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

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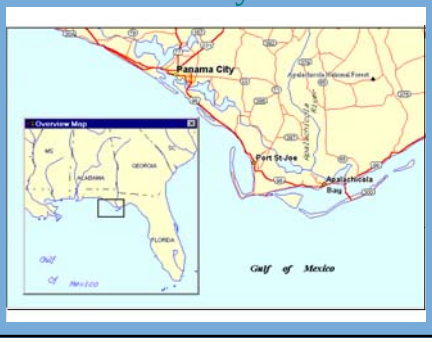
Research Project Objective:

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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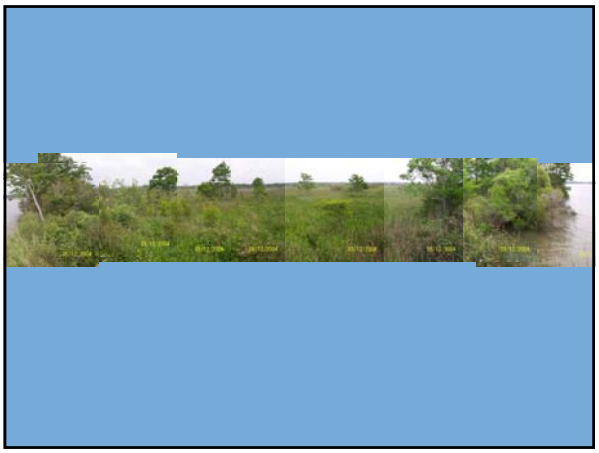

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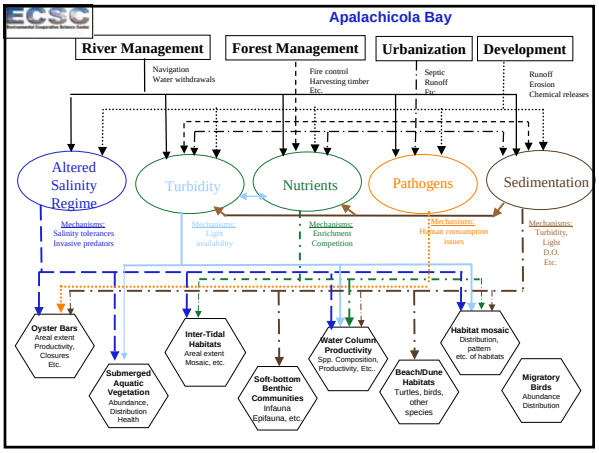

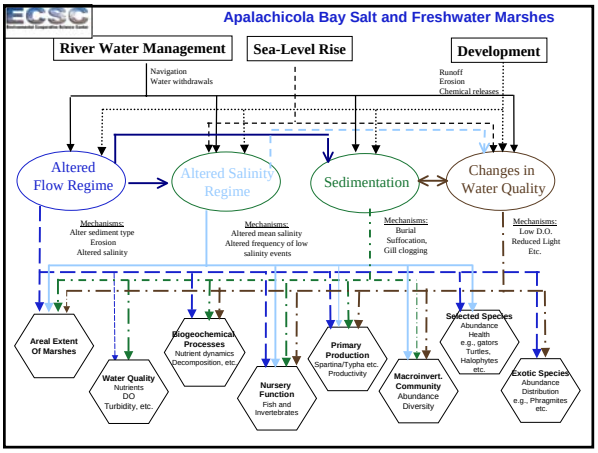

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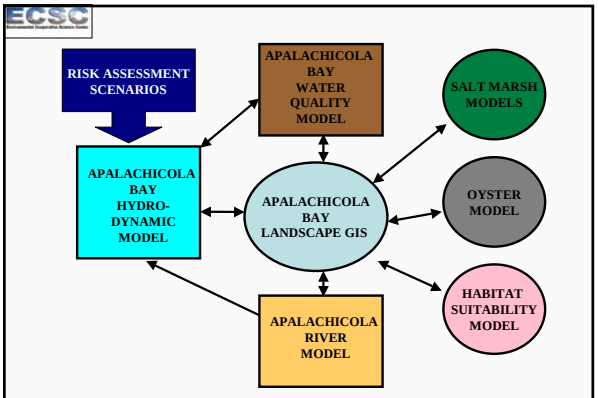
Research Tasks:

1. Adopt 3-D hydrodynamic model to Apalachicola Bay (based on Princeton Ocean Model)
2. Interface hydrodynamic model with EPA WASP WQ Model
3. Calibrate MODBRNCH to Apalachicola River
4. Ecological and WQ data gathering - using existing info, including high-resolution hyperspectral imaging
5. Develop ecological models for salt marsh, oysters, and landscape systems
6. Integrate data and models via GIS data layers
7. Conduct demonstration ecological risk assessment

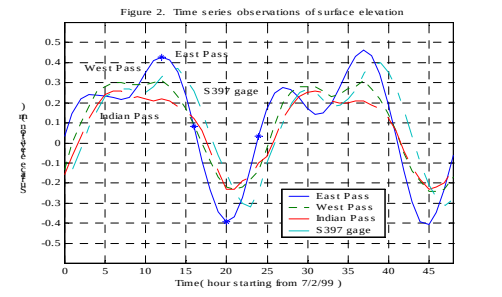


Modeling Framework for Coupled Apalachicola System

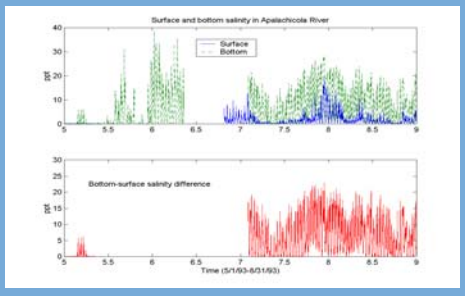
Characteristics of Apalachicola Bay

- 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



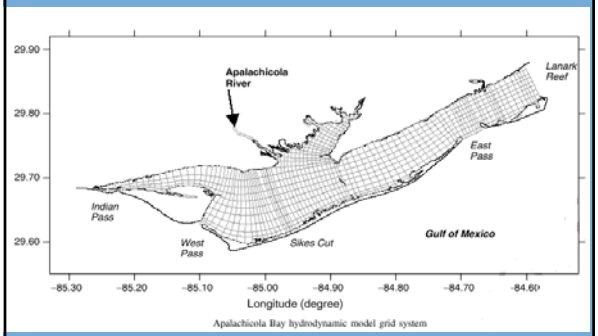
Strong Vertical Stratification



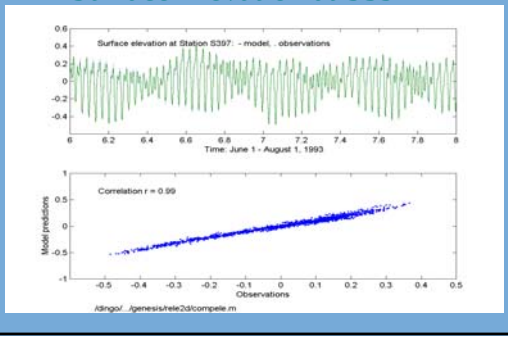
The Hydrodynamic Model

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

Model grid



Model Calibration: Surface Elevation at S397



Model Calibration: Salinity

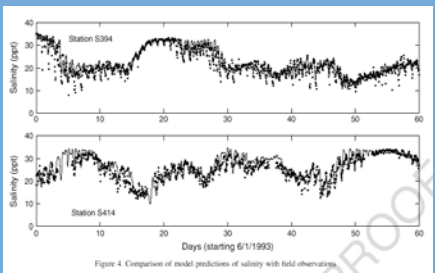
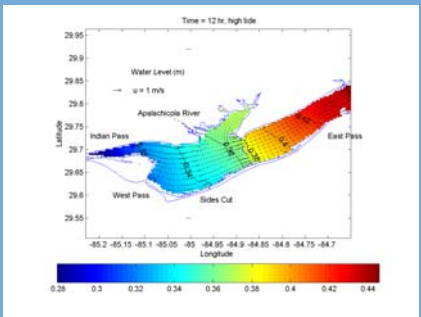
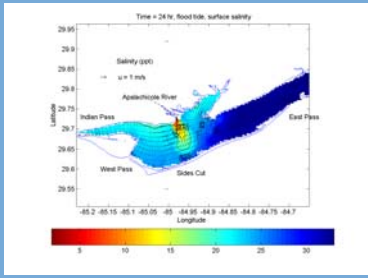


Figure 4. Comparison of model predictions of salinity with field observations.

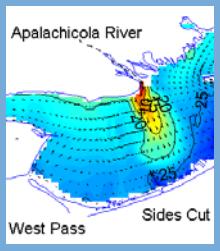
Tidal Circulation: 12 hr, high



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.