Biscayne National Park

South Florida Natural Resources Center

National Park Service
U.S. Department of the Interior

AN IMPROVED BISCAYNE BAY HYDRODYNAMIC MODEL FOR EVALUATION OF RESTORATION EFFORTS AND GROUNDWATER FLOW ON SALINITY

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Tuesday, April 20th @ 4:45 pm, session 14

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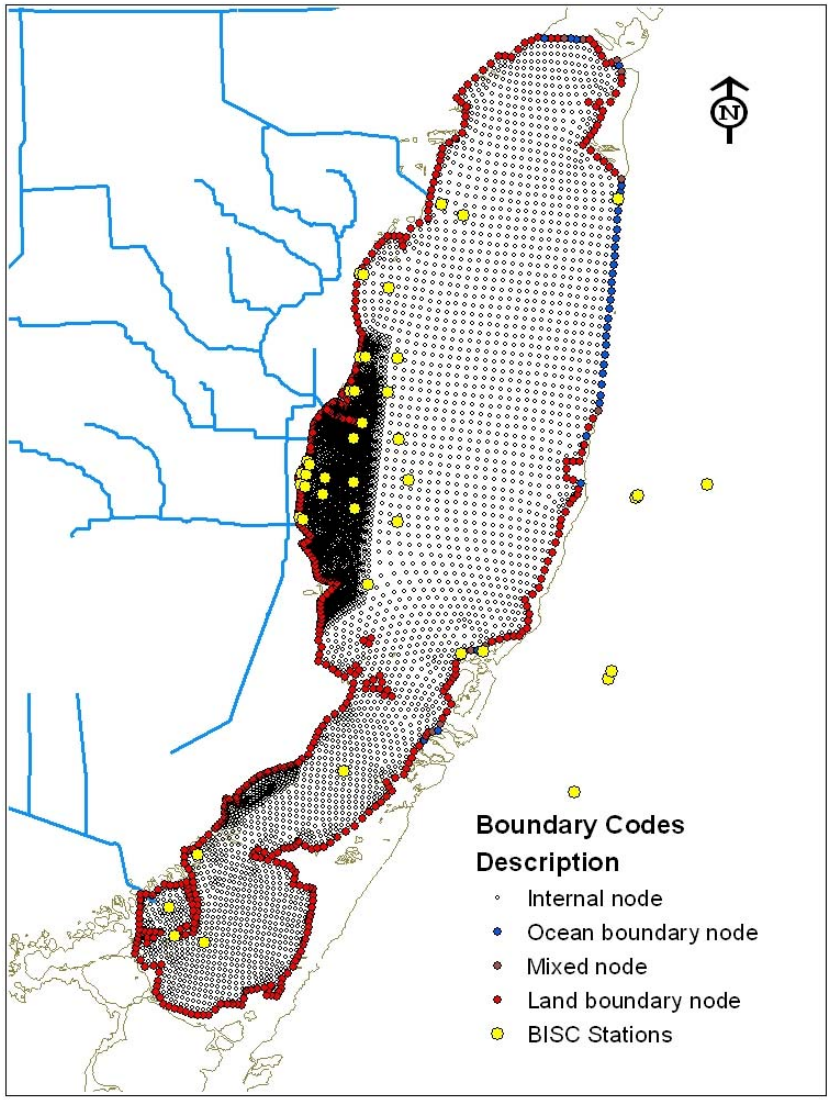
Overview

- **Physical setting and hydrodynamic modeling updates**
- Evaluation of BBSM v.4
- Uses and next steps

The Model

- Model developed by John Wang and others at the University of Miami
- Used in various forms since late 70's.
- General name = CAFE3D
  - Current implementation is single layer
  - Fortran
- Model has been used in Biscayne Bay to:
  - determine residence times for various locations in the bay
  - evaluate the effect of restoration alternatives with respect to salinity
  - investigate connectivity between basins

Biscayne Bay Simulation Model v.3



Predicting salinity regime under alternate discharge scenarios

BBSM model with:

- Advection and diffusion
- Rain and evaporation
- Wind stress
- Bottom friction
- Tidal mixing
- Surface water inflows
- Control on boundary conditions
- 11 years (1996 – 2006) at 20 minute resolution
- Model processing time = 37 hours

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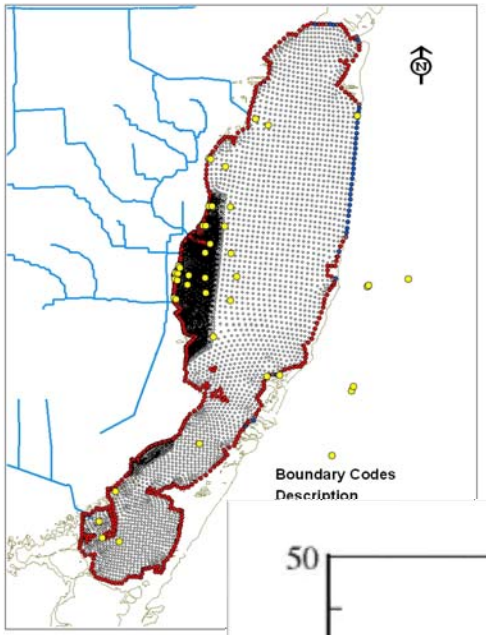
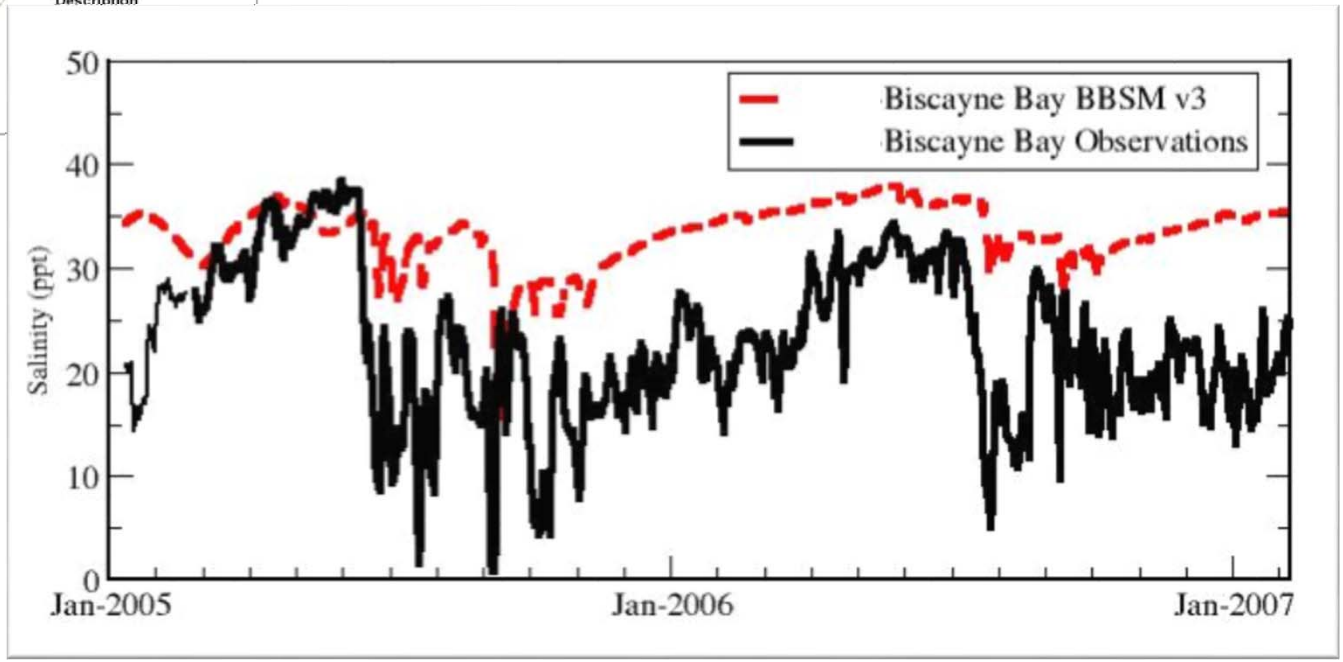


BBSM v3 strengths:

- Salinity mid-bay
- Seasonal aspects of salinity
- Currents are available

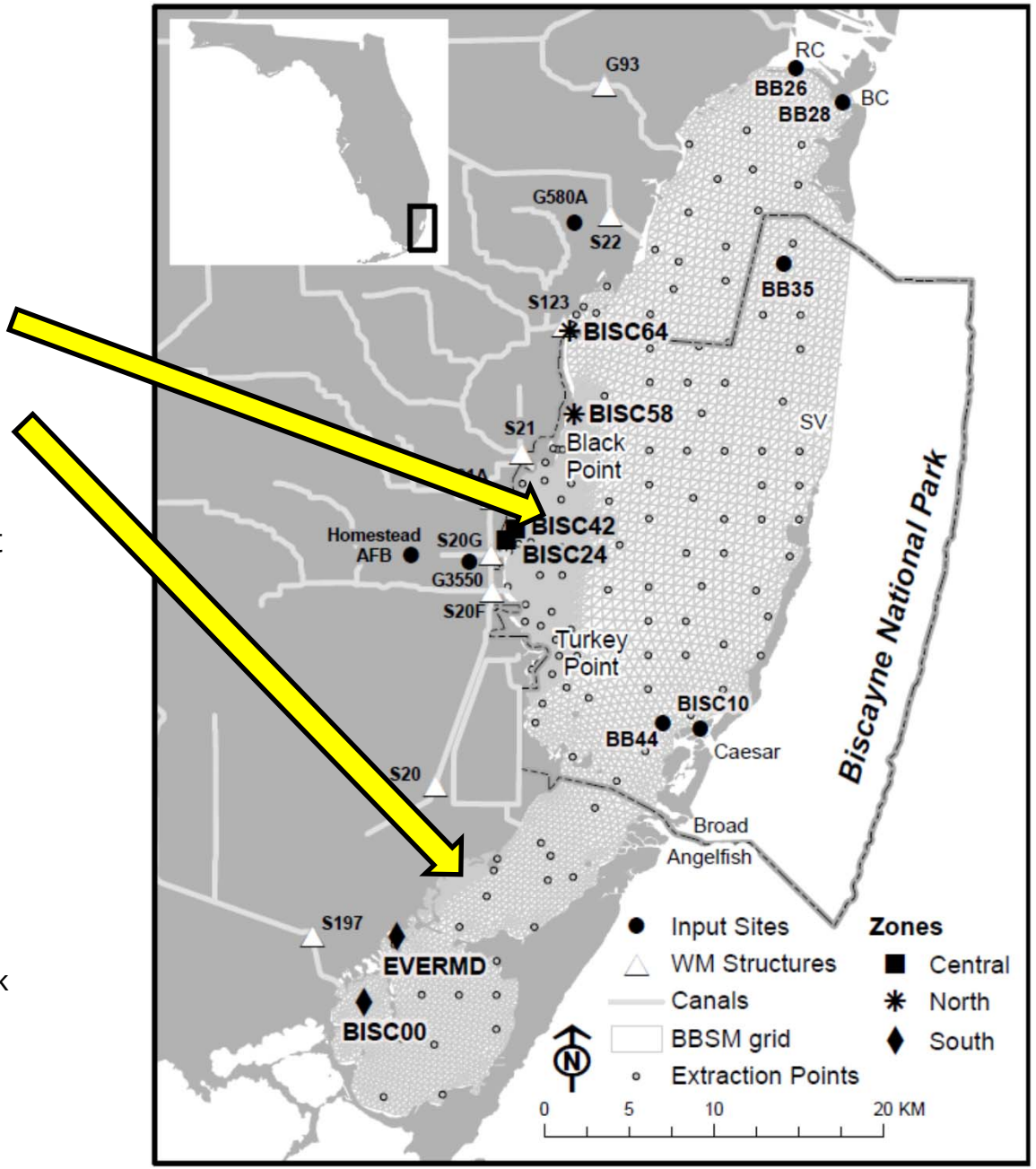
BBSM v3 weakness:

- Low variability in salinity nearshore
- Unrealistic representation of groundwater

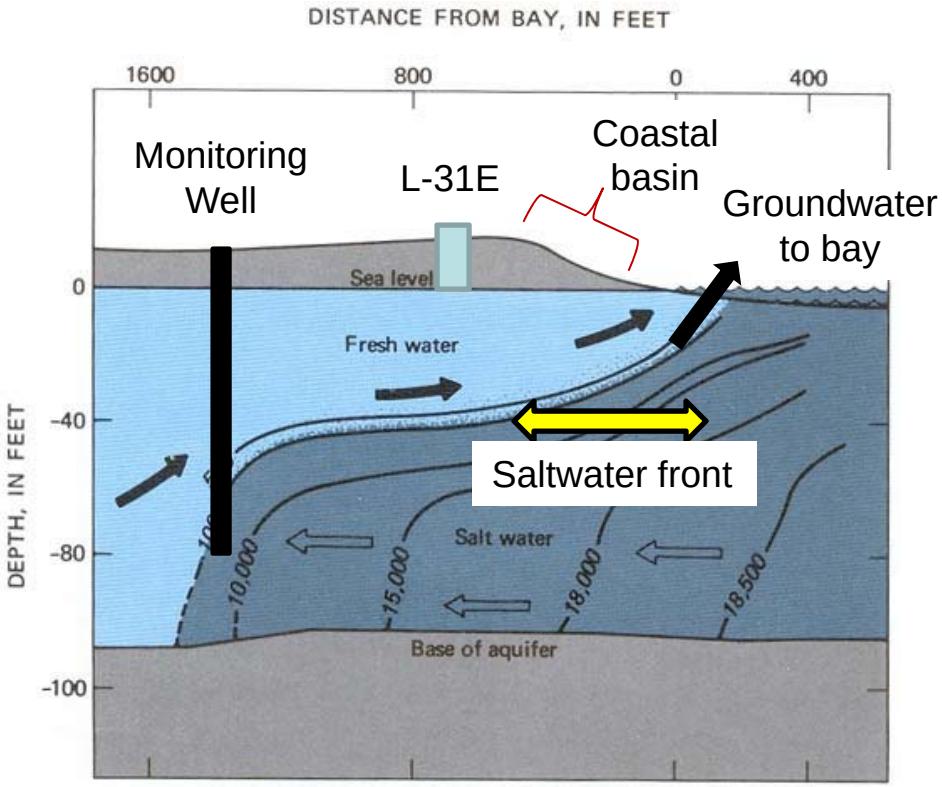


Biscayne Bay Simulation Model (BBSM) v.4

- **Maintained grid from v.3**
- **Updated friction to improve retention of water in shallow areas**
- Added surfacewater component for coastal basins
- Added groundwater component based on modeled and measured estimates
- Improved input parameters
  - Daily rain-evaporation
  - Daily salinity on boundary
  - Calculated tides on each creek
  - Updated structure discharge



Water management and groundwater connections



- Tidal and seasonal influences on groundwater motion
- Water levels in canals are variable
- Wells west of coastal zone reveal extent of saltwater intrusion
- Low density freshwater floats on top of denser saltwater component
- Precipitation on basin between L-31E and coast flows to bay

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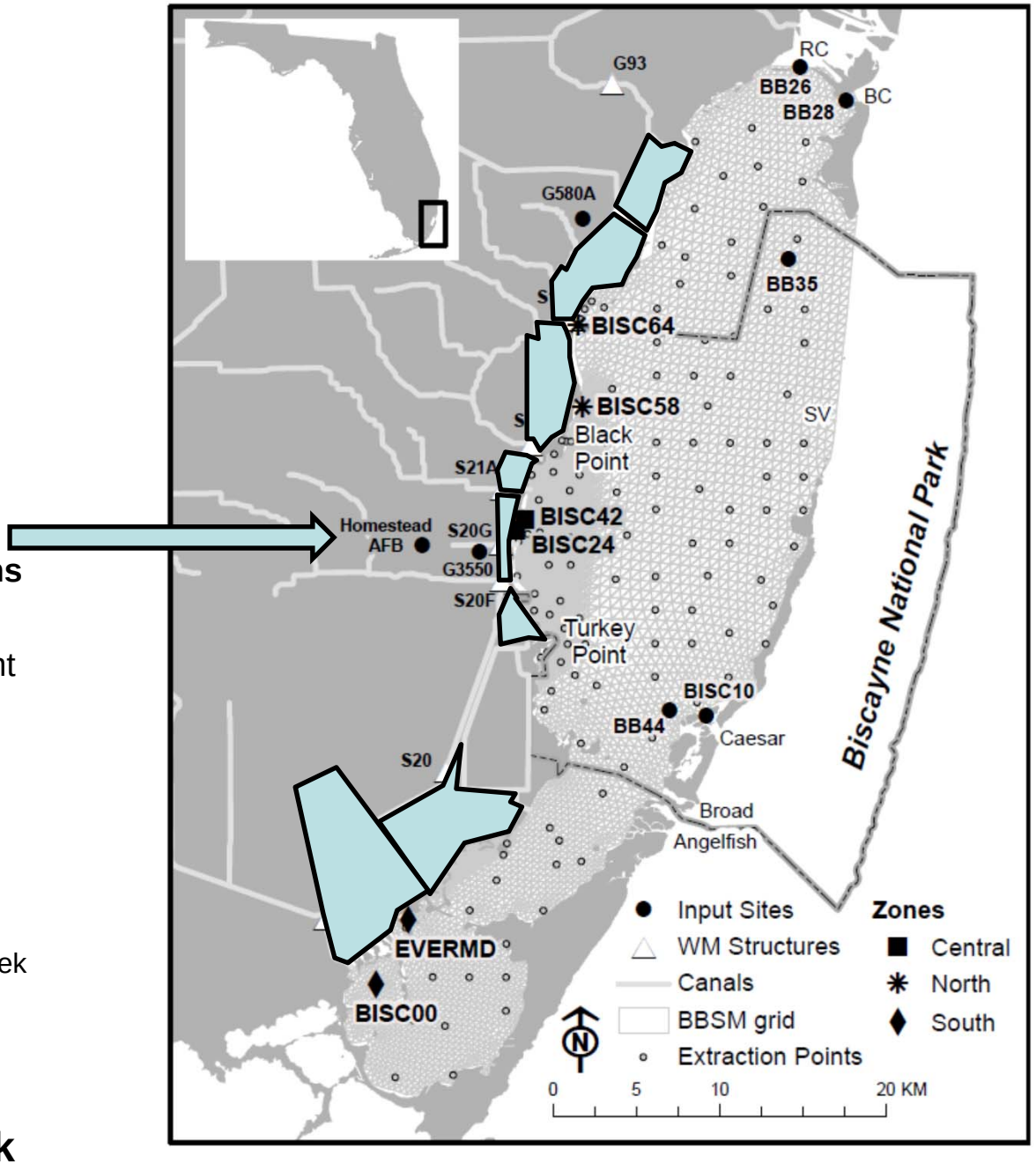

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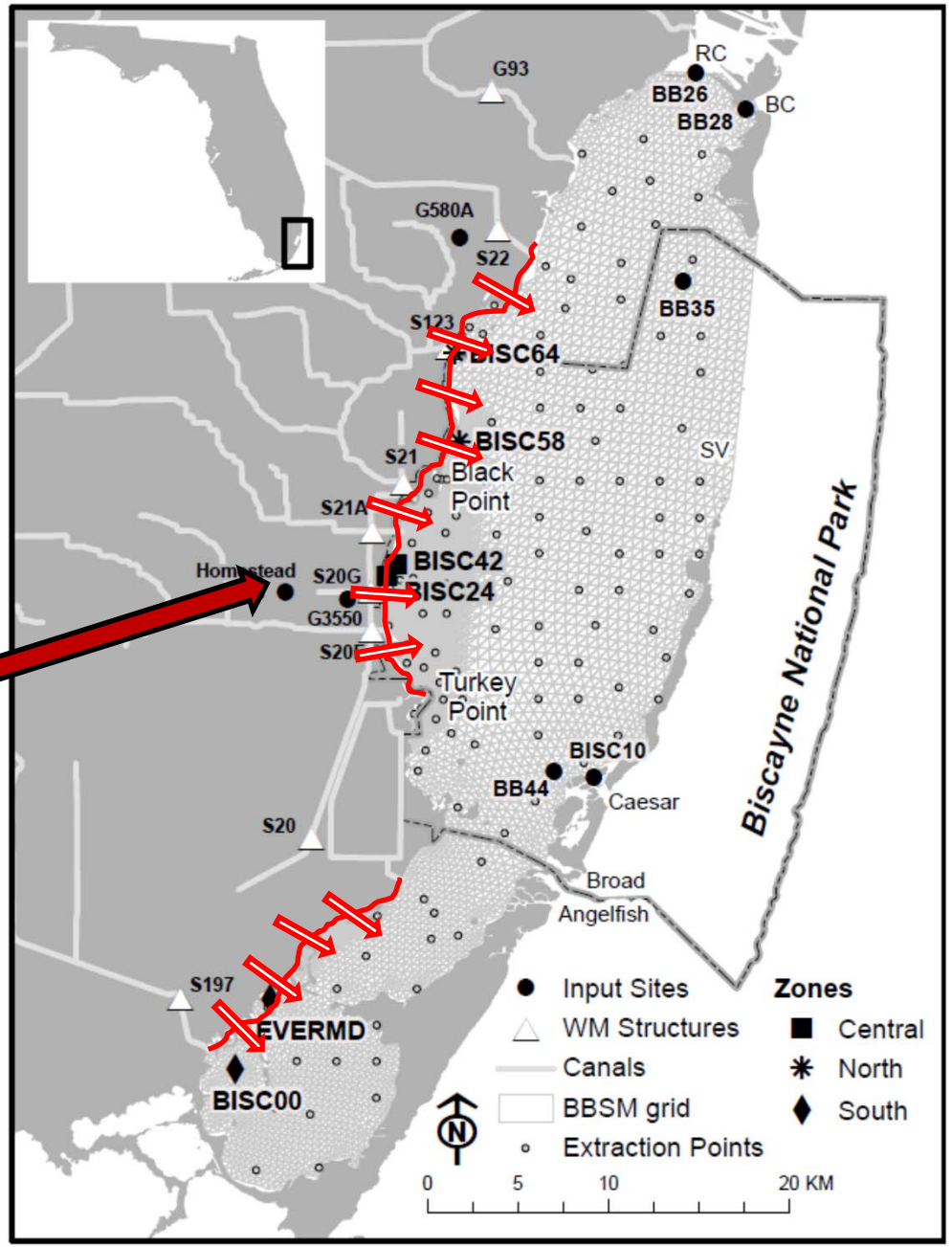

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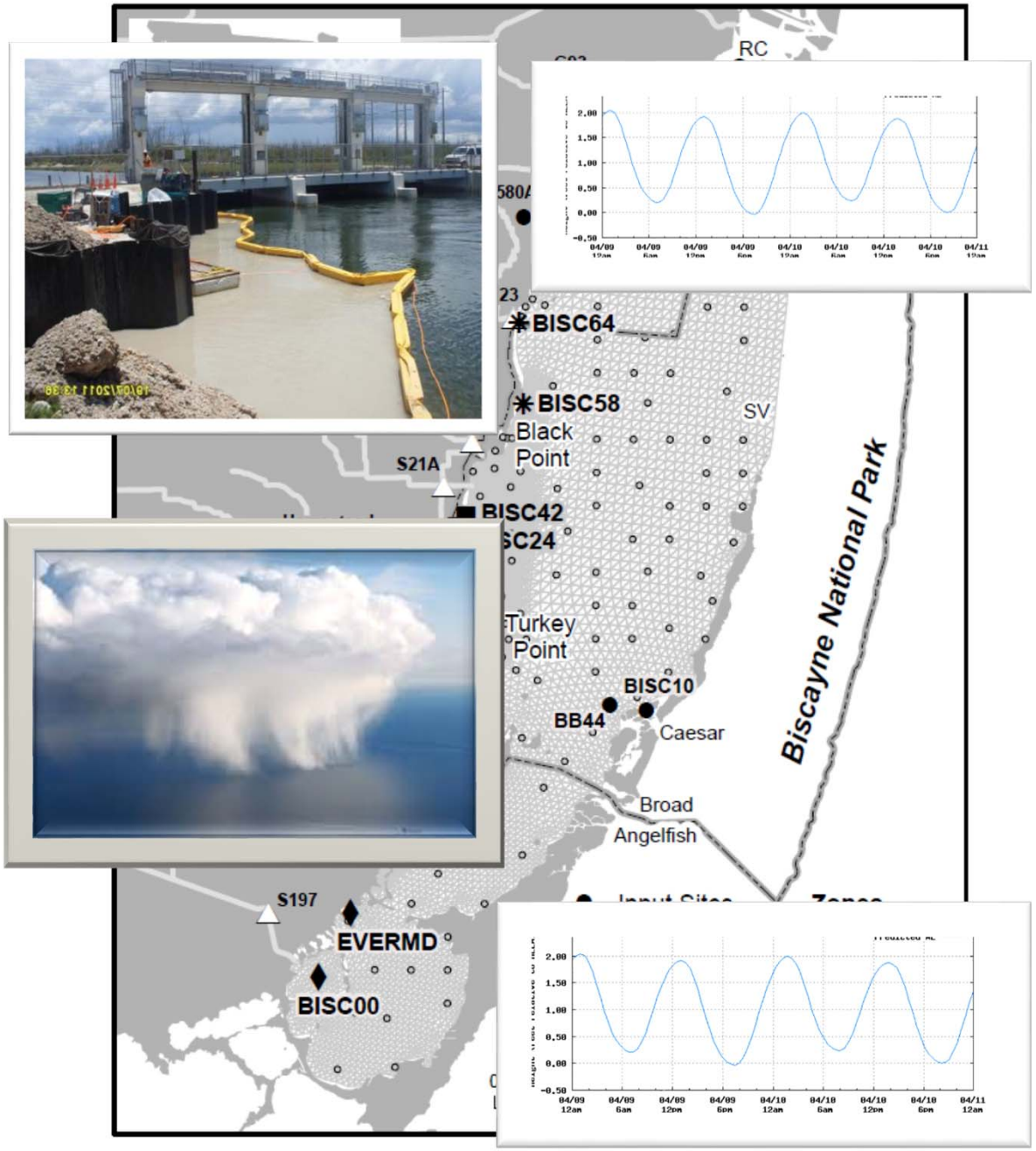

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Biscayne Bay Simulation Model (BBSM) v.4

Salinity monitoring starts in 2004

BBSM v3: 1996 – 2006

BBSM v4: 1996 – 2011

Improved input parameters

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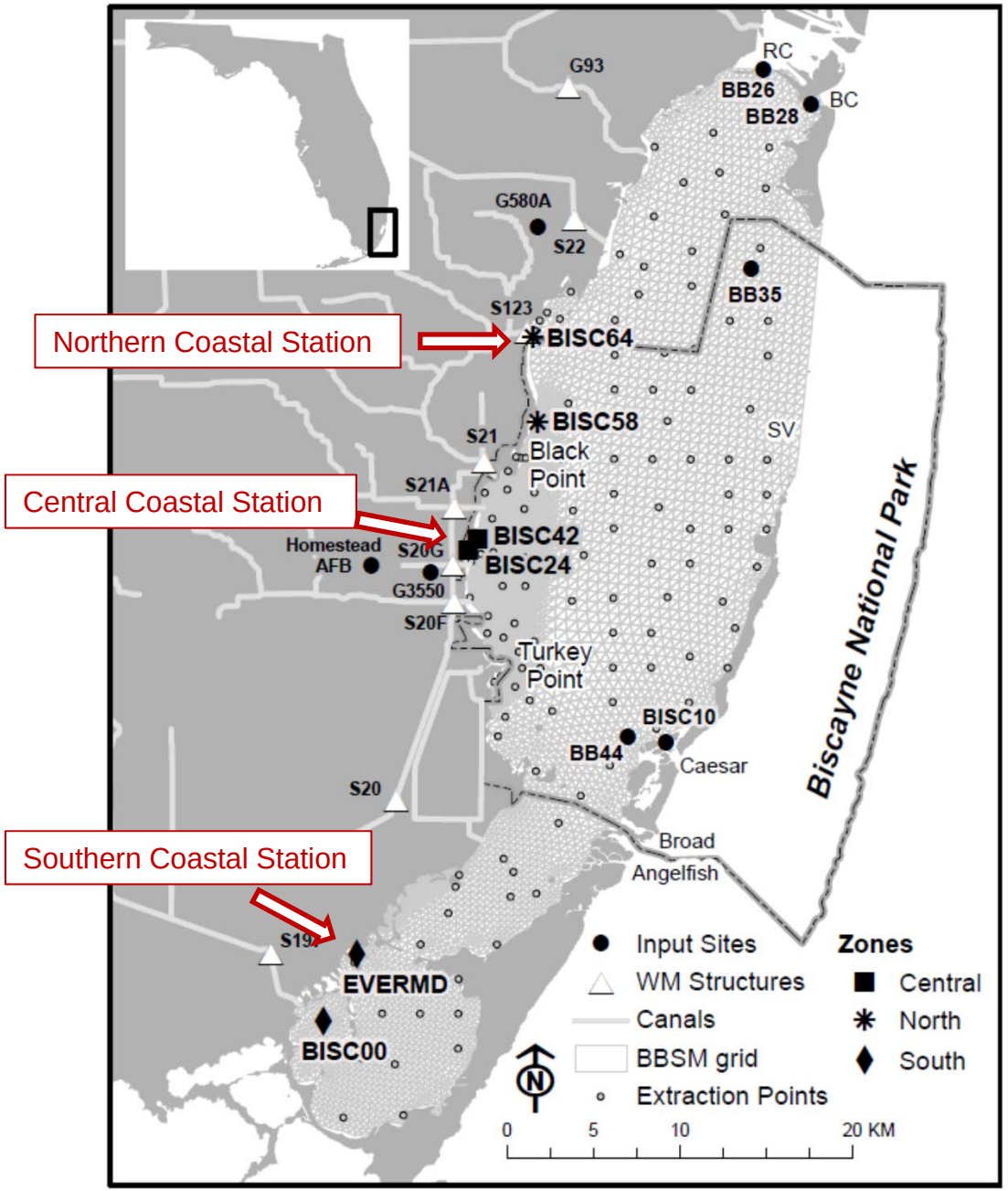
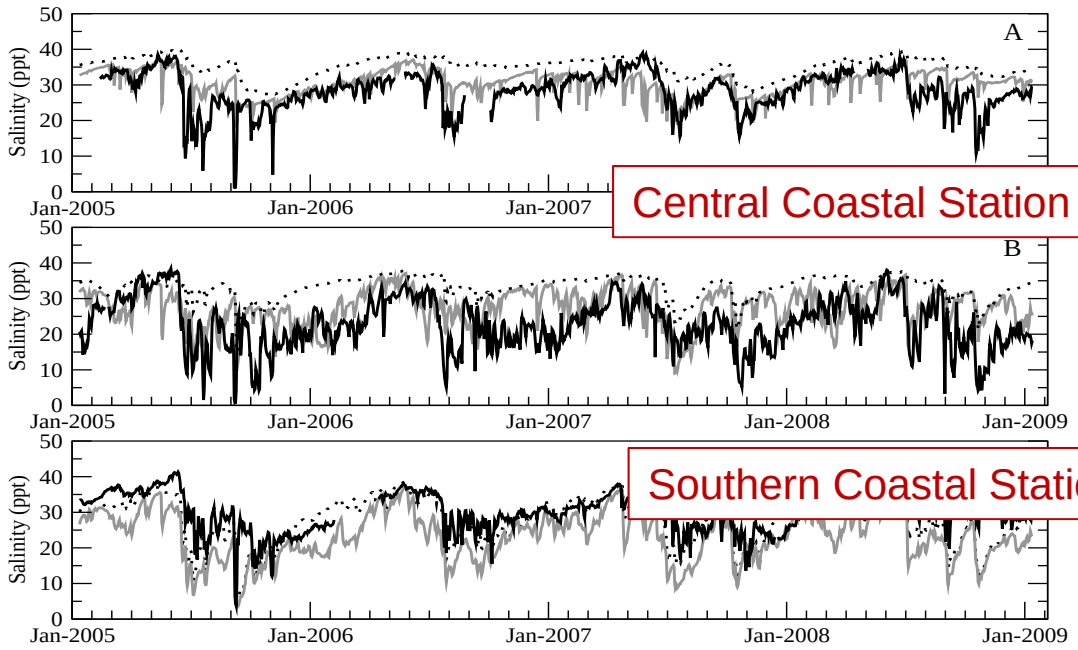


Comparison with available salinity data

Northern Coastal Station



Central Coastal Station

Southern Coastal Station

- Improved mean and variability
- Maintained seasonality

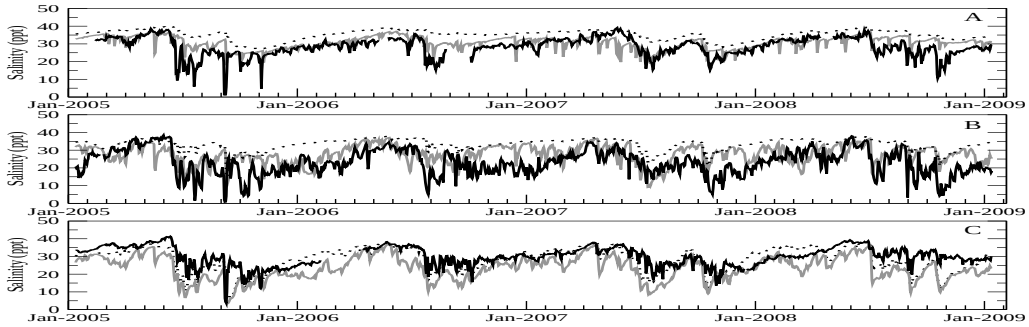
Salinity monitoring starts in 2004

BBSM v3: 1996 – 2006

BBSM v4: 1996 – 2011

Comparison with available salinity data

Dotted – BBSM v3
Grey – BBSM v4
Black - Observed



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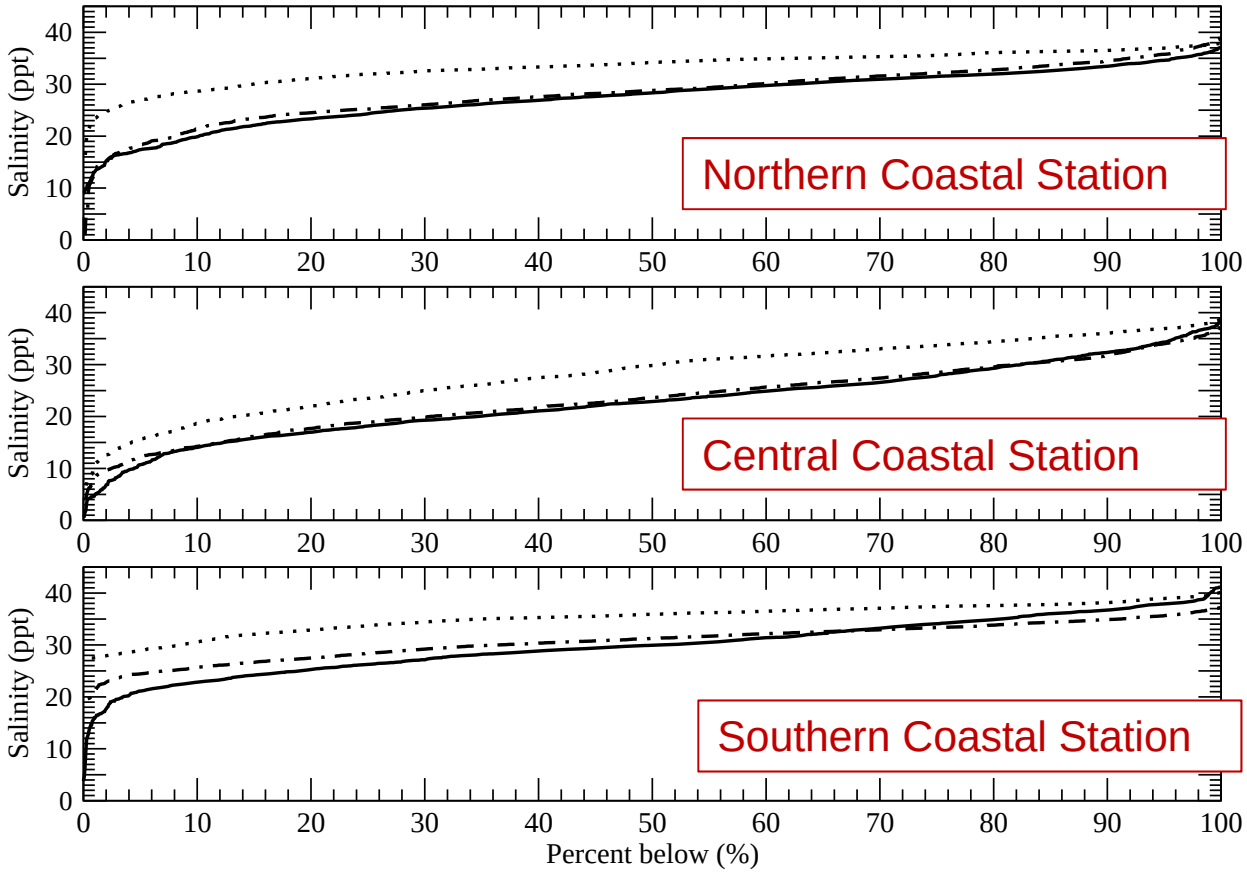

- More natural salinity distribution
- Room for improvement in highest flow (lowest salinity) period

Salinity monitoring starts in 2004

BBSM v3: 1996 – 2006

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Ongoing uses of BBSM v.4

L31E freshwater withdrawals

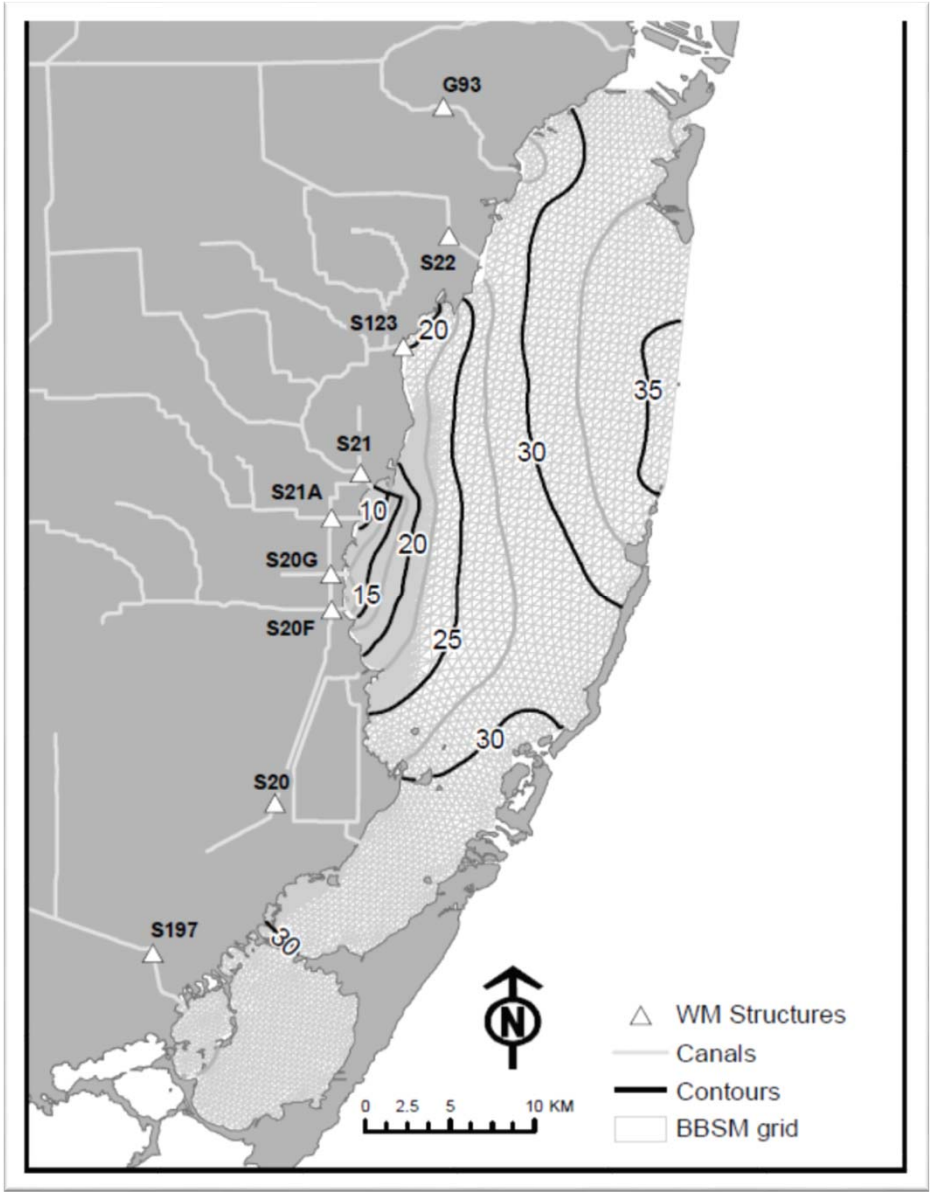
- FPL emergency operation to reduce salinity and temperature in IWF
- Freshwater being moved from coastal canal (L31E) to IWF
- Operations can be simulated and adjustments suggested to minimize impact

Restoration efforts

- Model and evaluate operations for phase 1 features
- Biscayne Bay coastal wetland phase 2 project

Dry Season flow request (2011)

- Trial operations authorized and performed
- BBSM v4 to be used to evaluate results

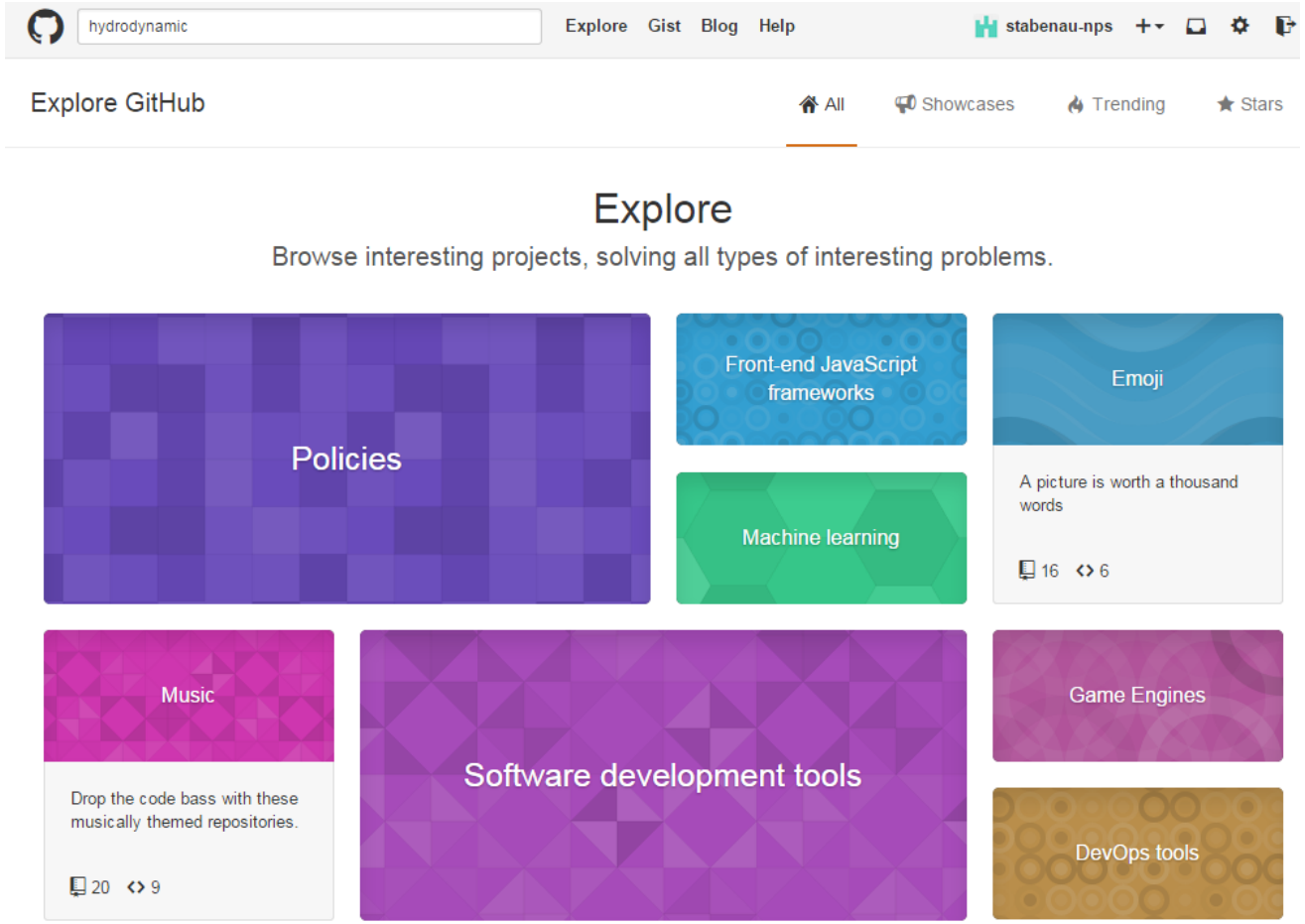


BBSM v.4 Available on GitHub

Open source

Language: Fortran

https://github.com/stabenau-nps/BBSM.git



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Data available at: EVER_data_request@nps.gov

BBSM v4 code available at: https://github.com/stabenau-nps/BBSM.git

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