

APPLYING HYDRODYNAMIC SURFACE- WATER/GROUNDWATER SALINITY-TRANSPORT MODEL TO BISCAYNE BAY AND SOUTHEASTERN EVERGLADES RESTORATION

Eric Swain – U.S. Geological Survey

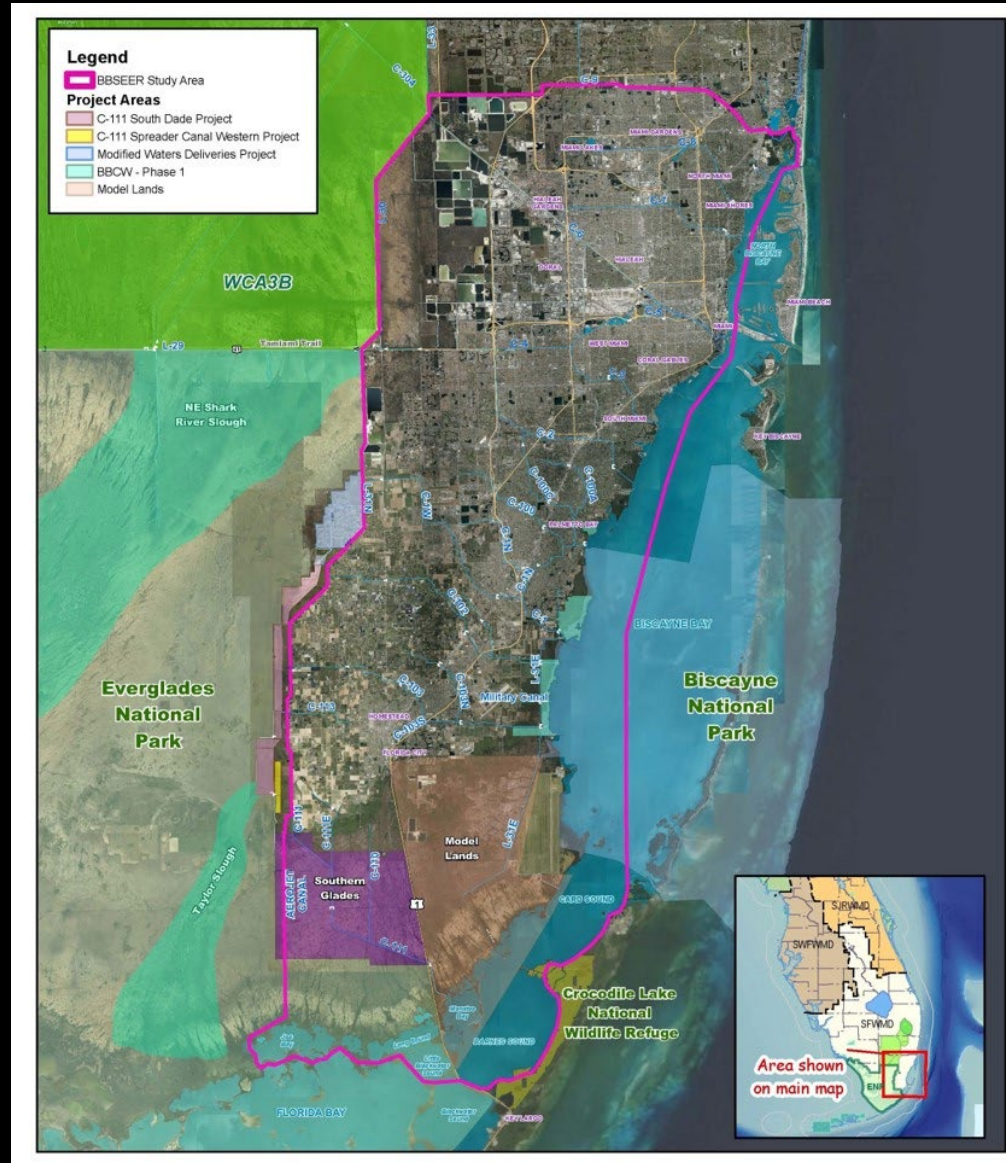
Khandker Ishtiaq – Everglades Foundation

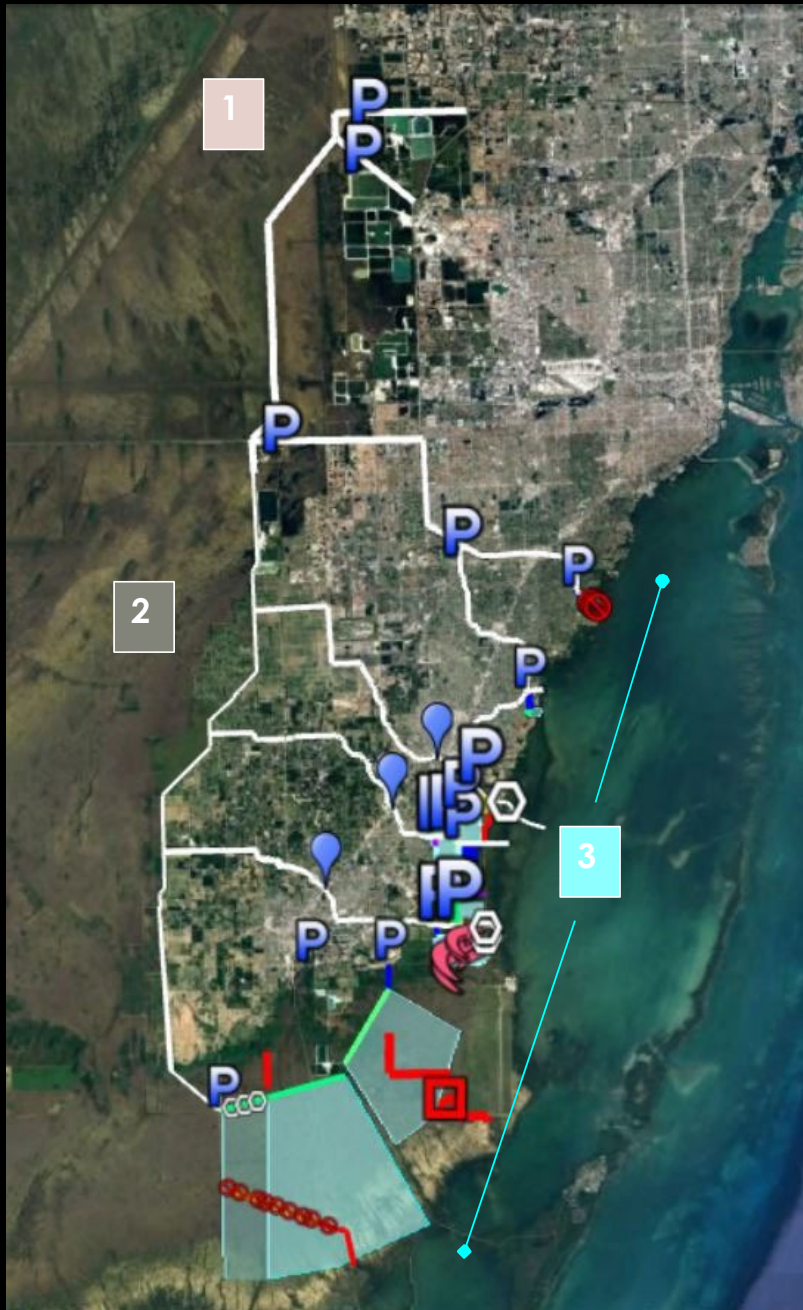
Tiffany Troxler – Florida International University

NCER2024

Biscayne Bay SouthEastern Everglades Ecosystem Restoration

BBSEER aims to restore natural areas in southeastern Miami-Dade County, including the Model Lands, Southern Glades, nearshore estuarine habitats of Biscayne Bay, and the associated coastal and freshwater wetlands.





BBSEER restoration plans involve redistribution of fresh water with operational changes to the canal system and the incorporation of new hydraulic structures

PRIMARY FEATURES



1) WATER SOURCING

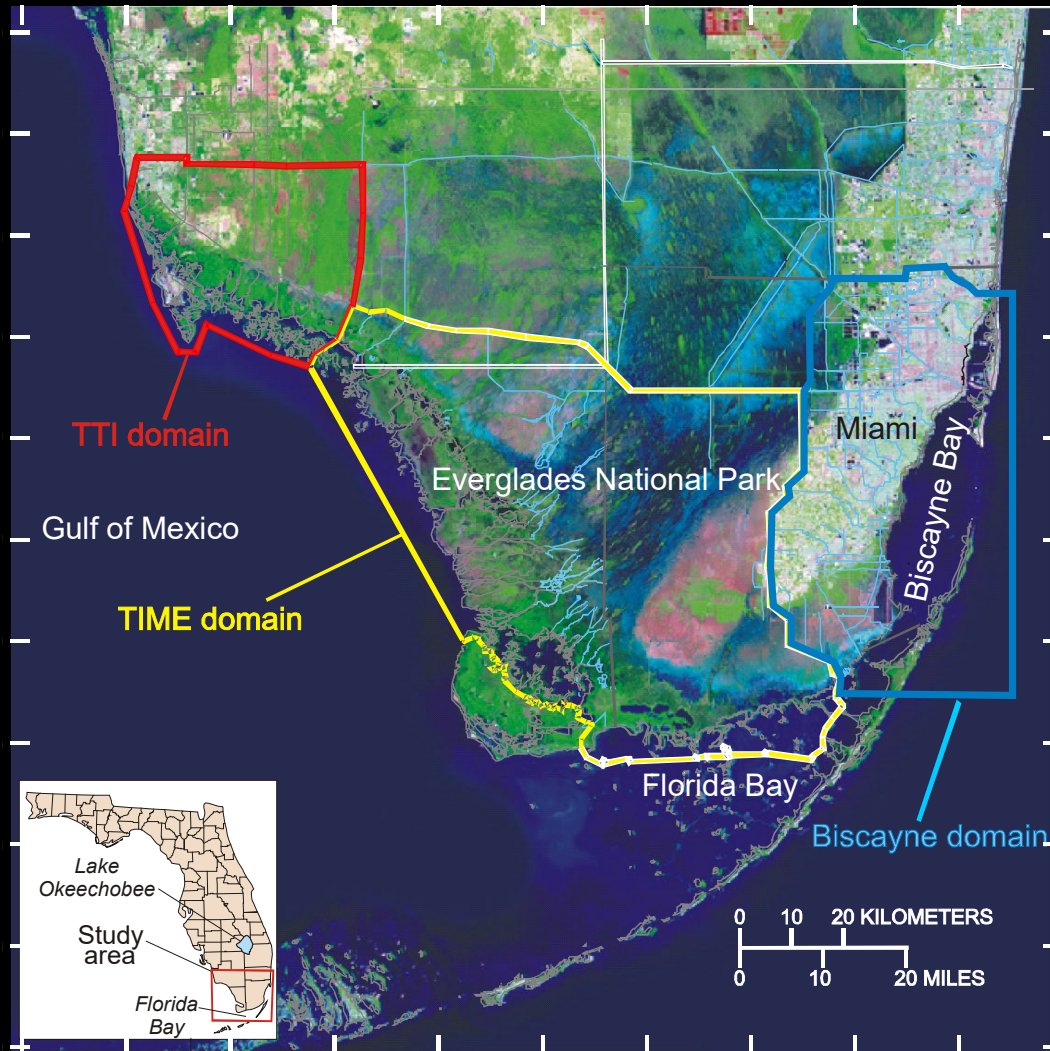


2) CONVEYANCE (EXISTING CANALS)
AND OPERATIONAL CHANGES IN CONVEYANCE CANALS



3) REDISTRIBUTION AND HYDRATION (INCLUDING USE OF PUMPS)

Linking hydrodynamic surface water and groundwater – BISECT Model



Code first applied to Florida Bay area in Southern Inland and Coastal Systems (SICS) model to examine coastal interactions

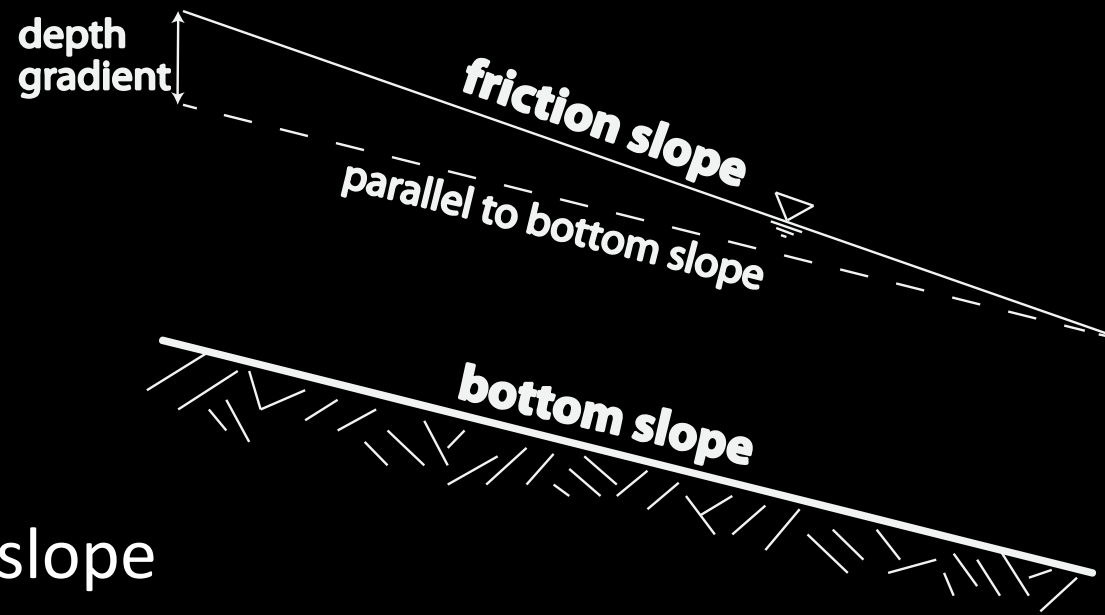
Tides and Inflows in the Mangrove Ecotone (TIME) model developed for Everglades National Park area

Application to Ten Thousand Islands area including heat transport for temperature computation

BISCAYNE application to the coastal and urban area of Biscayne Bay to examine hypersalinity events

TIME and BISCAYNE applications combined to produce Biscayne Southern Everglades Coastal Transport (BISECT) model

Surface Water Momentum Formulations



Kinematic Wave

friction slope = bottom slope

Diffusive Wave

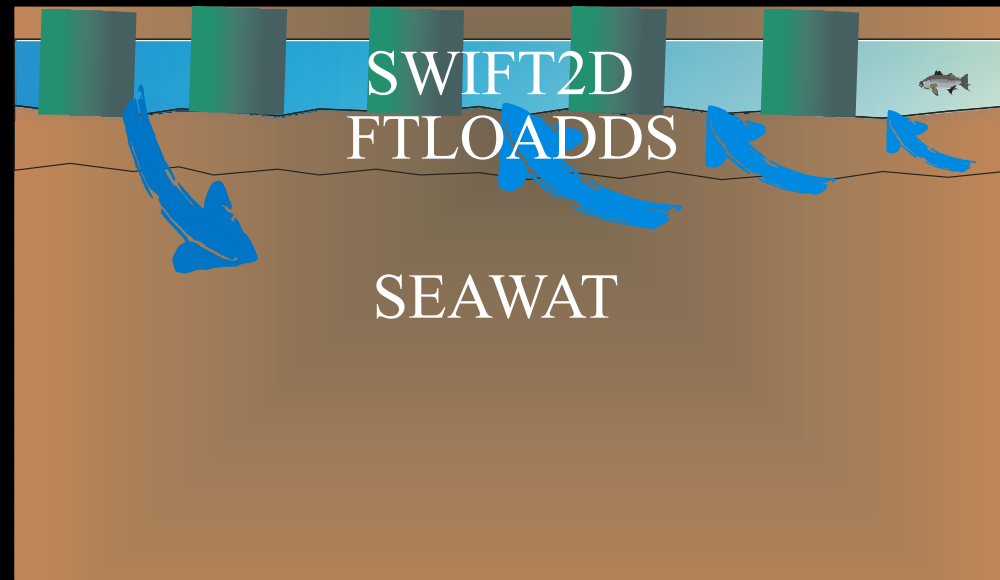
friction slope - depth gradient = bottom slope

Hydrodynamic

friction slope - depth gradient + temporal acceleration
+ spatial acceleration = bottom slope

Numerical Modeling Code

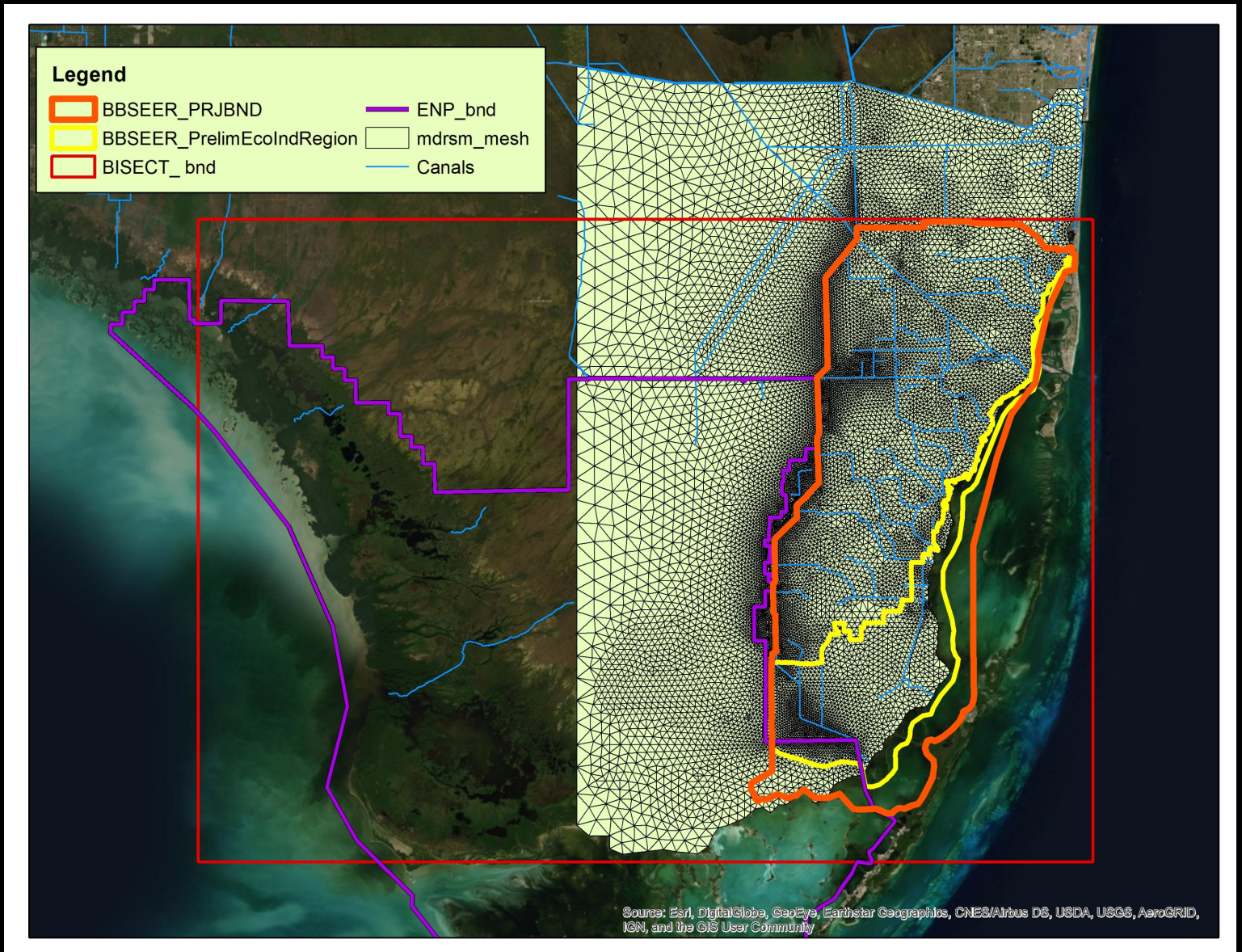
- BISECT uses the code FTLOADDS (Flow and Transport in a Linked Overland/Aquifer Density Dependent System) which combines:
 - **SWIFT2D** hydrodynamic surface water code
 - **SEAWAT** variable density ground-water flow and transport code
- Satisfies requirements for BBSEER
 - Hydrodynamic representation of surface water in two-dimensions
 - Three dimensional representation of groundwater
 - Salinity transport is represented in each model and passed with leakage



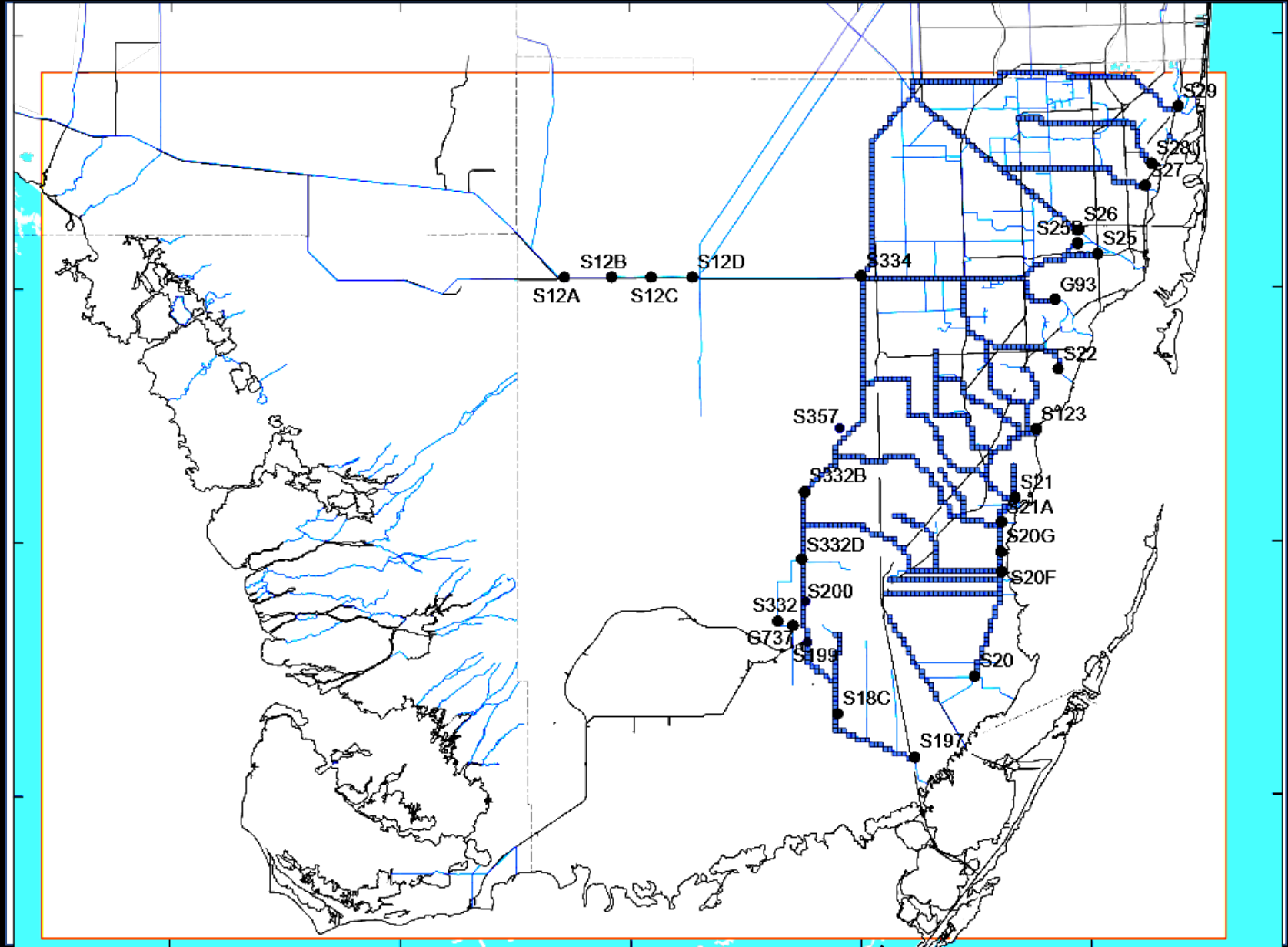
Interface between RSM and BISECT

The Regional Simulation Model (RSM) is a large-scale finite-volume model representing water management in the inland areas of South Florida

Hydrology of RSM scenario transferred to BISECT through surface-water control network (canal levels and structure flows)



Canals in BISECT simulation are assigned water-levels along with structure flows out of the canals from the RSM scenario simulation, driving the inland flows while BISECT simulates the coastal area.



Salinity

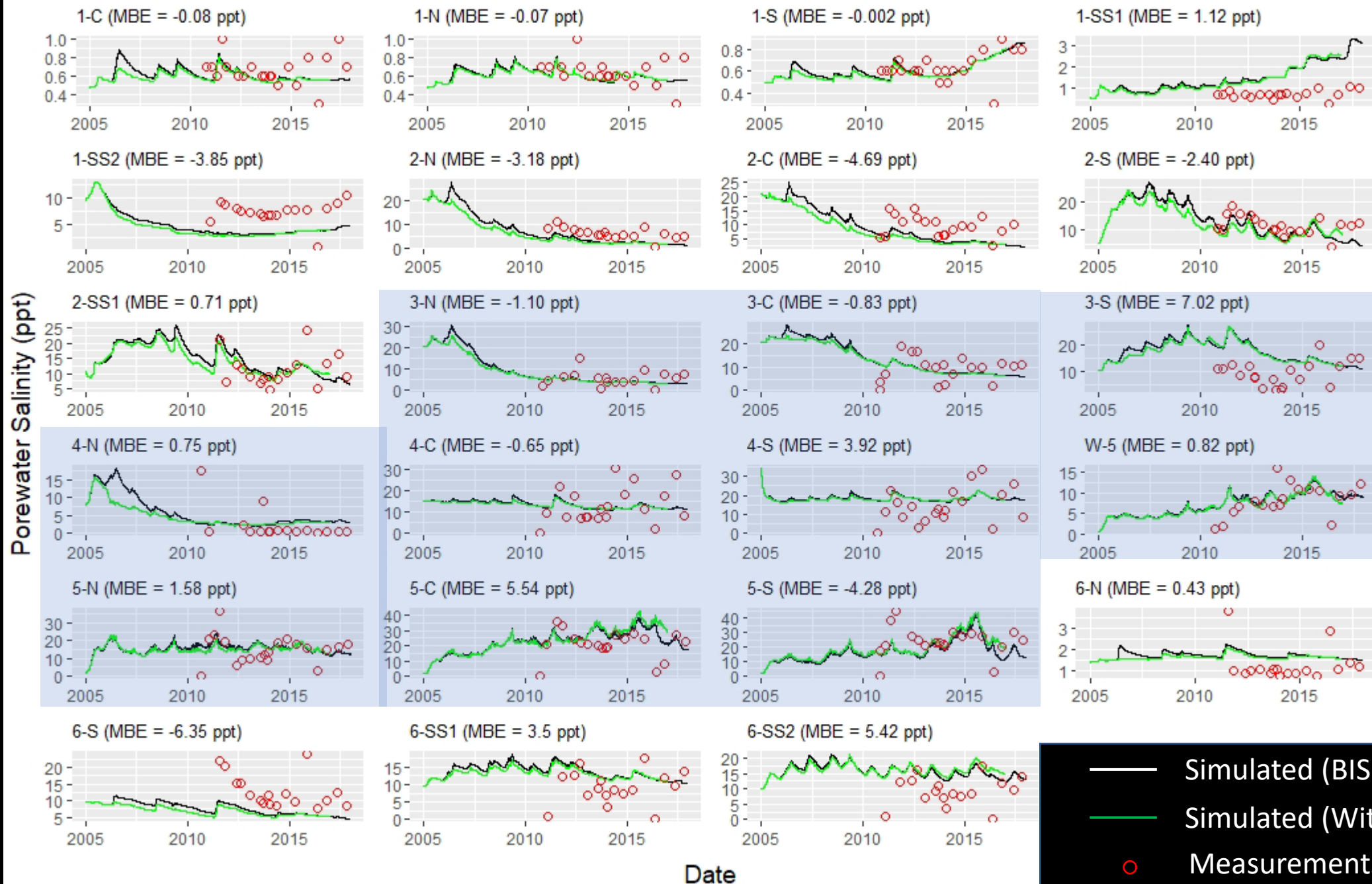
Calibrations

Sites

Salinity measurement transect locations provide a data set for additional BIsect calibration in coastal areas of importance to Ecosystem Restoration



Calibration Plots (Transect 1 to 6)

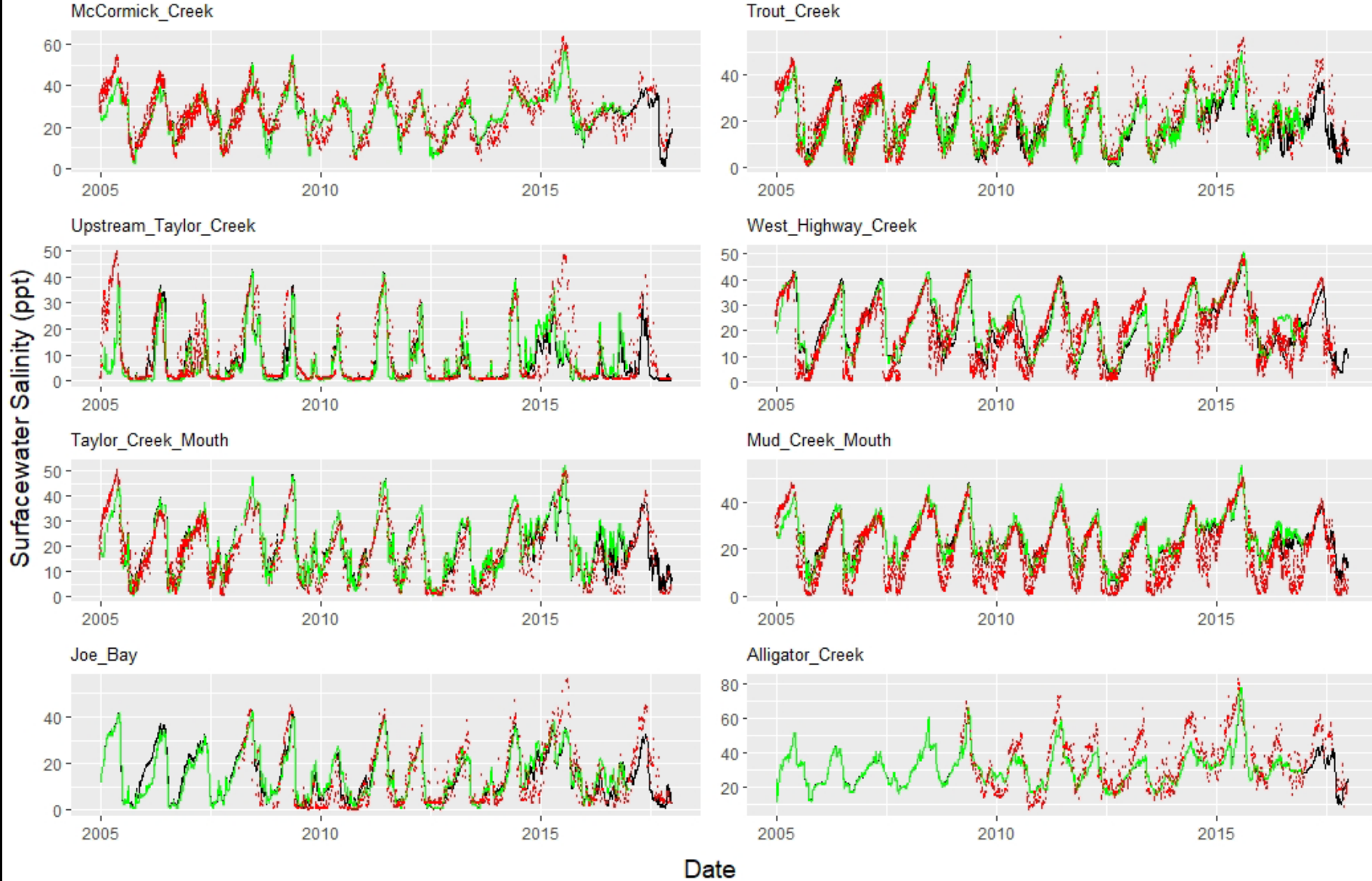


Porewater Salinity

Creek Salinity



Creeks

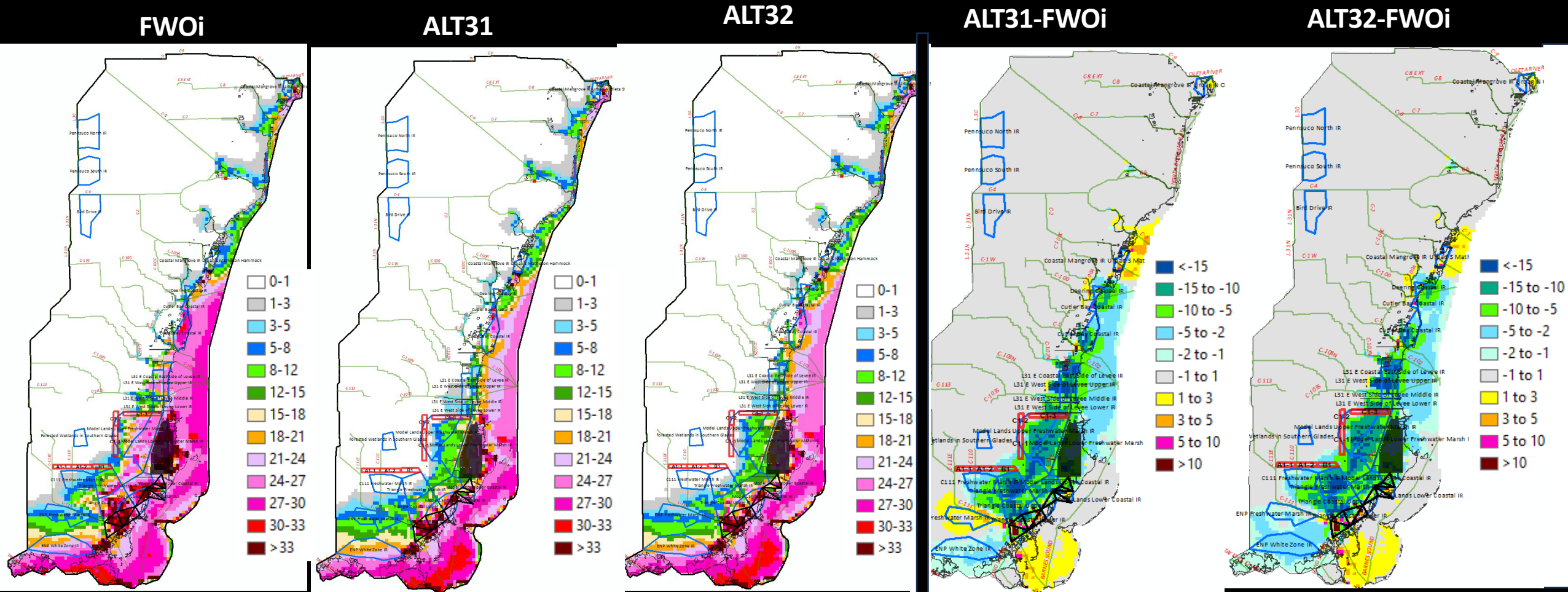


Creek Salinity

- Simulated (BISECT Calibration)
- Simulated (With RSM Data)
- Measurements

The median porewater salinity (2007-16) is compared between simulations representing future condition without management (FWOi) and restoration alternatives (ALT)

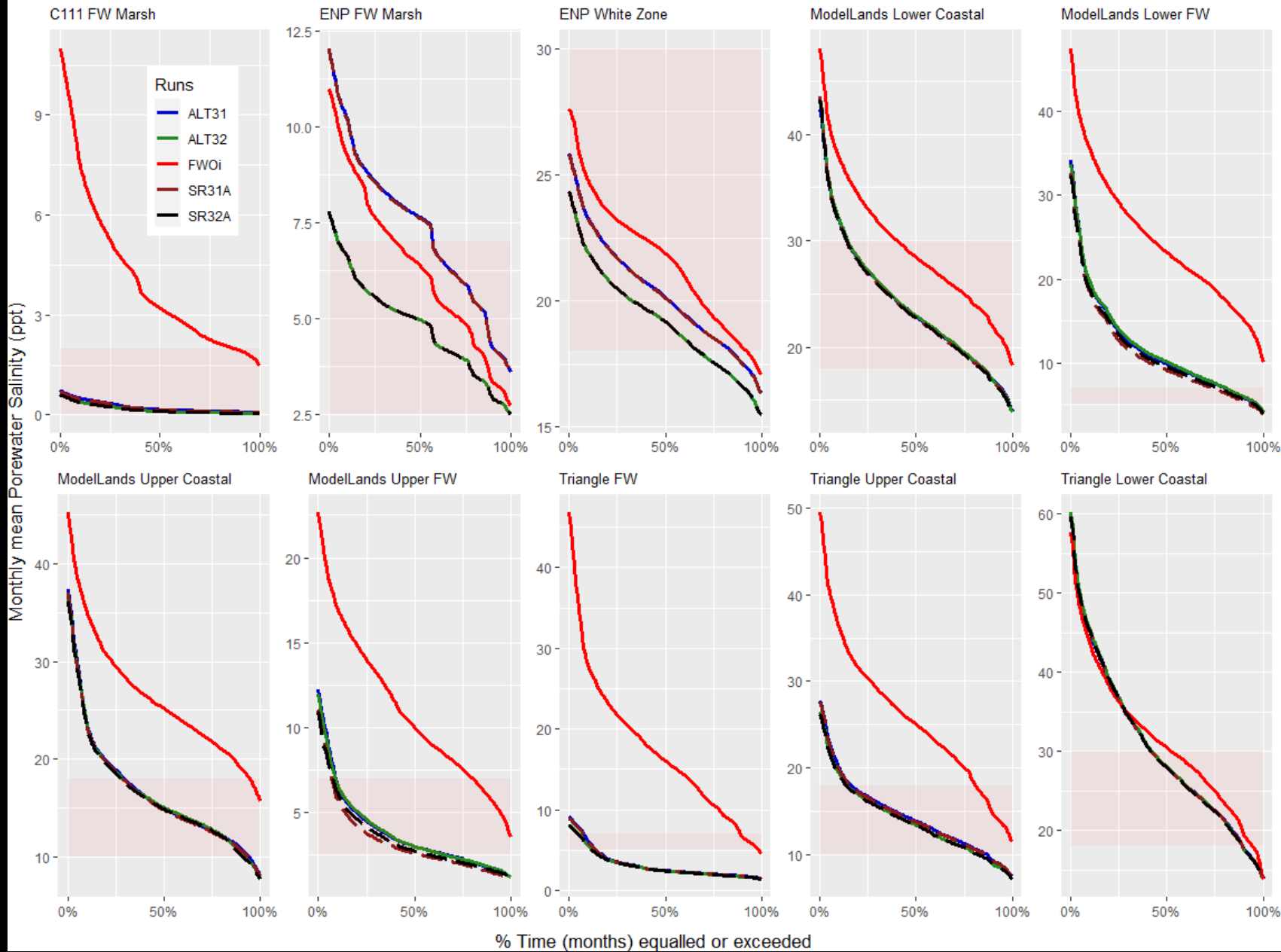
Blue and Green shades indicate salinity decreased in the ALTs from FWOi



Salinity values

Salinity differences

Salinity duration curves for Southeastern IRs

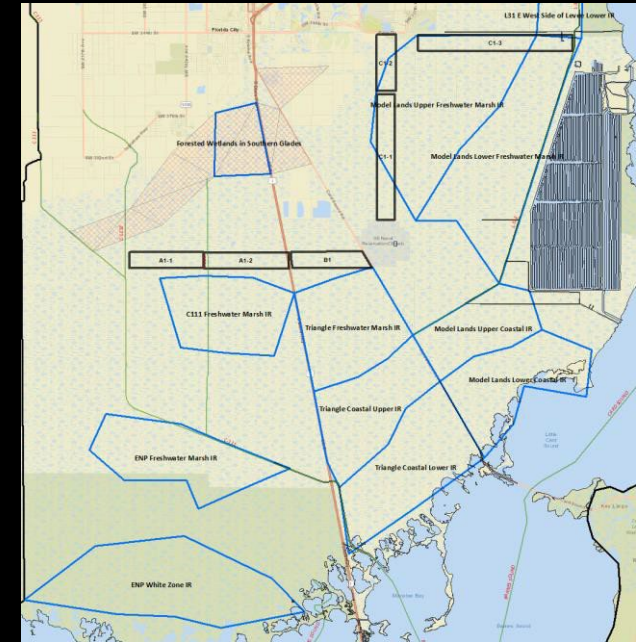


Blue ALT31

Green ALT32

Red FWOi

Dotted lines: SR31A and SR32A



Summary

- The interface between RSM and BISECT allows hydrologic-management scenarios simulated in RSM to provide inland forcings to BISECT simulations, which then can represent the effects on salinity and other coastal parameters
- The simulations provide criteria for evaluating the effectiveness of BBSEER restoration scenarios
- Substantial reduction of salinity is seen in target locations (Model Lands and further south).

Questions?