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

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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
Biscayne Bay Simulation Model v.3

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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Biscayne National Park

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Salinity monitoring starts in 2004

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Northern Coastal Station
Central Coastal Station
Southern Coastal Station

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Comparison with available salinity data

- Improved mean and variability
- Maintained seasonality

Salinity monitoring starts in 2004

**BBSM v3**: 1996 – 2006
**BBSM v4**: 1996 – 2011
Comparison with available salinity data

• Improved mean and variability
• Maintained seasonality

Salinity monitoring starts in 2004

Comparison with available salinity data

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

Salinity monitoring starts in 2004

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• Uses and next steps
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
Product of the South Florida Natural Resources Center

Contact: Erik_Stabenau@nps.gov or 305-224-4209
Data available at: EVER_data_request@nps.gov
BBSM v4 code available at: https://github.com/stabenau-nps/BBSM.git