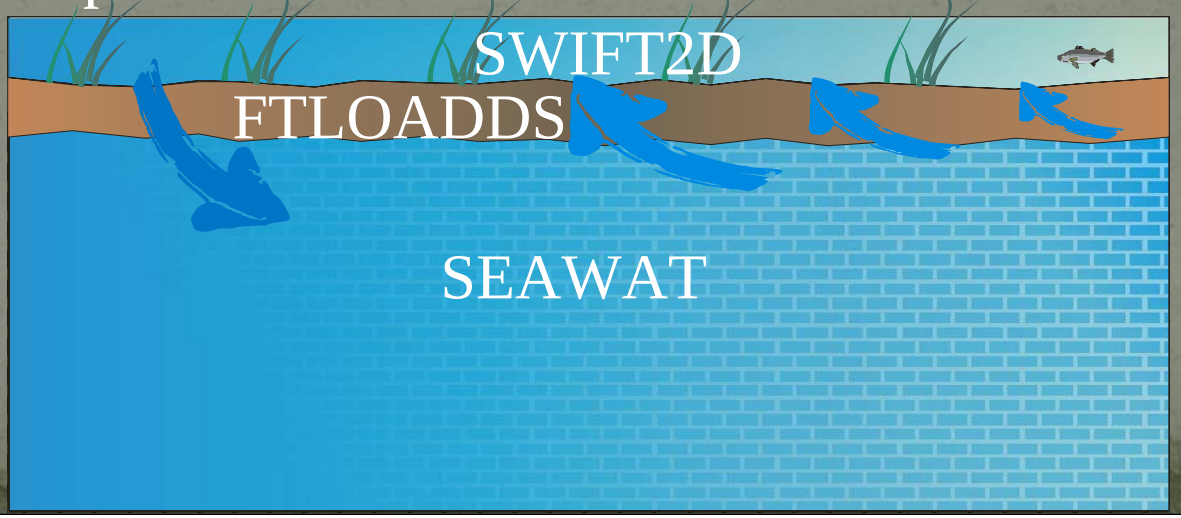
The Relationship of USGS Hydrologic Modeling Efforts to Ecosystem Restoration

By
Melinda Lohmann, Eric Swain, and Jeremy Decker

GEER- Greater Everglades Ecosystem Restoration
Naples, Fl
July 29, 2008

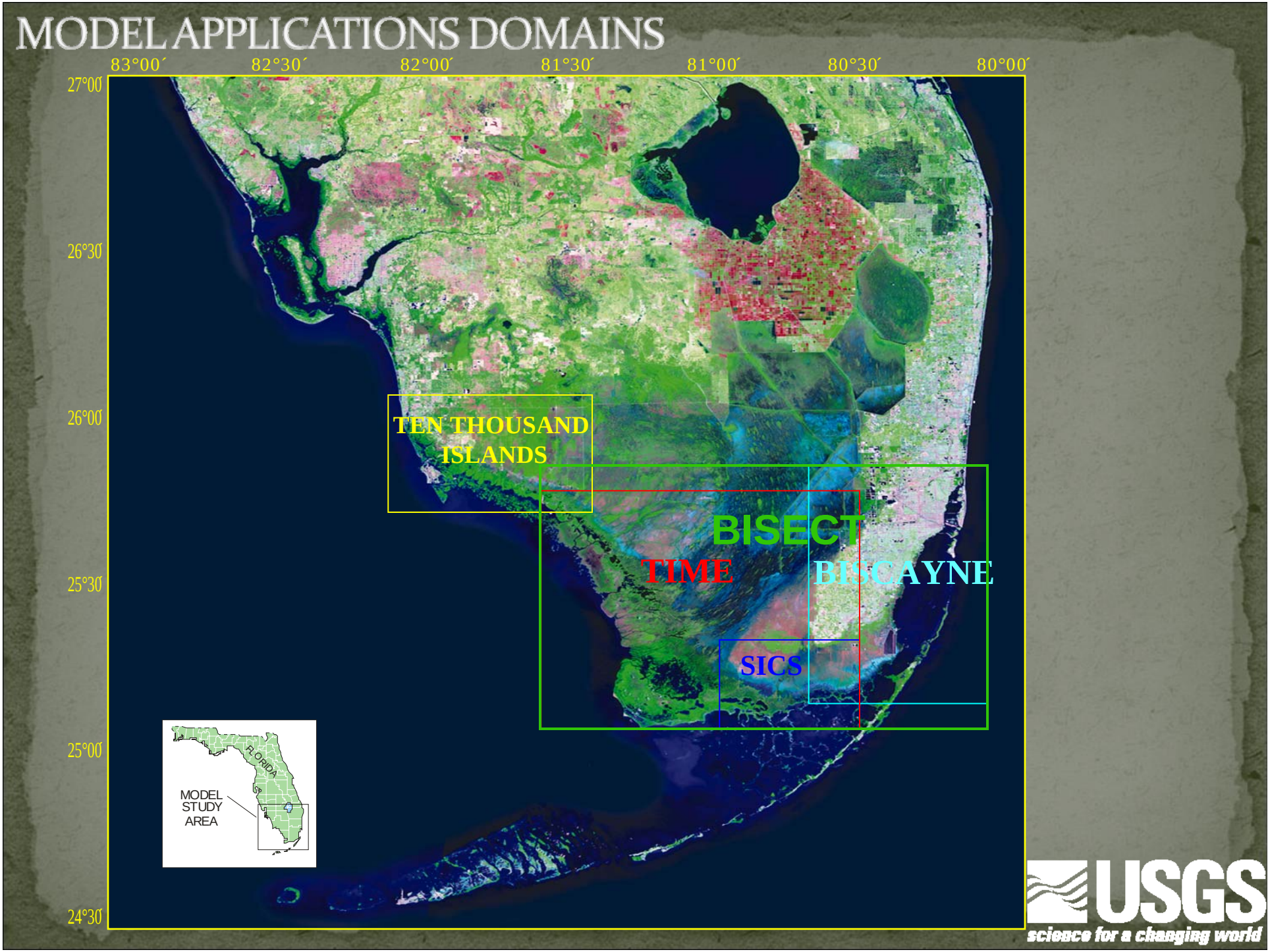
CODE DEVELOPMENT

- FTLOADDS (Flow and Transport in a Linked Overland/Aquifer Density Dependent System) Combines:
  - **SWIFT2D** surface water code
  - **SEAWAT** variable density ground-water flow and transport code
- Represents leakage between the Bay, wetlands, and the groundwater system
  - Salinity transport is represented in each model and passed with leakage
- Modifications
  - Heat Transport



USGS
science for a changing world

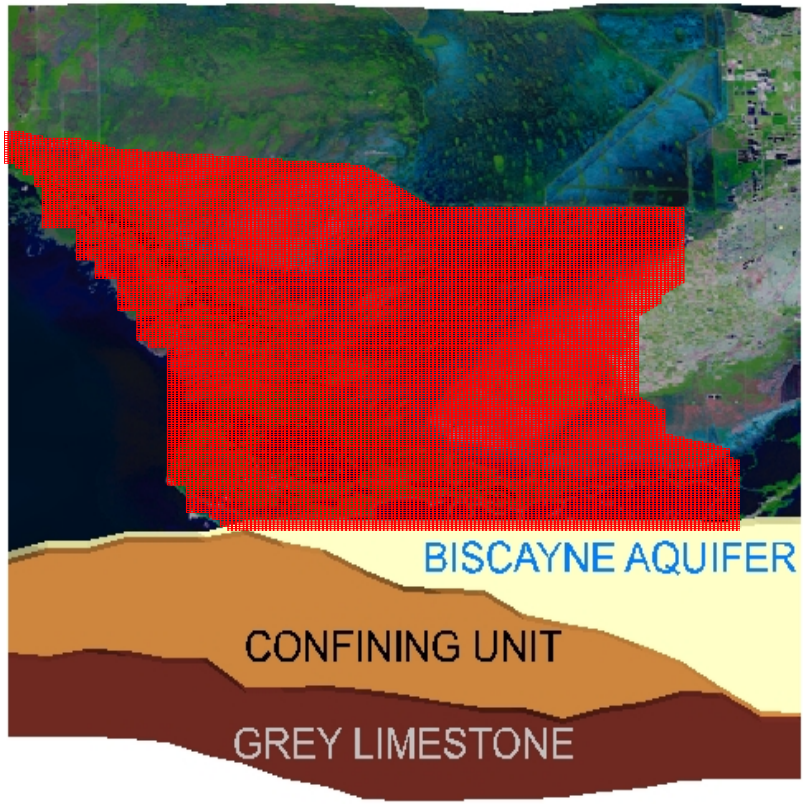
MODEL APPLICATIONS DOMAINS



USGS
science for a changing world

TIME APPLICATION

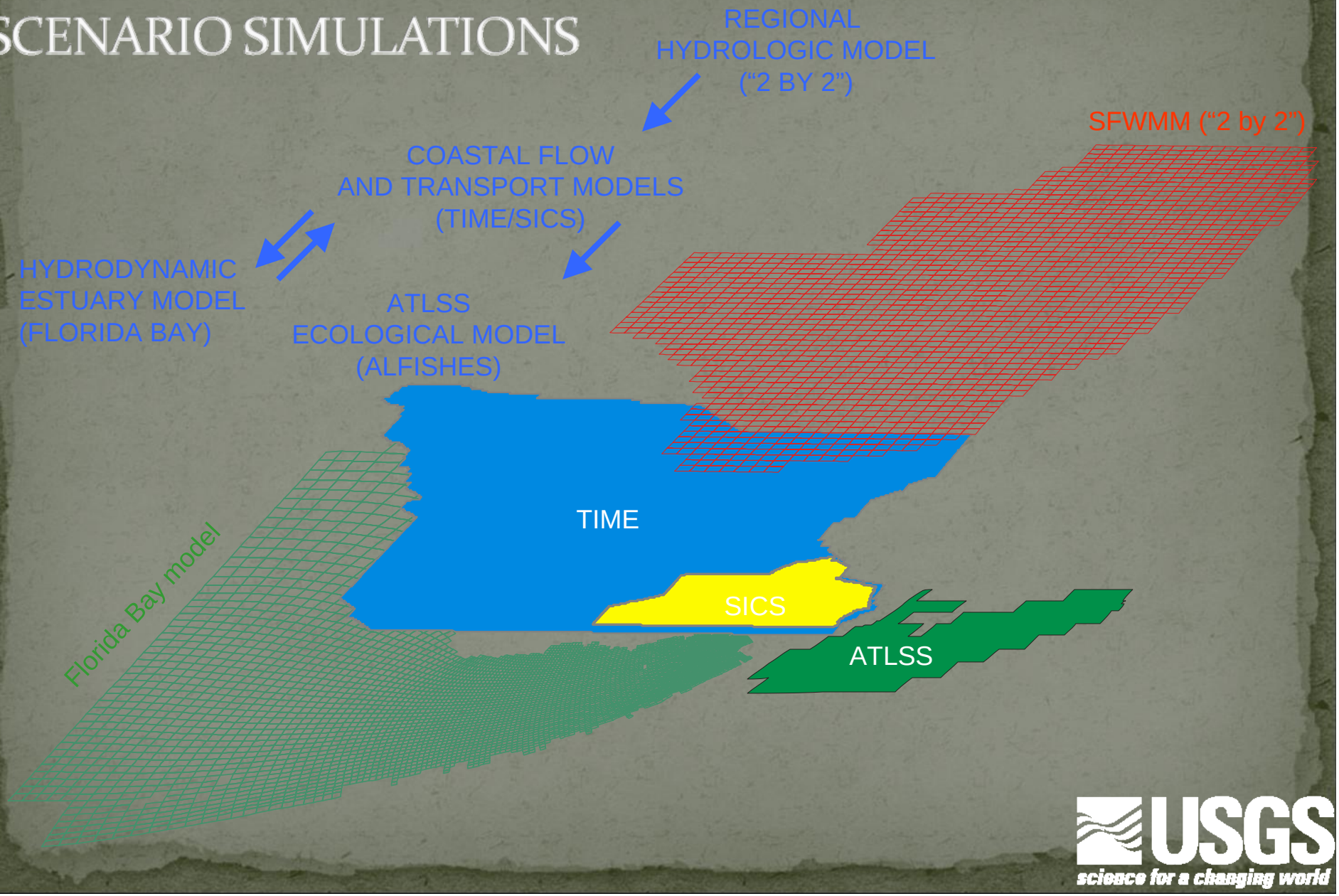
TIDES AND INFLOWS IN THE MANGROVES OF THE EVERGLADES



- TIME (PES and SFWMD funded) is a joint effort to research the effects of freshwater inflows and tidal forces in the mangrove ecotone of south Florida.
- Major Data Provided:
  - Water levels,
  - Total Discharge
  - Freshwater Discharges at the Coast
  - Hydro-periods
  - Salinity
  - Temperature.

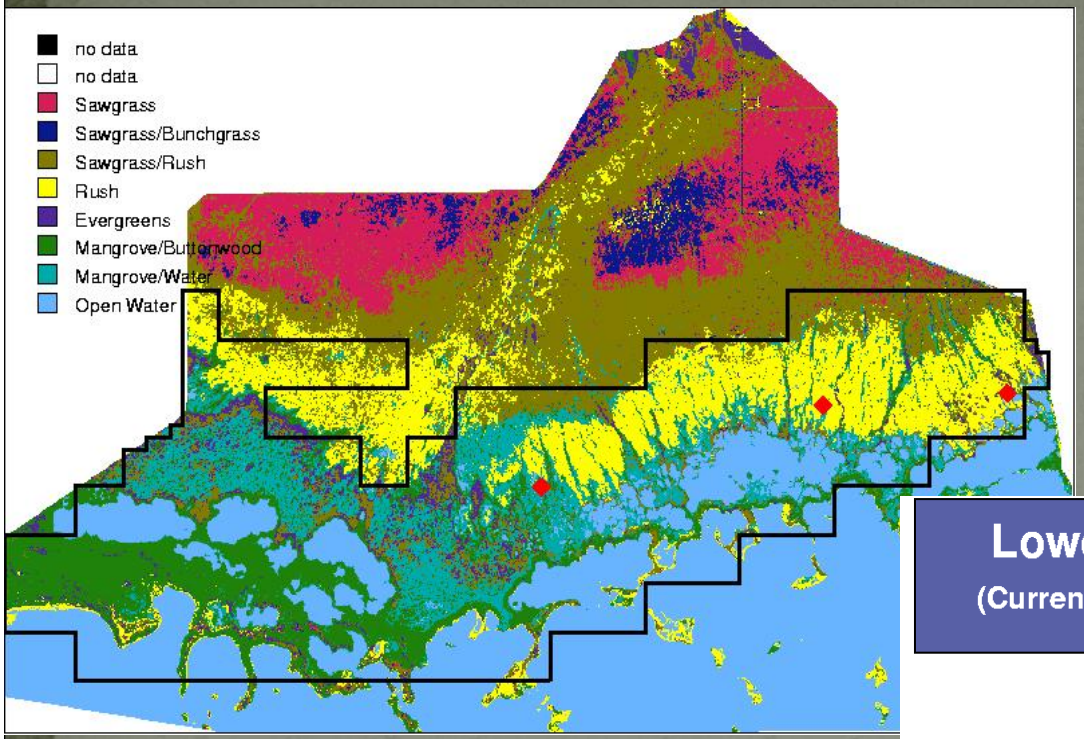
USGS
science for a changing world

TIME LINKAGE TO THE SFWMM MODEL AND THE EFDC HYDRODYNAMIC MODEL OF FLORIDA BAY FOR CERP SCENARIO SIMULATIONS



USGS
science for a changing world

SICS/TIME Linkage to ATLSS ALFISHES Model



Lower Trophics
(Currently Held Constant)

Hydrology
(SICS/TIME)

Move between Cells → **Move within Cell**

Survival

Growth → **Reproduction**

Wading Birds
(Currently Not Included)

Piscivorous Fish

USGS
science for a changing world

www.ATLSS.ORG
Across Trophic Level System Simulation

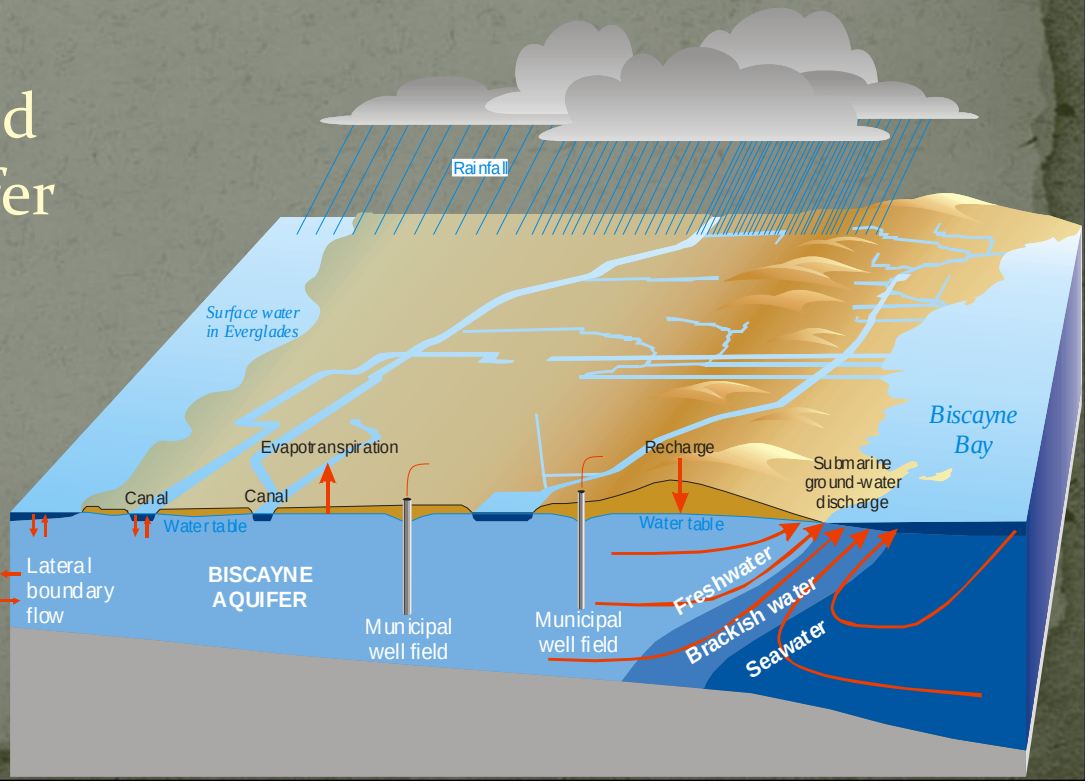
TIME LINKAGE TO TaRSE

- Transport and Reaction Simulation Engine (Dr. Munez at University of Florida)
- Developed for simulating P water-quality in Everglades (USGS report in preparation)
- TaRSE does not simulate hydrology
  - Linked to the South Florida Regional Simulation Model (RSM) to simulate P transport and cycling.
  - Currently integrating TaRSE with TIME

USGS
science for a changing world

BISCAYNE BAY APPLICAITON

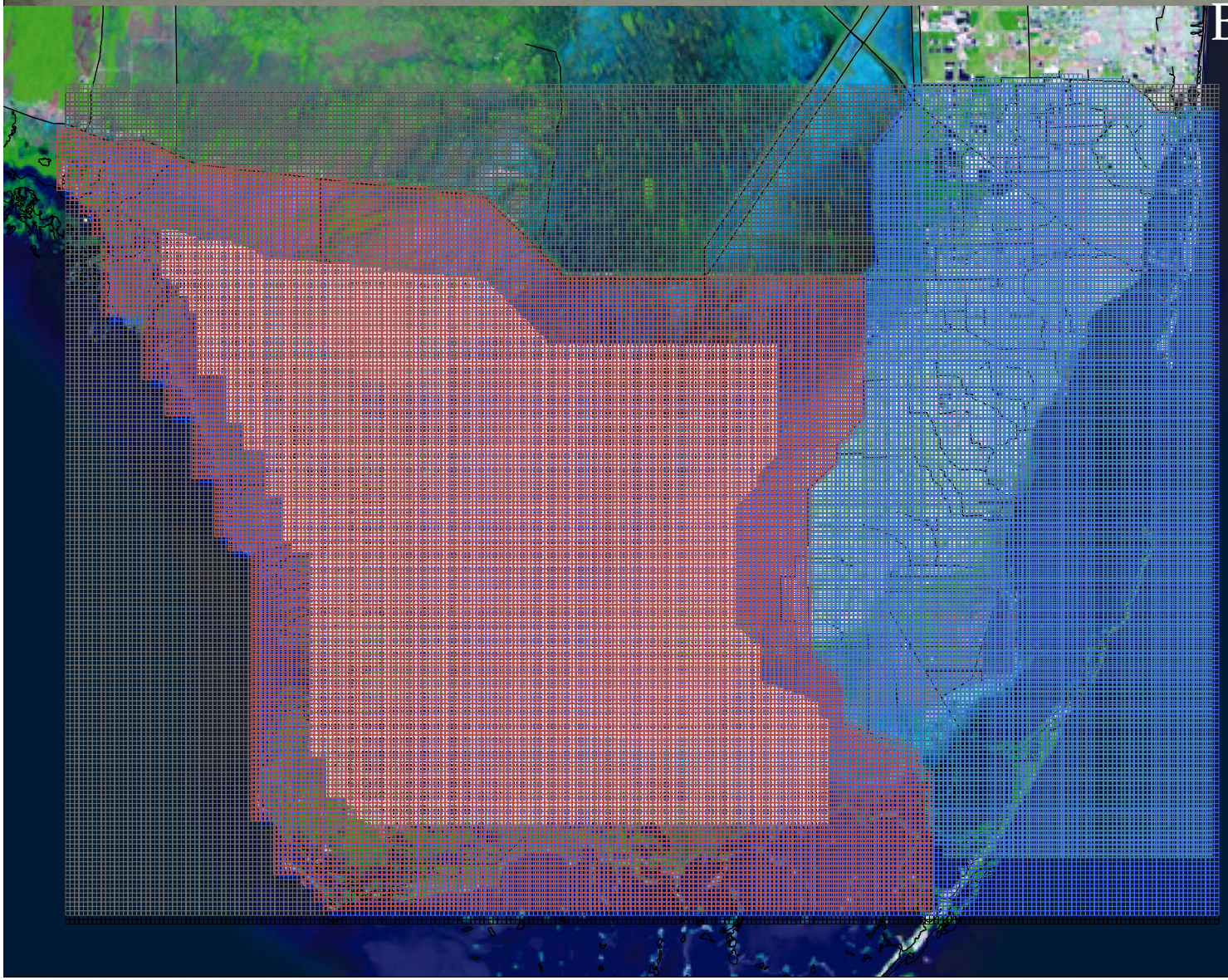
- Bay and Wetlands
  - 2-D overland flow and transport
  - SWIFT2D
- Aquifer
  - 3-D flow and transport
  - SEAWAT2000
- Canals
  - Not explicitly represented
  - Head boundary for aquifer
- GW/SW Interactions
  - FTLOADDS



USGS
science for a changing world

BISECT MODEL

BIscayne and Southern Everglades Coastal Transport MODEL



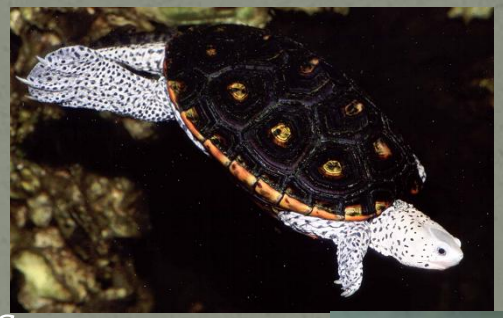
- Link TIME and Biscayne Models
  - A tool to evaluate CERP effects on both ENP and BNP
  - L-31N/ C-111 impact on GW
  - Estimate Pre-development conditions
  - Simulate potential climate change
    - Sea-level rise
    - Temperature change

USGS
science for a changing world

Heat Transport Model and Species Habitat Use

Collaborative Effort with Hydrology and Biology

- Coastal hydrology model:
  - water temperature and salinity fluctuations that determine habitat suitability
- Model which can be used for research and management of many organisms and communities
  - Manatees
  - Oysters
  - Sharks
  - Many species of fish
  - Diamond Back Terrapins
  - Invasive Species



USGS
science for a changing world

TEN THOUSAND ISLANDS AND 3-D Port of the Islands MODEL

Objectives

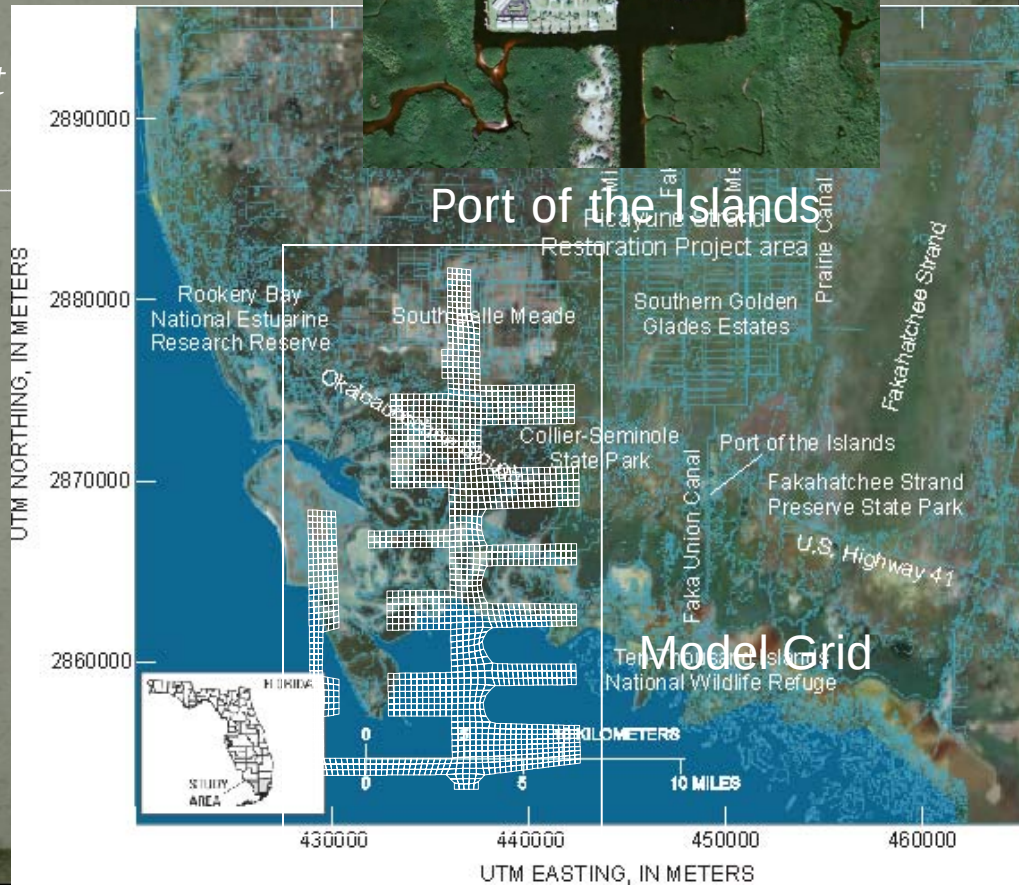
(1)Develop a hydrodynamic model of the Ten Thousand Islands

(2)Develop a 3-D model of the Port of the Islands

(3)Evaluate effects of Restoration on habitat

Tools

Environmental Fluid Dynamics Code (EFDC)



POTENTIAL FUTURE USES OF THE MODELS & RESEARCH

- **Water Supply Issues**
- **Understanding climate change and effects to organisms**
  - *Sea level rise*
  - *Temperature increases*
- **Delineating manatee critical habitat use and carrying capacity in the Greater Everglades.**
  - *Population growth*
  - *Immigration from northern areas when power plants shut down.*
- **Understanding hurricane damage to habitats and the effects to hydrological processes and parameters that impact organisms**
  - *Before and after models to identify mechanisms and assess resilience of populations to storm events.*

USGS
science for a changing world

USGS Modeling Team and Collaborating Scientists

- **USGS Fort Lauderdale**
  - Melinda Wolfert-Lohmann
  - Christian Langevin
  - Eric Swain
  - Jeremy Decker
- **USGS Gainesville**
  - Brad Stith
  - Catherine Langtimm

- **Collaborating Scientists**
  - John Wang, UM
  - Jon Cline, University of Tennessee
  - Rafa Munez and Stuart Miller, UF
  - John Hamrick, Tetratech
  - Jerry Lorenz, Audubon
  - Michael Kohler and Momo Chen, SFWMD
  - Kiren Bahm, Ed Kearns, Dewitt Smith, ENP

USGS
science for a changing world

QUESTIONS?

USGS
science for a changing world