Development of Coupled Physical and Ecological Models for Stress-Response Simulations of the Apalachicola Bay Regional Ecosystem

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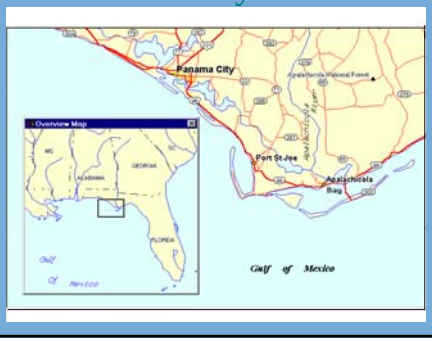
Research Project Objective:

To develop a coupled physical-ecological model of the Apalachicola Bay ecosystem that can be used as a quantitative tool to assess the ecosystem responses to natural and anthropogenic stressors

Apalachicola Bay Study Area



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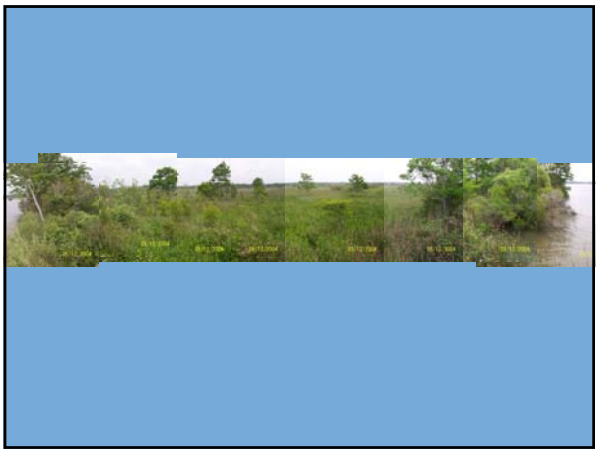

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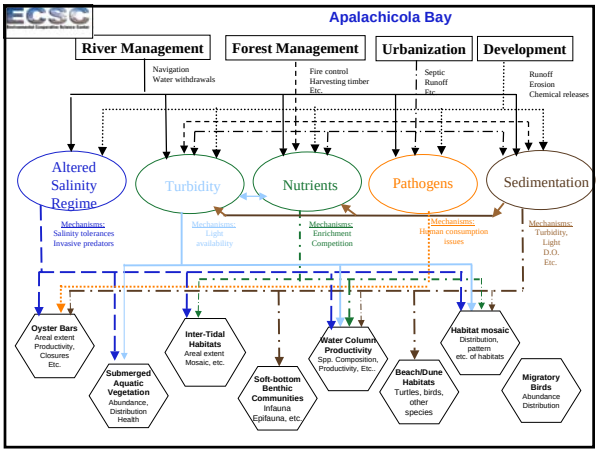
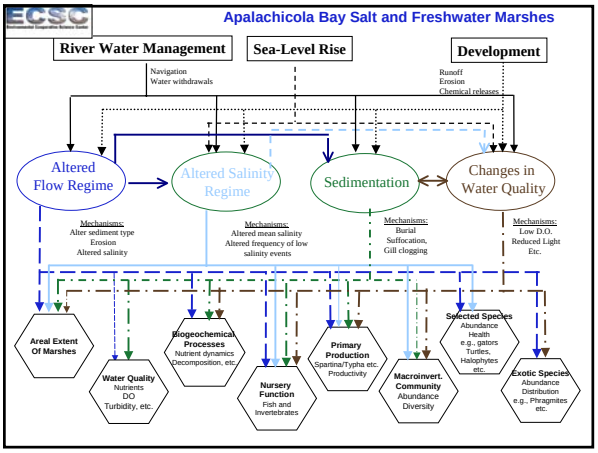
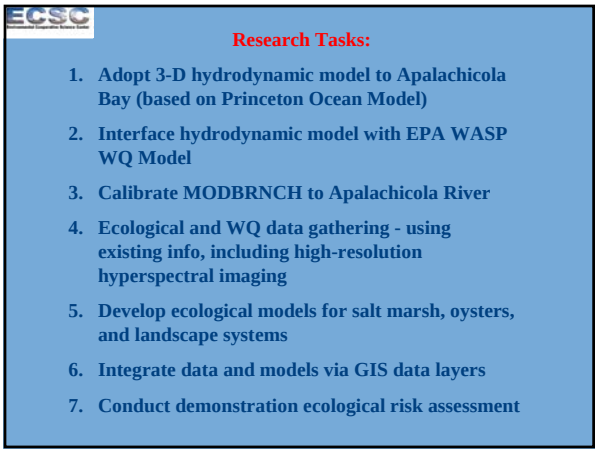
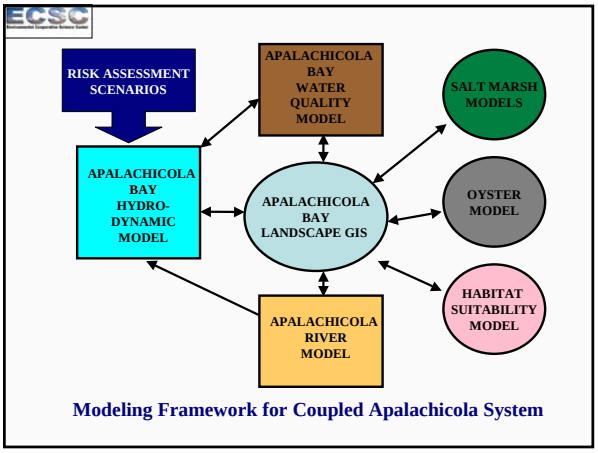




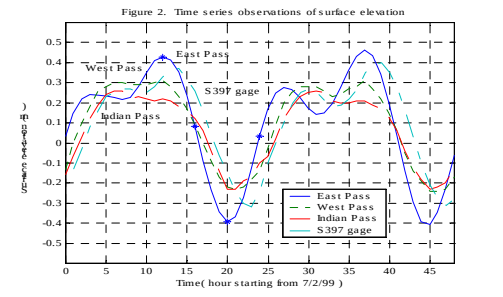




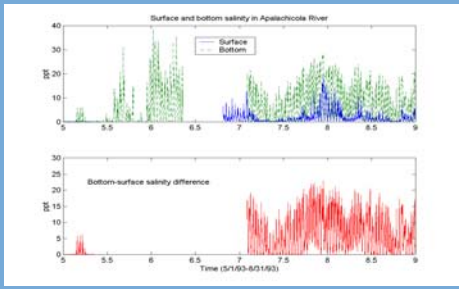
Characteristics of Apalachicola Bay

- Shallow water, multiple tidal boundaries.
- Strong freshwater discharge:
  Q_{min}=155 m^3, Q_{ave}=770 m^3, Q_{max}=2300 m^3.
- River discharge perpendicular to the estuarine axis and a long barrier island.
- Strong vertical stratification near the river.

Multiple tidal forces with different amplitudes



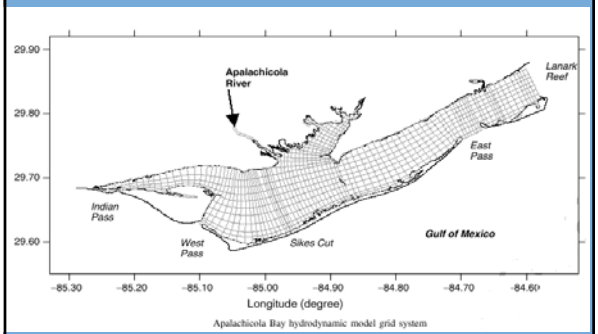
Strong Vertical Stratification



The Hydrodynamic Model

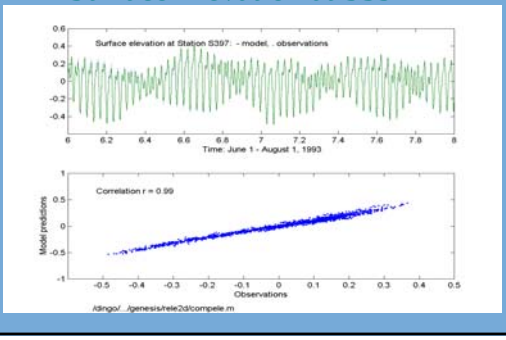
- Princeton Ocean Model (POM) (Blumberg and Mellor, 1987)
- Semi-implicit, finite-difference method
- Second-order turbulent closure (Mellor and Yamada)

Model grid



Apalachicola Bay hydrodynamic model grid system

Model Calibration: Surface Elevation at S397



Model Calibration: Salinity

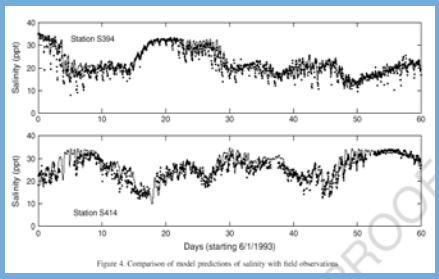
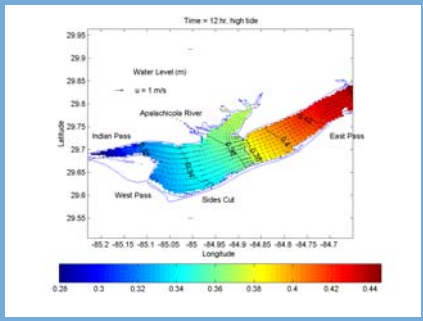
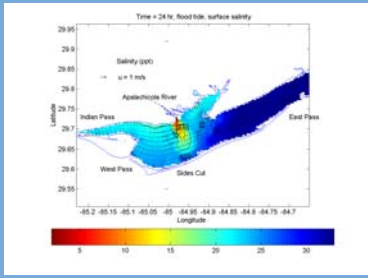


Figure 4. Comparison of model predictions of salinity with field observations.

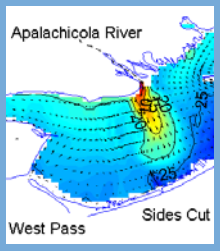
Tidal Circulation: 12 hr, high



Salinity at flood tide



SUMMARY



- Model is calibrated to simulate 3D hydrodynamics and salinity in the Bay.
- Estuary's characteristics: a) multiple tidal forces with different amplitudes, b) strong river discharge perpendicular to the estuarine axis, c) shallow water.