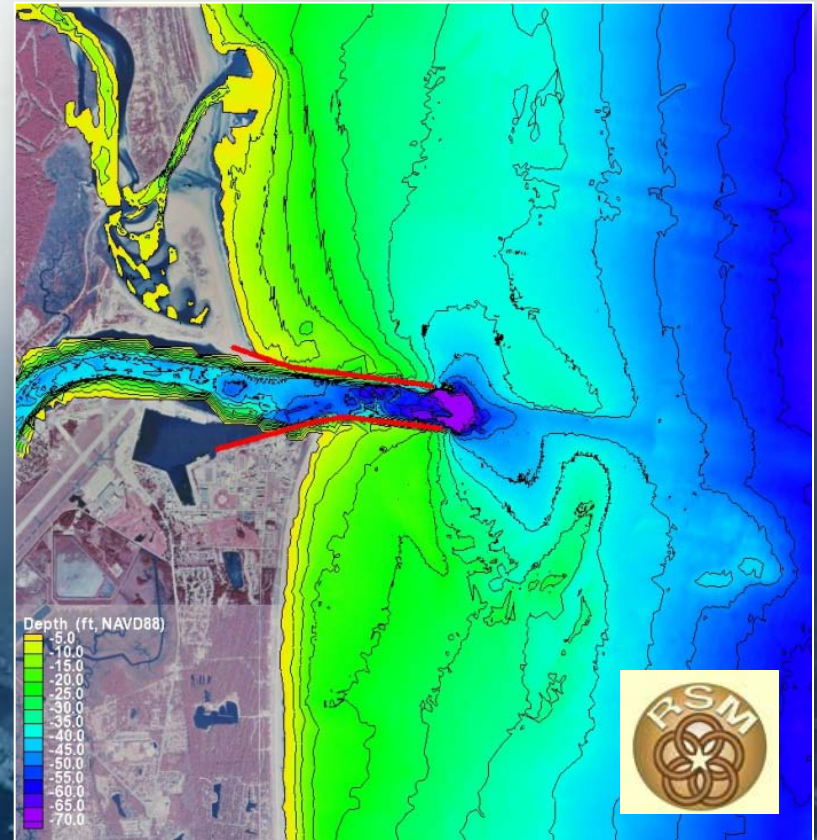- Multi-Project
- 10s of miles
- Decades

Shoaling Rates 10 to 40 KCY/yr

Modeling

Design

Impacts

Field Measurements → Forcing → Hydro-Modeling → Ship Sim → Design → Salinity → Shoaling → Coastal
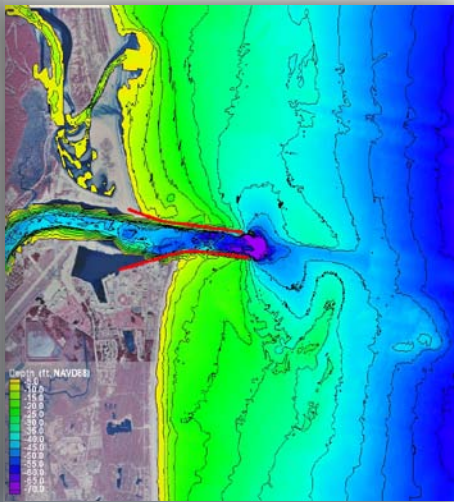
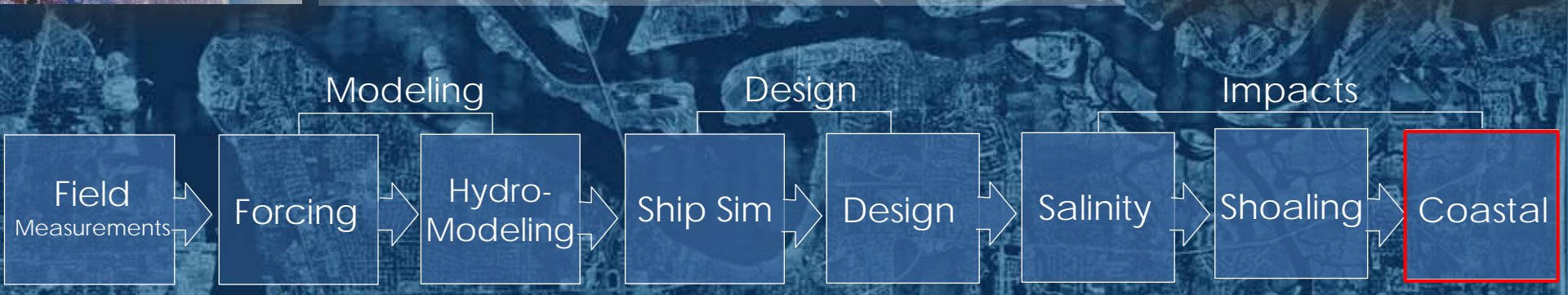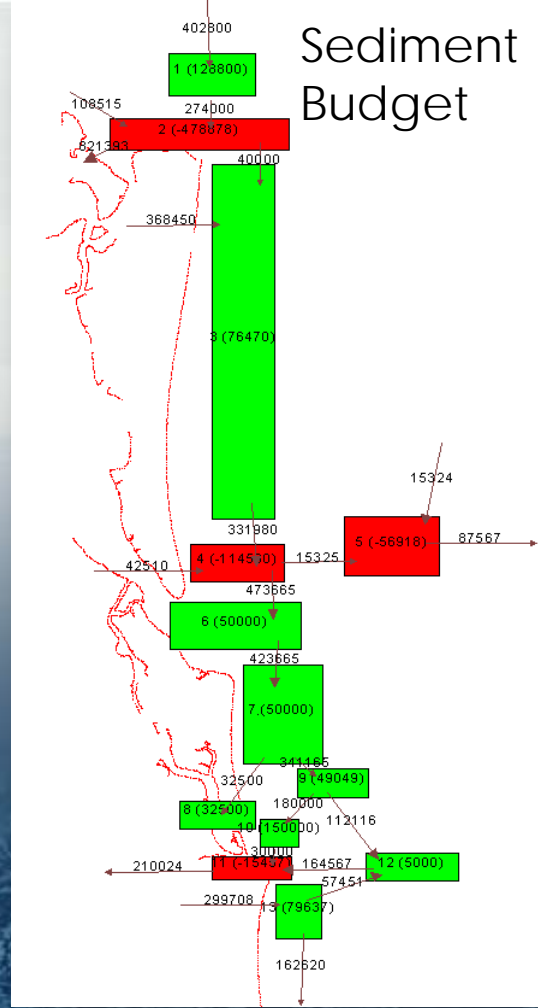# Impacts to the Littoral Zone
Beaches and Inlets

- Regional Sediment Management
- Sediment managed as valuable resource
- Regional – Multi project level
- Understand existing condition
- Inlet and adjacent beach morphology
- Regional effects of project modification

  - Sediment transport modeling
    - Deposition/erosion

Depth (ft, NAVD88)
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
-40.0
-45.0
-50.0
-55.0
-60.0
-65.0
-70.0

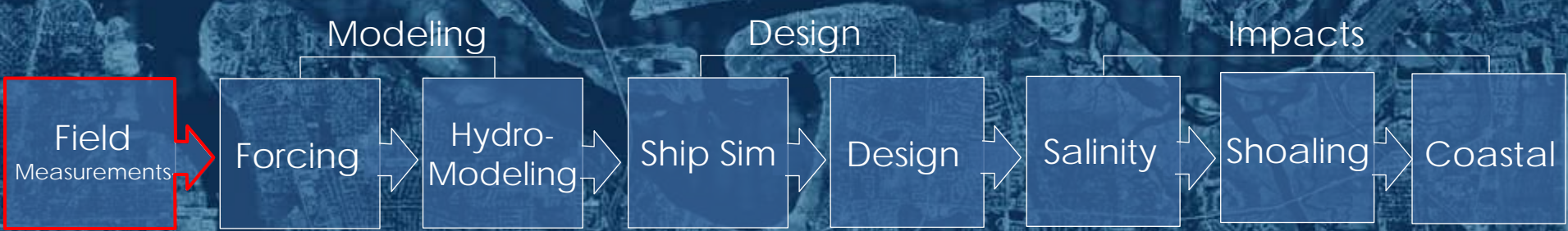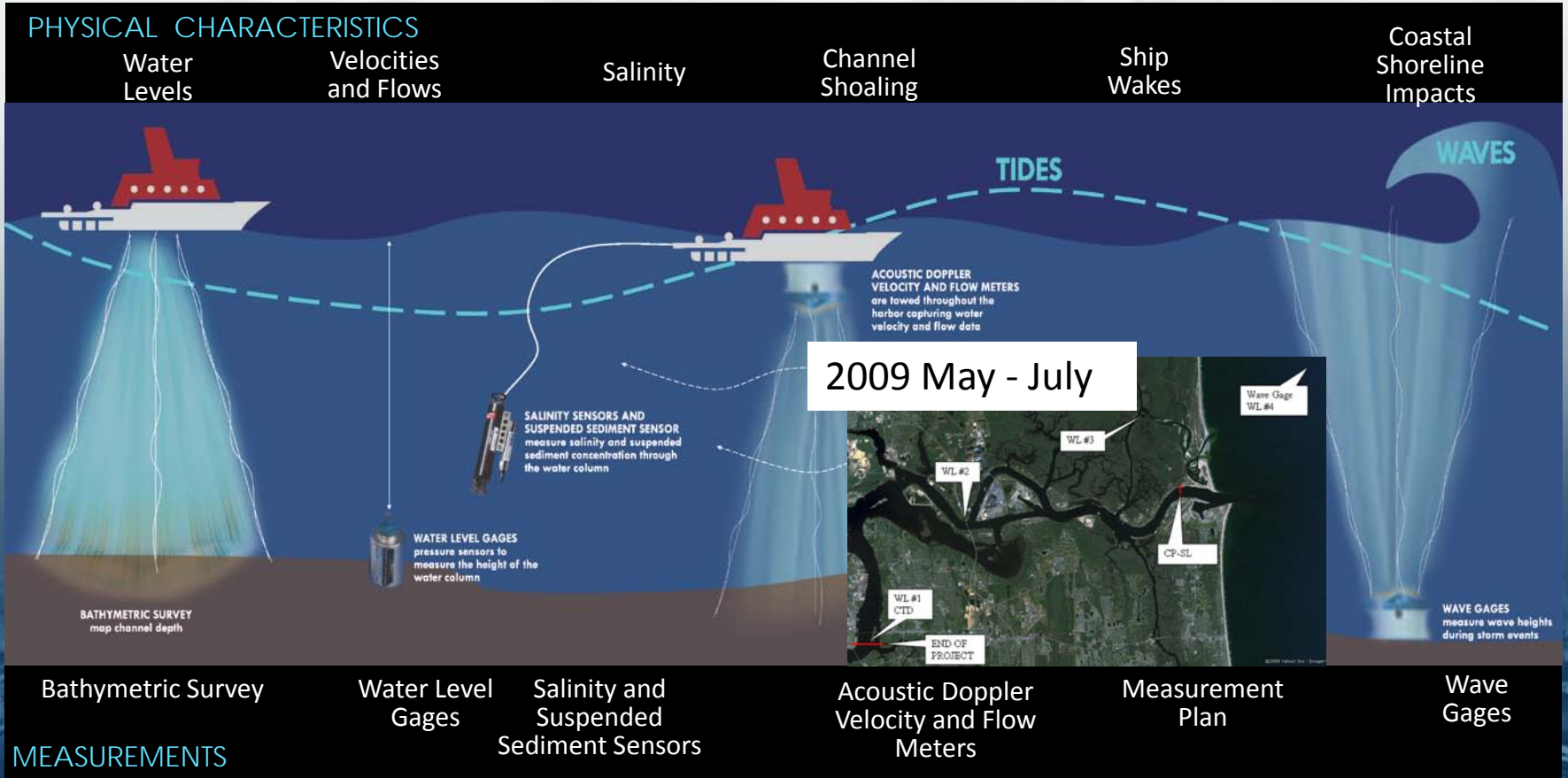| Modeling			Design			Impacts		
Field Measurements	Forcing	Hydro-Modeling	Ship Sim	Design	Salinity	Shoaling	Coastal	

Regional Sediment Management

- Mining Ft. George Flood Shoal and Wards Bank
- Improve Ft. George River Flow
- Back pass to Little Talbot
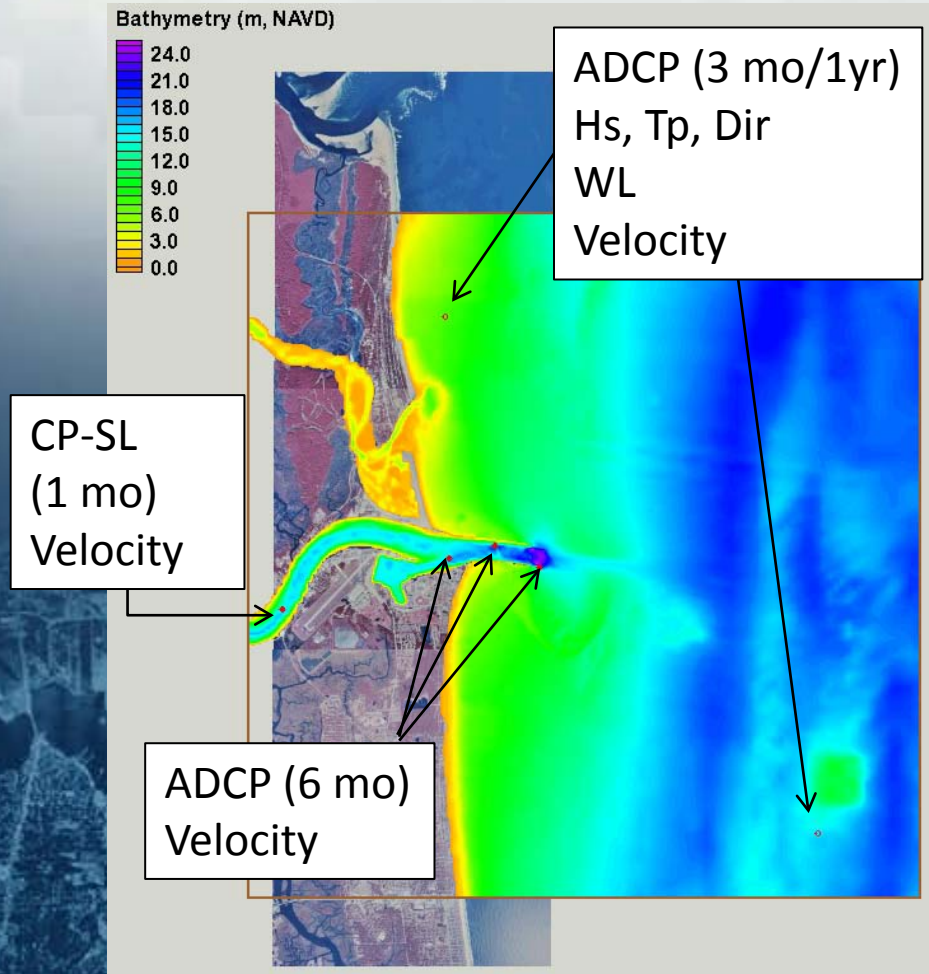- Bypass to Duval County SPP
- Nearshore Placement Duval Co SPP

Sediment Budget

Little Talbot Is
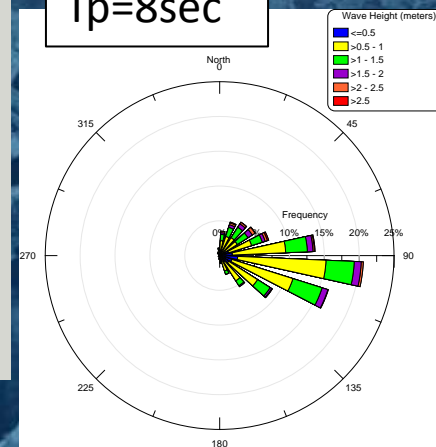Ft George River
Wards Bank
Duval SPP

Field Measurements → Forcing → Hydro-Modeling → Ship Sim → Design → Salinity → Shoaling → Coastal

Modeling · Design · Impacts

Field Measurements and Modeling

Coastal Measurements

Bathymetry (m, NAVD)
24.0
21.0
18.0
15.0
12.0
9.0
6.0
3.0
0.0

ADCP (3 mo/1yr)
Hs, Tp, Dir
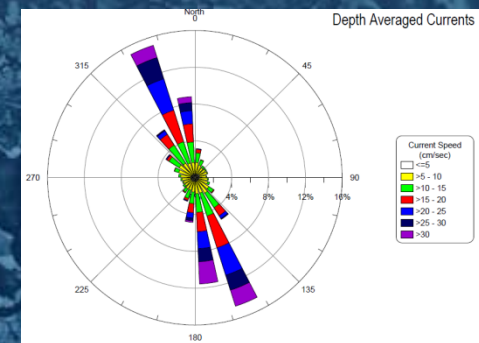WL
Velocity

CP-SL
(1 mo)
Velocity

ADCP (6 mo)
Velocity

- Waves, WL, Currents
- Bathymetry (channel)
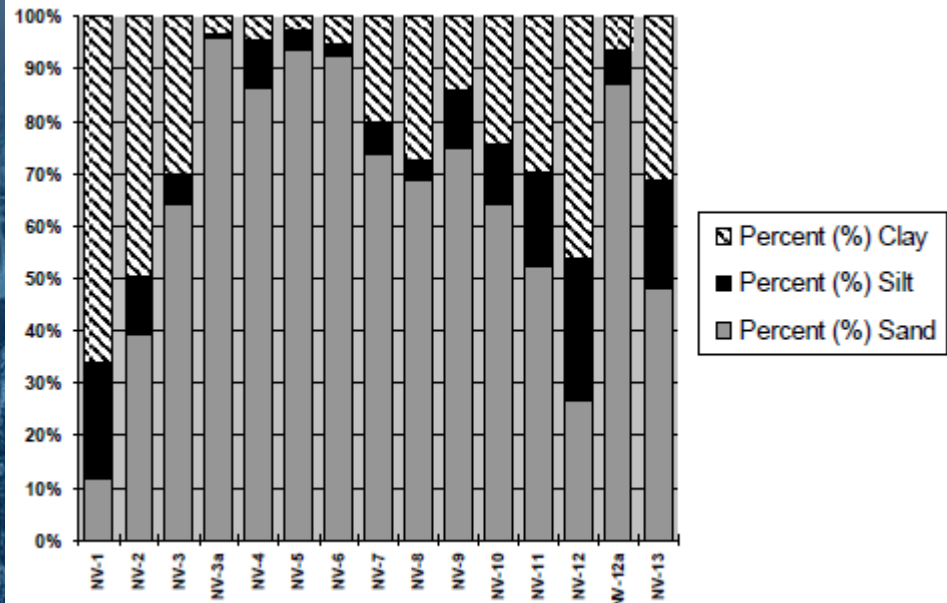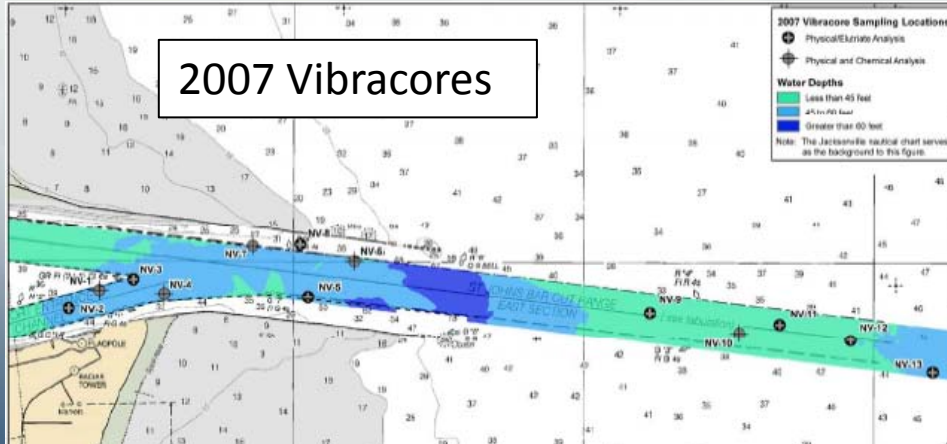- Sediment (channel)

Waves
Hs=1m
Tp=8sec

Currents

JAX ODMDS ADCP

Sediment Characteristics

2007 Vibracores

Distribution (2010)

- 75 -60% fine sand
- 15 % med/cor
- 10 -25 % silt/clay

Ebb Shoal

D_{50} 0.125 to 0.25 mm

Extratropical Storm Events

Storm Event	Date	Max Hs	Max Vbtm	Duration Max Vbtm above 35 cm/s
		(m)	(cm/s)	(days)
1	Sep, 10-15, 2006	**2.0**	35	0.5
2	Nov, 2-9, 2006	**2.8**	45	2.5
3	Nov, 18-25, 2006	**3.0**	45	1.5
4	Jan, 16-22, 2007	**2.8**	47	1.5
5	Mar 29-Apr 4, 2007	**2.3**	40	0.5
6	Apr 19-24, 2007	**2.7**	45	0.5
7	May 5-13, 2007	**3.0**	44	3.0
8	May 29-Jun 5, 2007	**3.6**	35	0

- ExtraTrop: 10-12/yr
- Tropical: 1 / 2yr

JAX ODMDS ADCP

Julian Days - November 19-24,2006
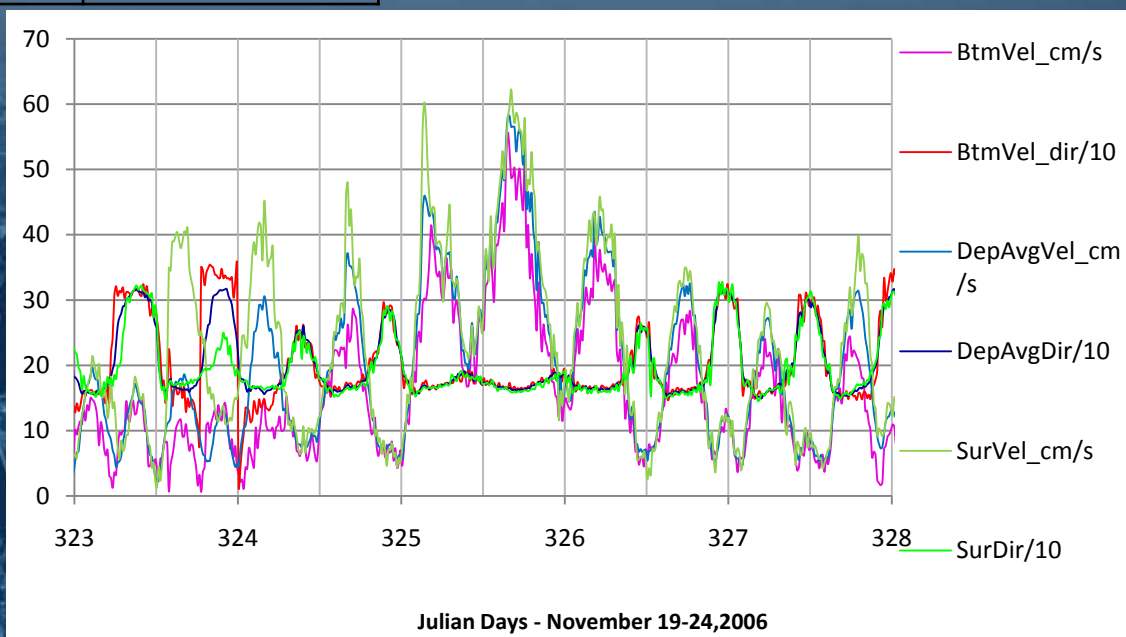
JAX ADCP Wave – WL #4 (pressure)

JAX Gage (7m Depth) Wave, Current, WL

BUILDING STRONG®
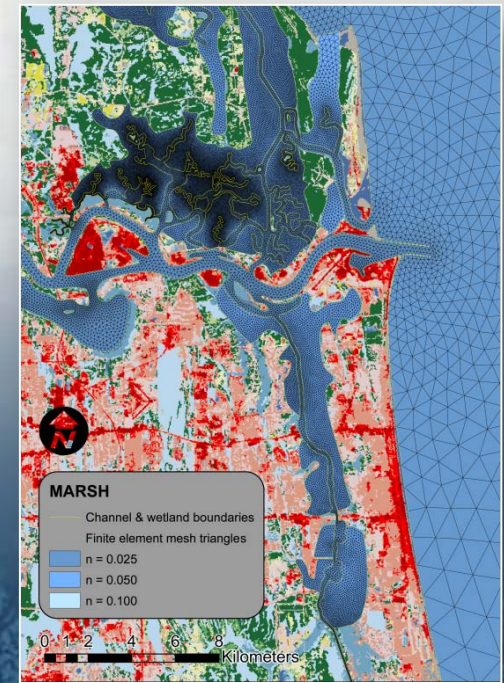
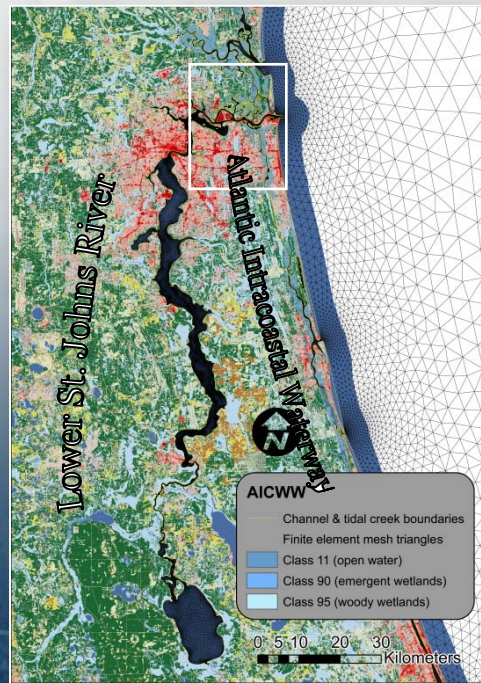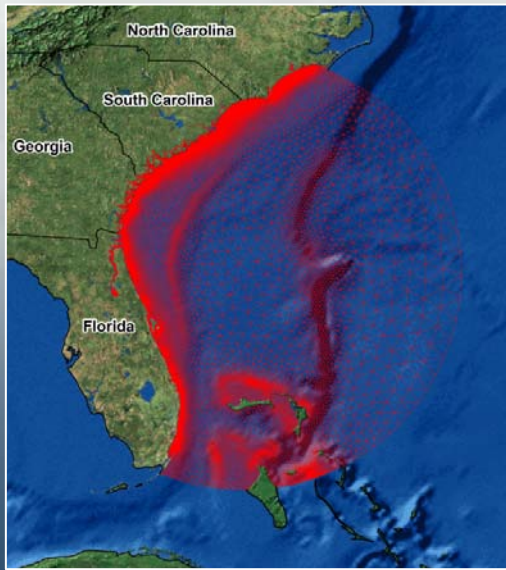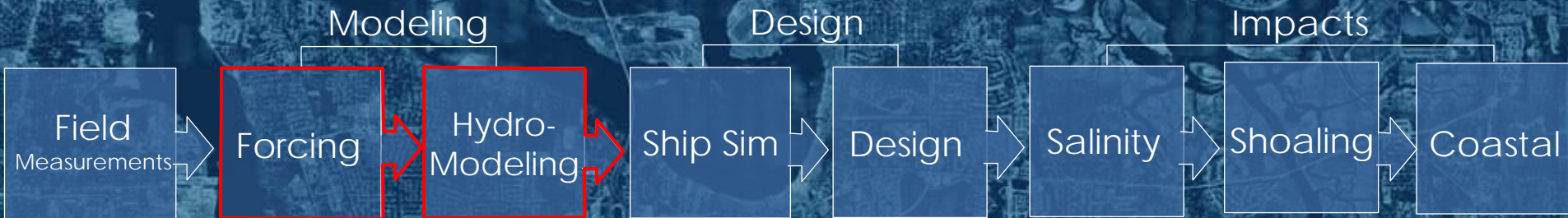US ARMY CORPS OF ENGINEERS | Jacksonville District
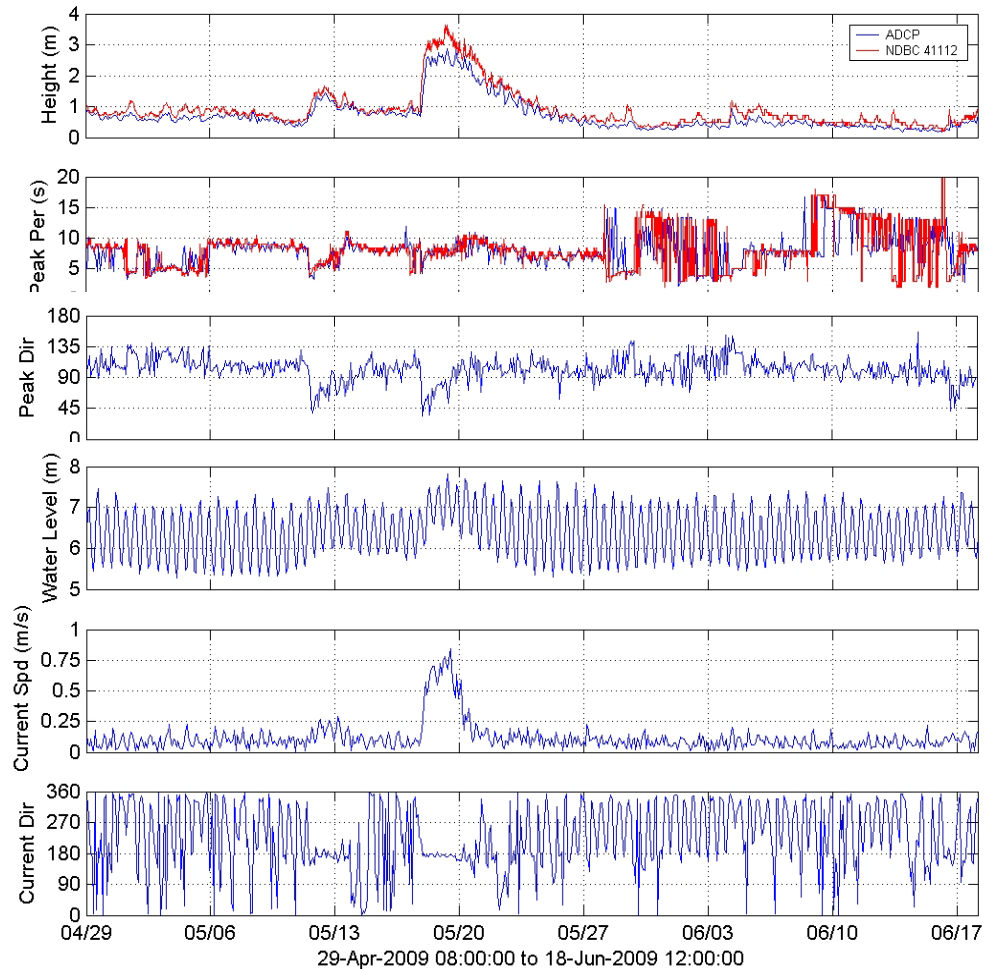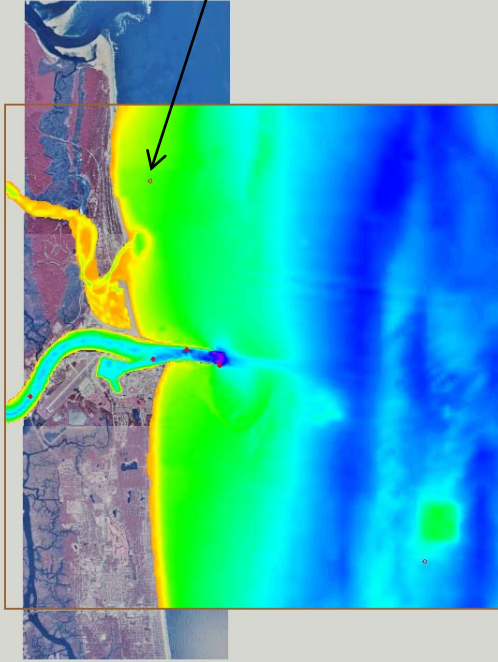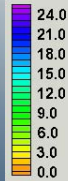
Modeling

- ADCIRC
  - Depth Averaged Water level & Current Boundary Conditions
  - Nov 2006, May – July 2009 (complete)

- Coastal Modeling System (CMS)
  - Channel Shoaling Rates   (*Preliminary)*
  - Sediment budgets & sediment transport for coastal shoreline

- GenCade – Long Term Morphology (start 2011)

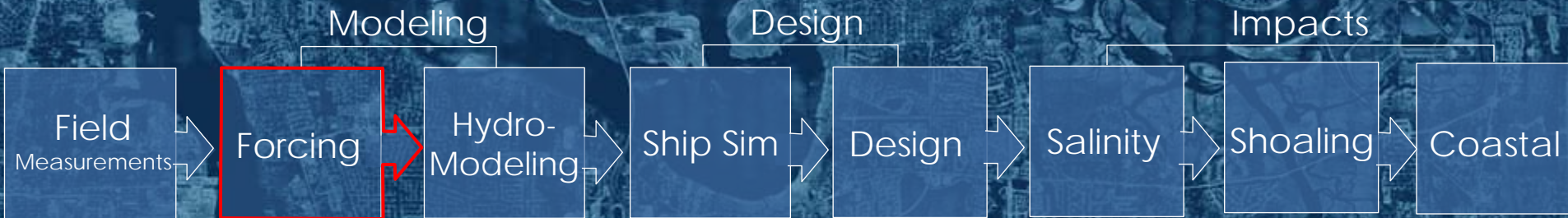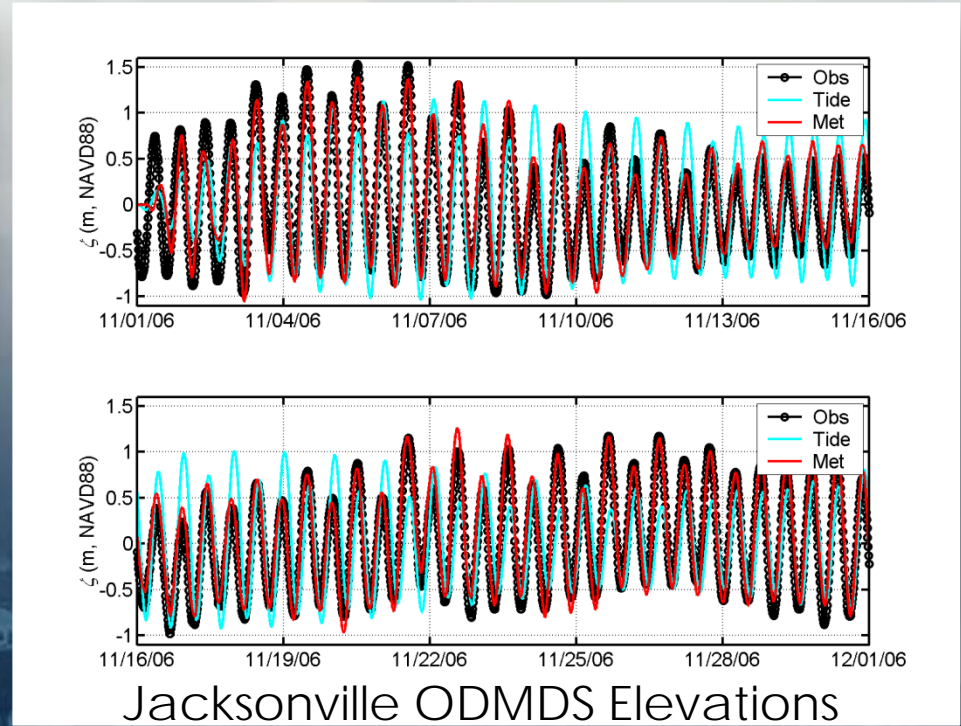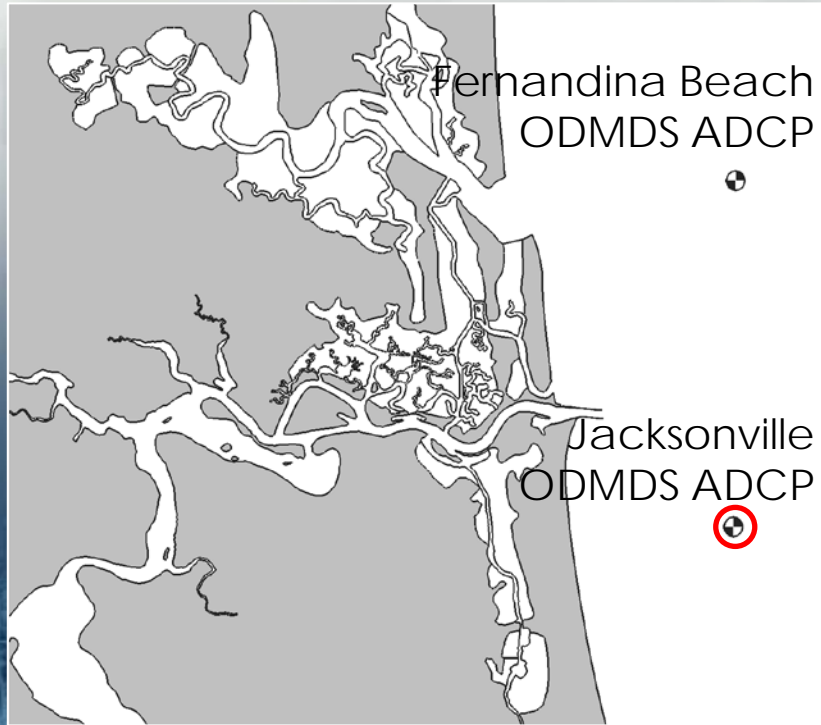# ADCIRC - Salt Marsh, Tidal Creeks & IWW

AICWW
- Channel & tidal creek boundaries
- Finite element mesh triangles
- Class 11 (open water)
- Class 90 (emergent wetlands)
- Class 95 (woody wetlands)

0 5 10 20 30 Kilometers

MARSH
- Channel & wetland boundaries
- Finite element mesh triangles
- n = 0.025
- n = 0.050
- n = 0.100

0 1 2 4 6 8 Kilometers

Advanced Circulation (ADCIRC) Models
Coastal water levels and velocities

Modeling   Design   Impacts

Field Measurements → Forcing → Hydro-Modeling → Ship Sim → Design → Salinity → Shoaling → Coastal

Local Model Applications - Regional ADCIRC Boundary Conditions

Tidal and Meteorologic

● Channel Design
● Salinity
● Coastal

Modeling

Design

Impacts

Field Measurements → Forcing → Hydro-Modeling → Ship Sim → Design → Salinity → Shoaling → Coastal
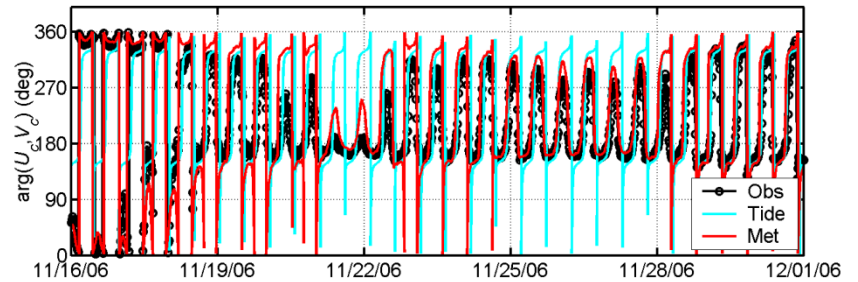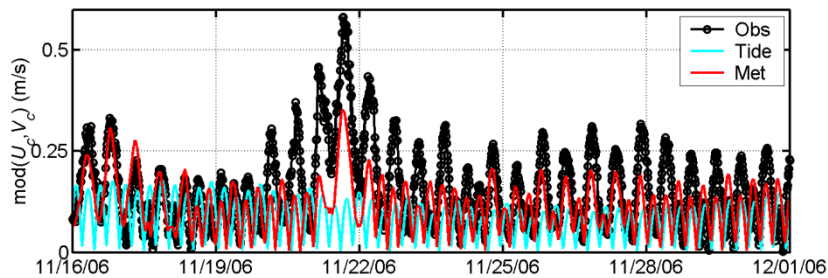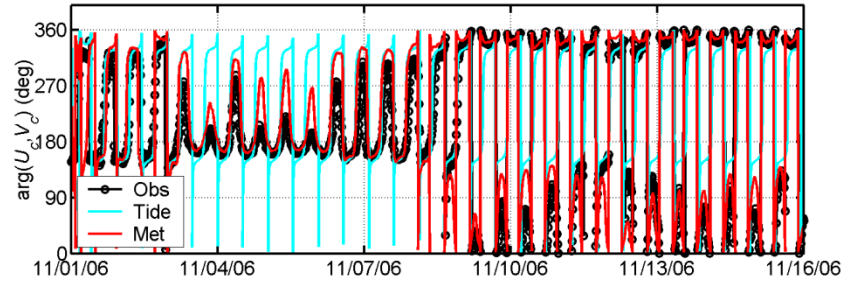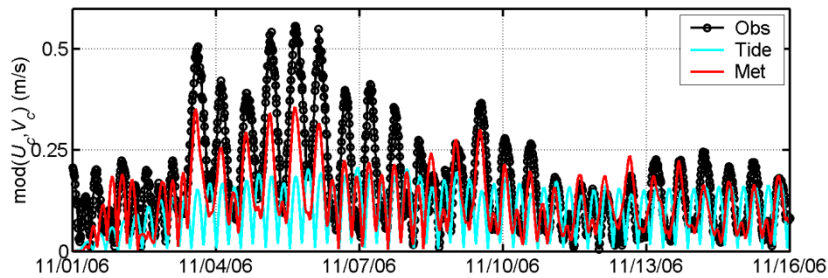
Time Series Validated
(in terms of elevations and velocities at two stations)

Jacksonville ODMDS Elevations

Modeling · Design · Impacts

Field Measurements → Forcing → Hydro-Modeling → Ship Sim → Design → Salinity → Shoaling → Coastal
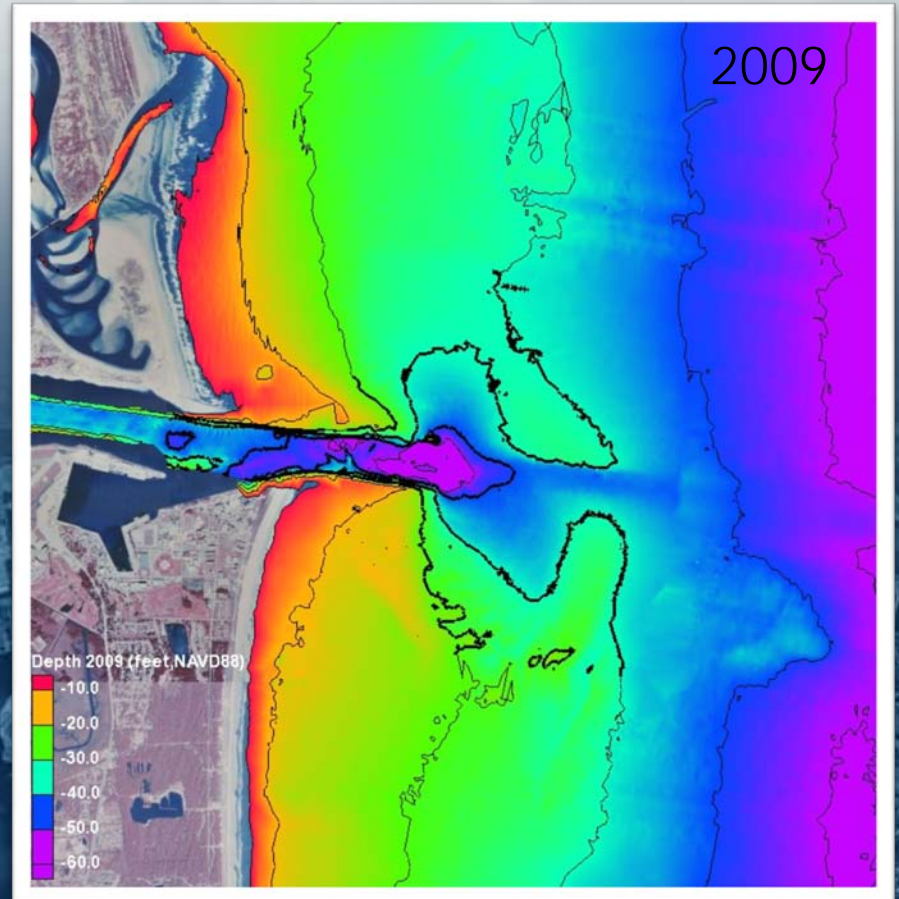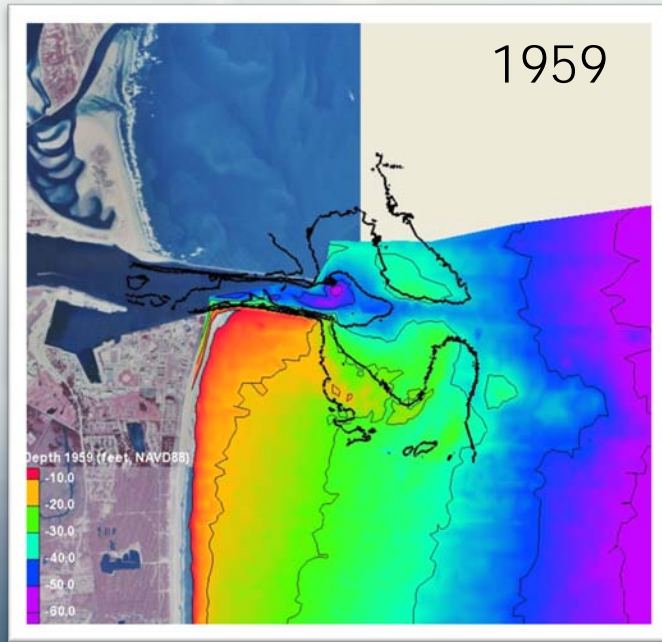
Jacksonville ODMDS
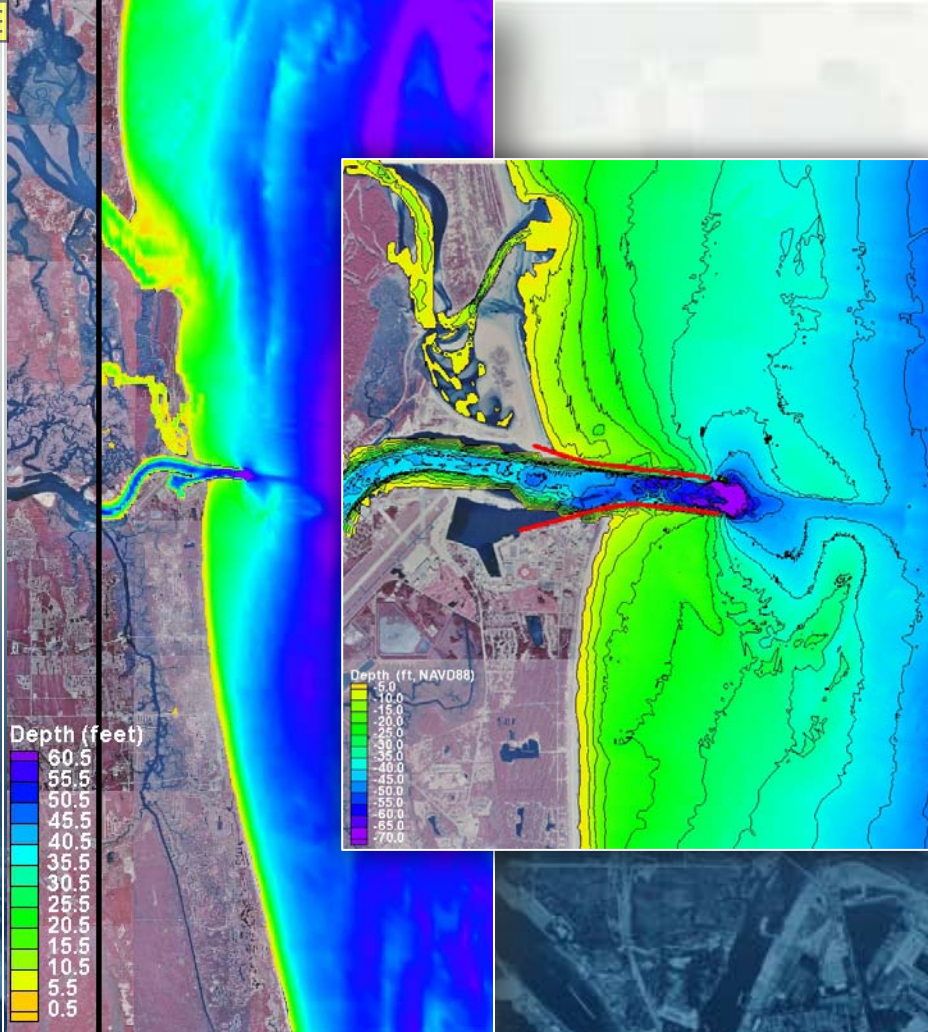## Velocity and Direction
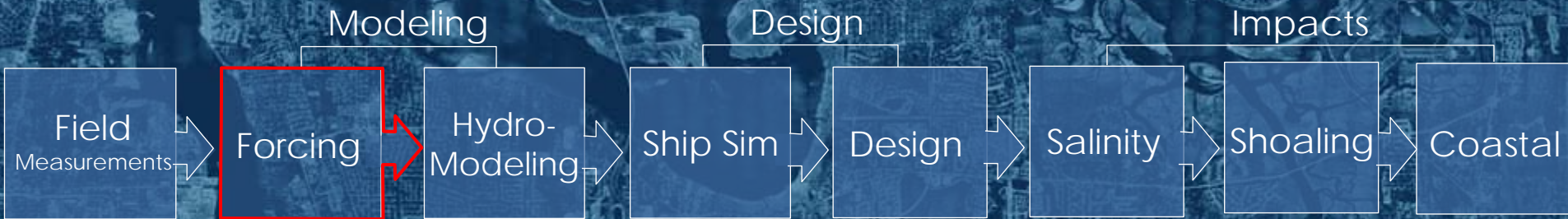
St. Johns Inlet Evolution

1856 chart of the St. Johns River entrance
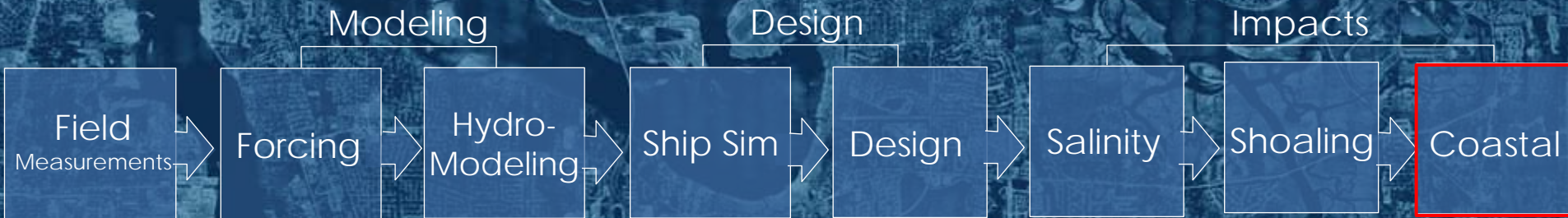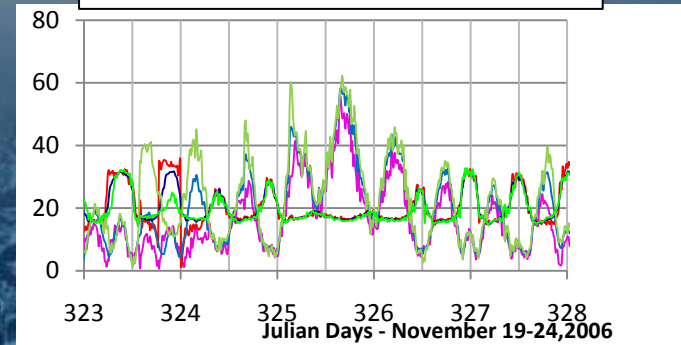
St. Johns Inlet Evolution
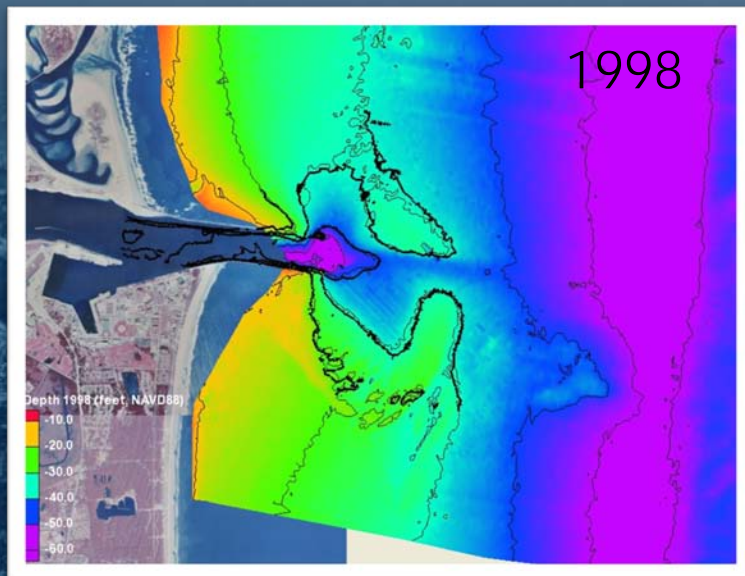
CMS Modeling
St. Johns River Inlet

- Coastal Modeling System
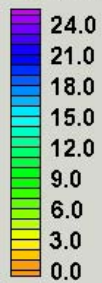- Coupled wave, current, sediment transport and bottom change
- 2-D / 3-D
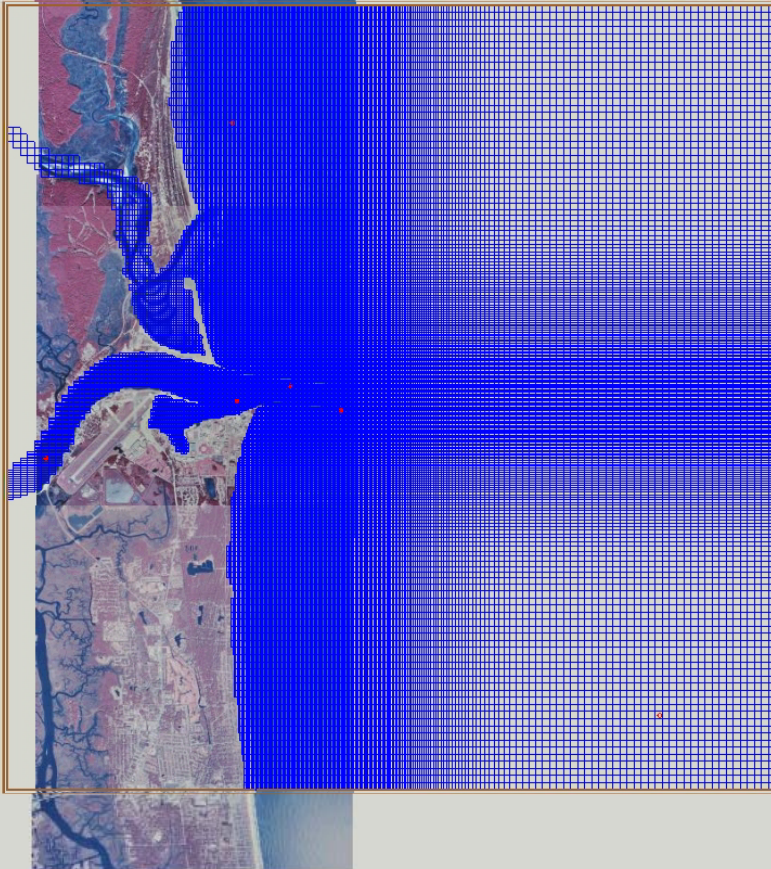

Storm Events – Currents (cm/s)

Julian Days - November 19-24, 2006
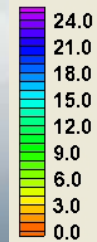

Modeling

Design

Impacts

Field Measurements → Forcing → Hydro-Modeling → Ship Sim → Design → Salinity → Shoaling → Coastal

Project & Regional Scale CMS

- CMS-Flow grid
- 60K cells
- 150m – 30m

- CMS-Flow
- Telescope   grid
- 68K cells
- 400m – 25m

Bathymetry (m, NAVD)
24.0
21.0
18.0
15.0
12.0
9.0
6.0
3.0
0.0

Bathymetry (m , NAVD)
24.0
21.0
18.0
15.0
12.0
9.0
6.0
3.0
0.0
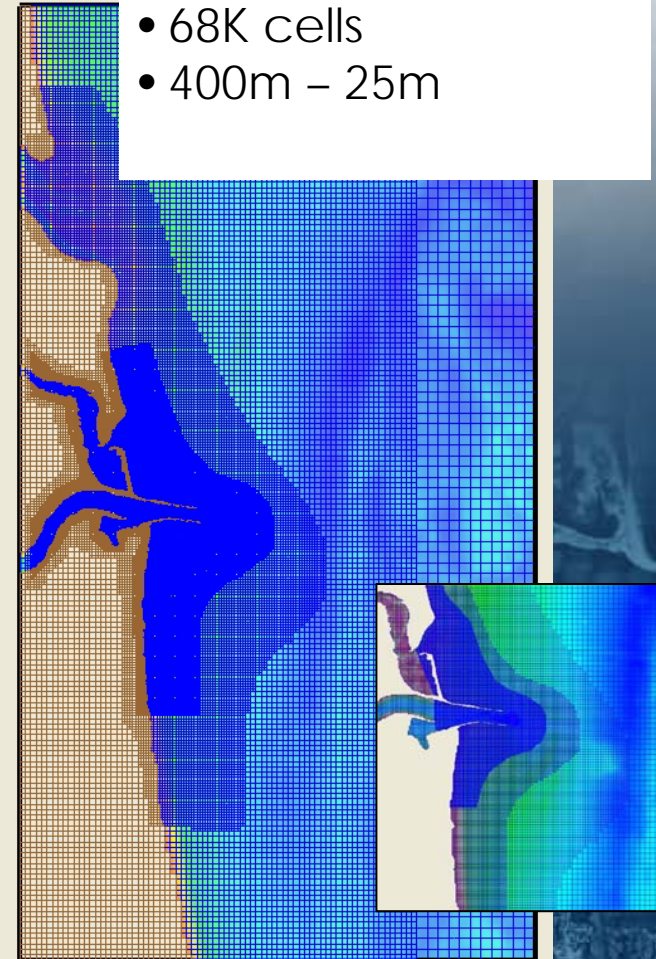
Project Level CMS-Flow Tides & Current


Falling Tide – Ebb Current
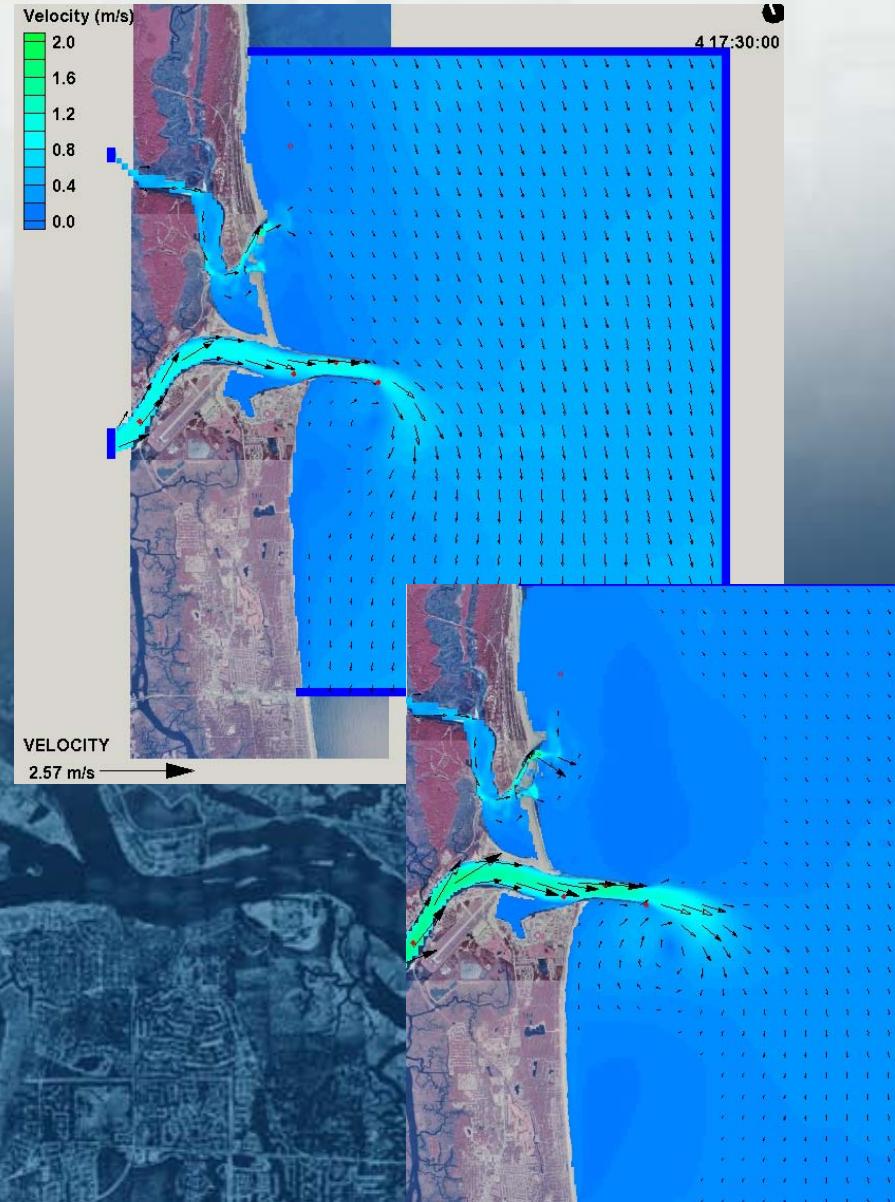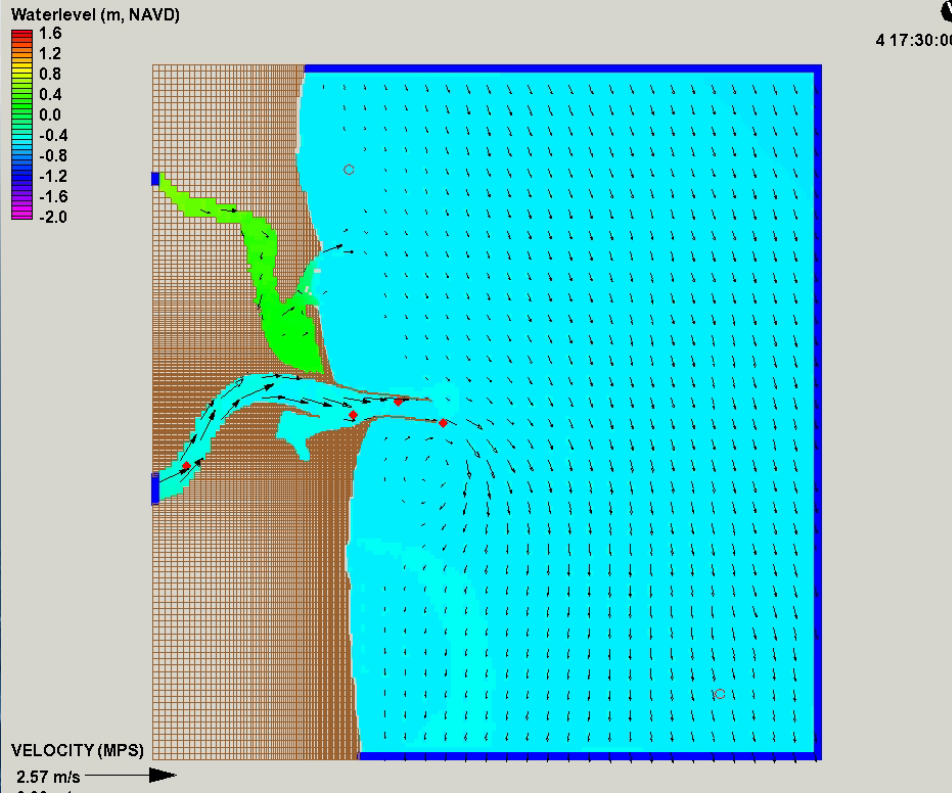
CMS Tasks

- Calibrate, & Verify
  - ➤ Hydrodynamics, Waves, Sediment Transport & Morphology
  - ➤ 2D-Depth Averaged or 3D ?
  - ➤ Simulate 1 year storm climate

- Define Sediment Transport Pathways

- Calculate Sediment Transport Rate
  - ➤ Channel Shoaling Rates
  - ➤ Sediment Budget

Regional Sediment Management Plan

- CMS - St. Augustine Inlet

- CMS - St. Johns River Inlet

- GenCade
    Long Term Morphology
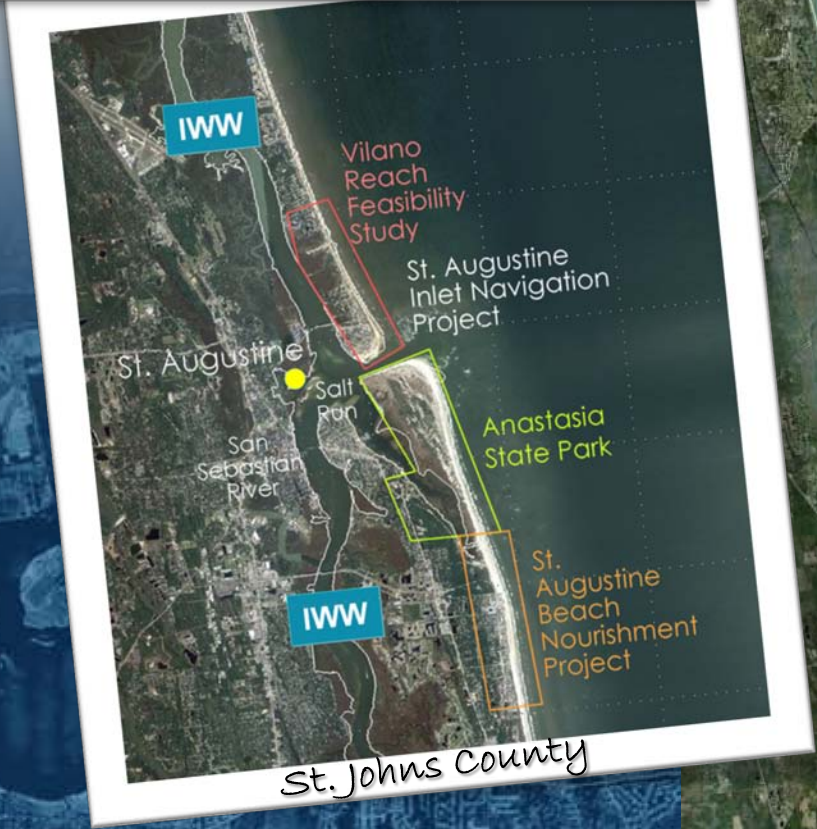
Summary

- Jacksonville Harbor / Mayport Deepening Projects
- Project & Regional Sediment Management Perspectives
- Modeling Tools
  - ADCIRC
  - Coastal Modeling System (CMS)
  - GenCade

Thank You !