SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Three Dimensional Model Evaluation of Physical Alterations of the Caloosahatchee Estuary, Impact on Salt Transport

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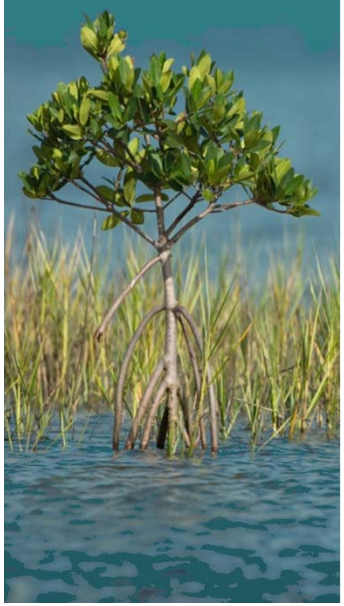
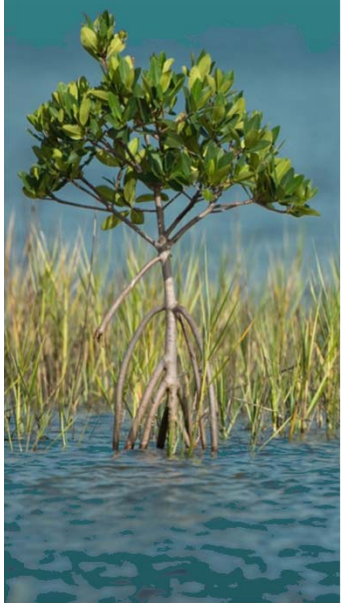


Background

- Impacts of physical alterations noted worldwide
- South Florida estuaries have experienced significant changes
- Impacts possibly irreversible



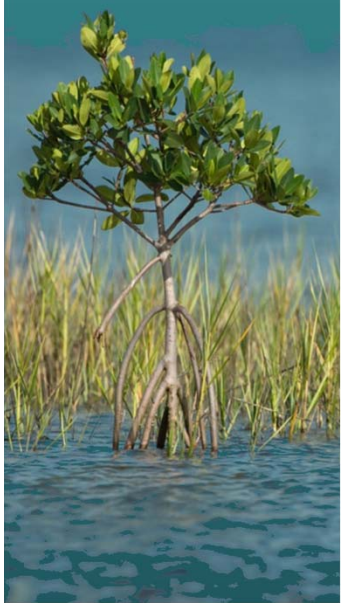
Background

Why the study?

- Part of Caloosahatchee River Estuary Minimum Flow and Level update study
- What the salinity would look like if no alterations
- Potential implication for developing environmental flow targets

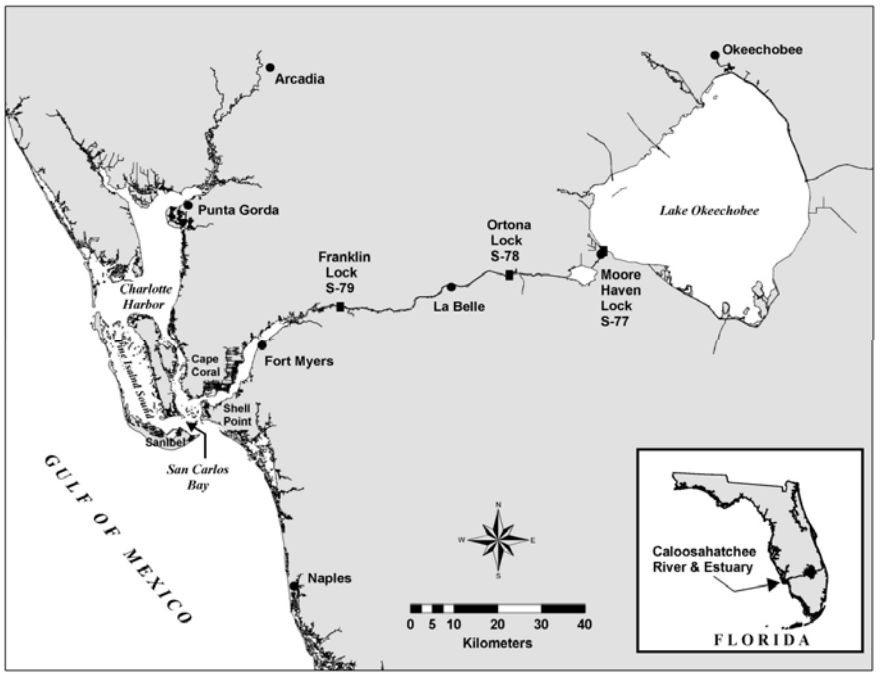
Historical Changes

1. 1887 Caloosahatchee River (4x35)
2. 1881 H. Disston Drainage Canal
3. 1882 Caloosahatchee (7x100)
4. 1891 Charlotte Harbor (12x200)
5. 1902 Orange River (4x50)
8. 1912 Boca Grande (24x300)
9. 1915 Caloosahatchee (5x40)
10. 1930 E.W. Crayton (3x40
11. 1945 Realigned
12. 1960-64 Gulf Intracoastal Waterway
13. 1955Big Hickory-Wiggins Pass (4x50)
14. 1960-68 Matanzas Pass
15. 1963 Two man-made islands built for construction of Sanibel Causeway
16. Historical oyster bars removed
17. 1930s Moor Haven Lock and Ortona Lock
18. 1960s Franklin Lock



Objectives

- Quantitatively evaluate the impact of physical alterations on salt transport in the Caloosahatchee River Estuary
- Identify which alteration is primarily responsible for the salinity changes

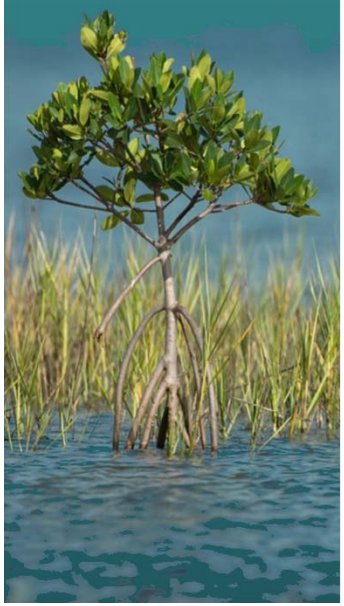


Modeling Methodology

- **Modeling the existing condition (calibration/validation)**
- **Alteration made relative to existing condition by modifying grid and/or depth**
- **Keep forcing boundary conditions the same**
- **Compare salinities**
- **Five alteration cases modeled**

Model Validation

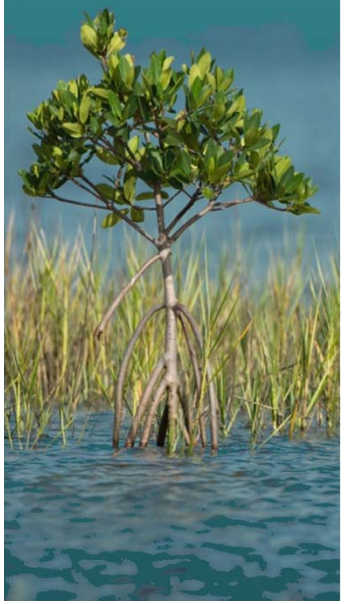
- 5300 horizontal cells
- 5 vertical layers
- Covers CRE, San Carlos Bay, Pine Island Sound, part of Charlotte Harbor and offshore areas of Gulf of Mexico
- Validated with more than 10 years of tide, salinity data and 3 years of tidal discharge data

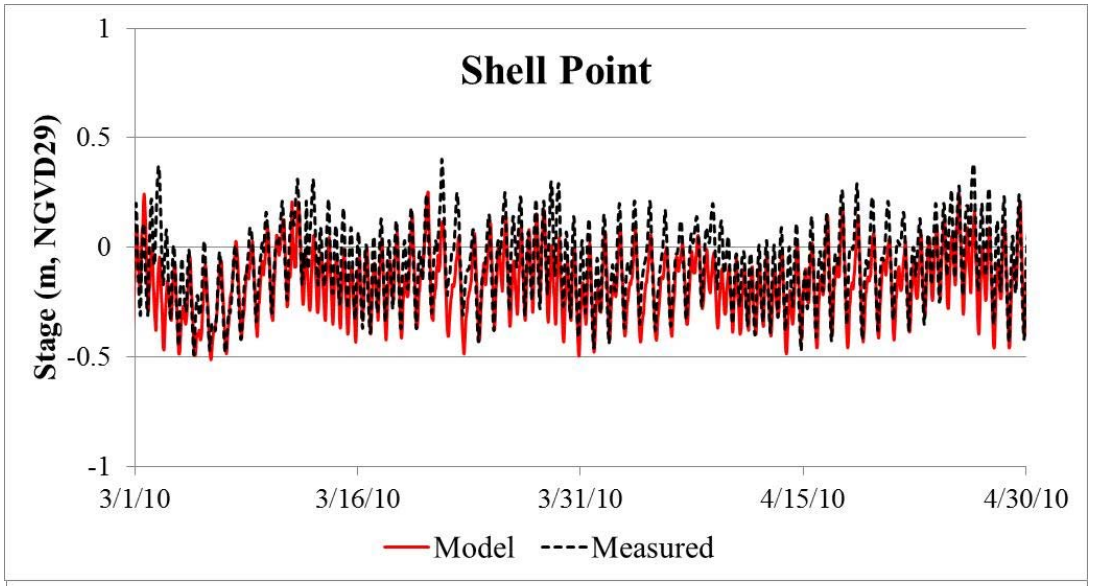


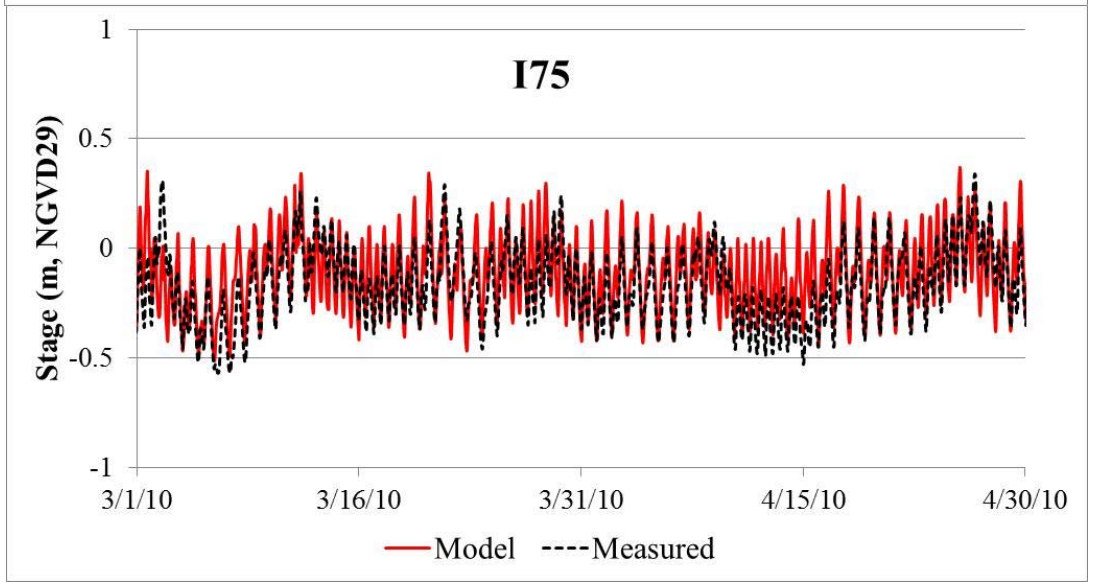
Model Validation

Monitoring stations

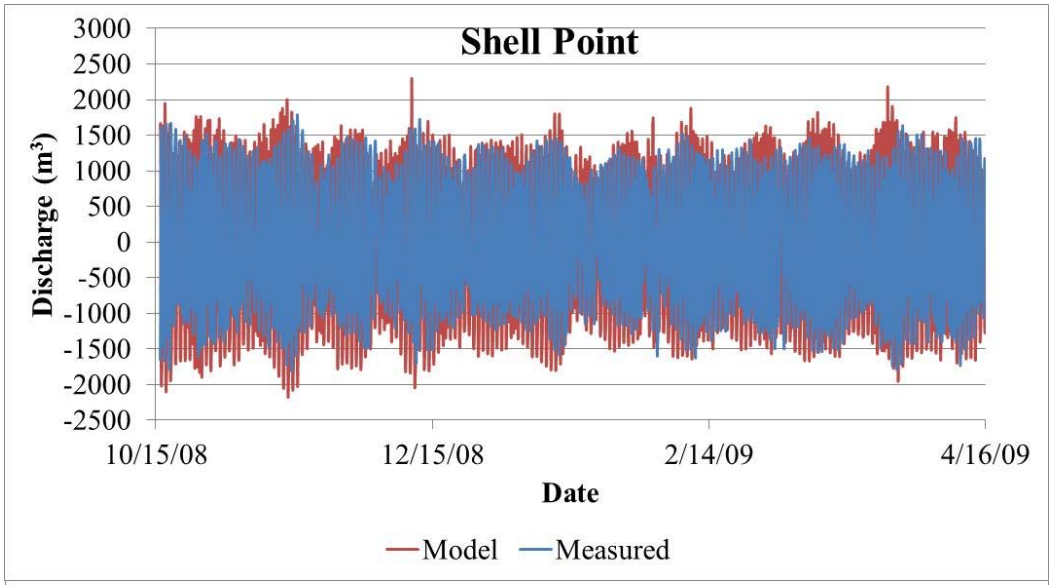
Model Validation (stage)

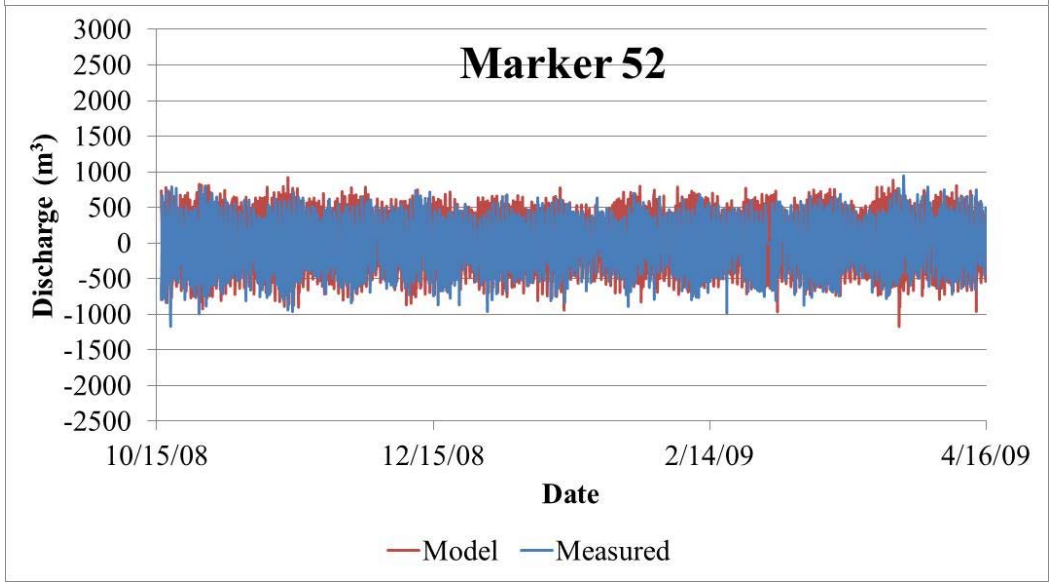




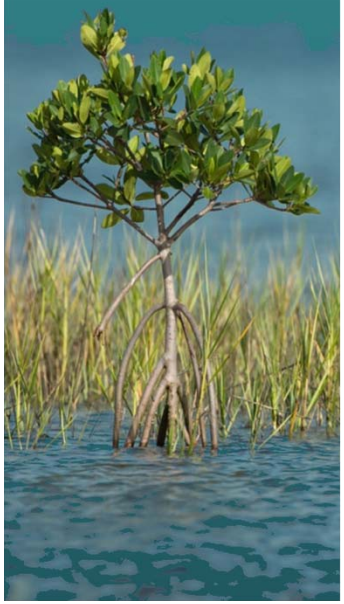


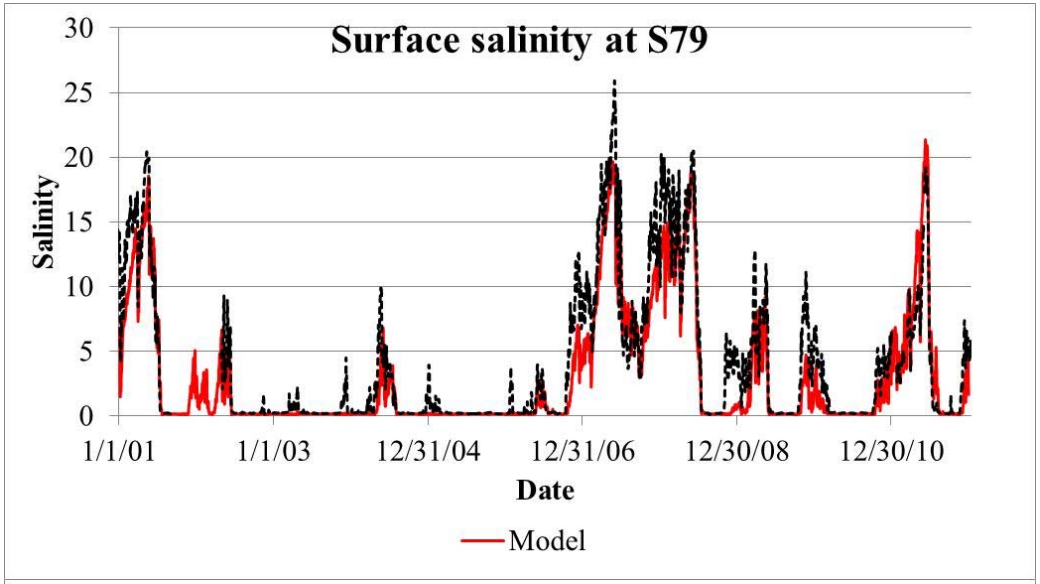
Model Validation (flow)

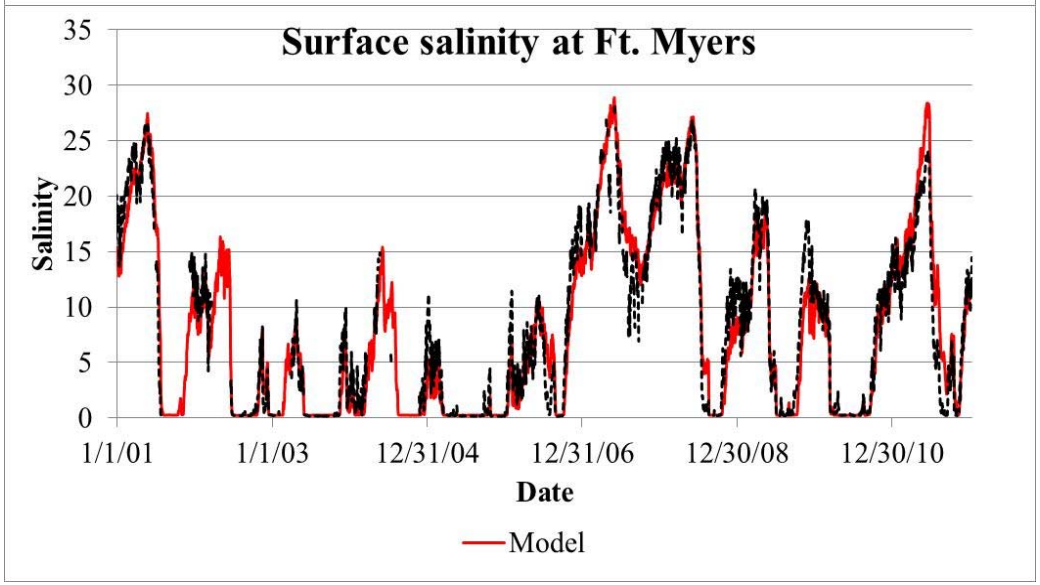


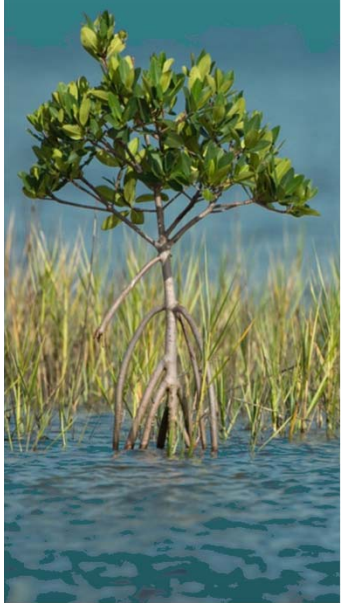


Model Validation (salinity)





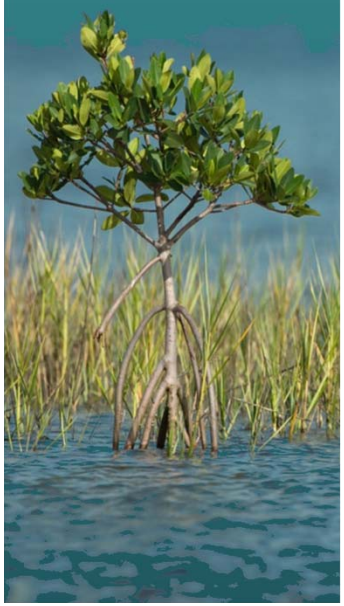


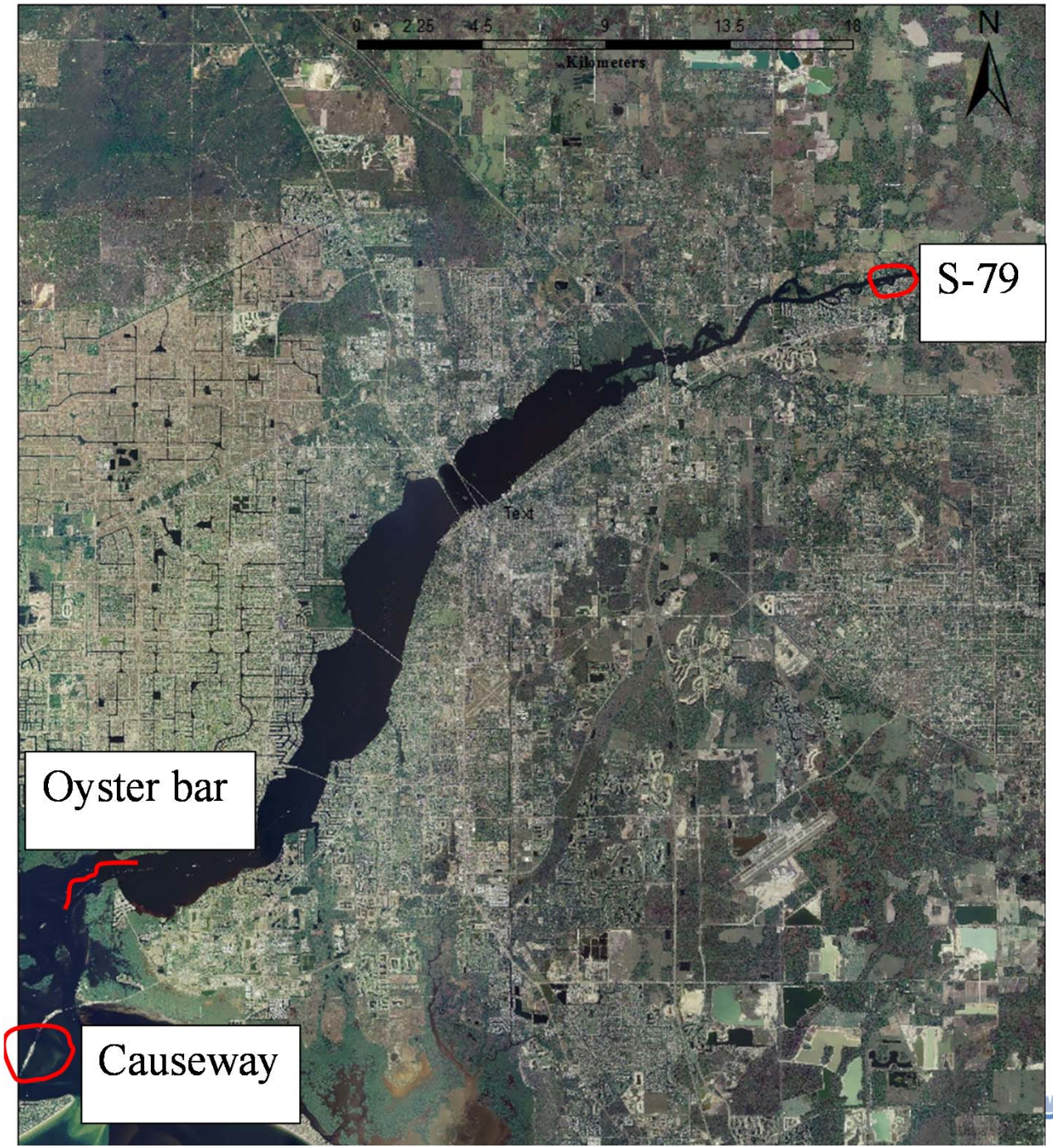


Modeling of Physical Alterations

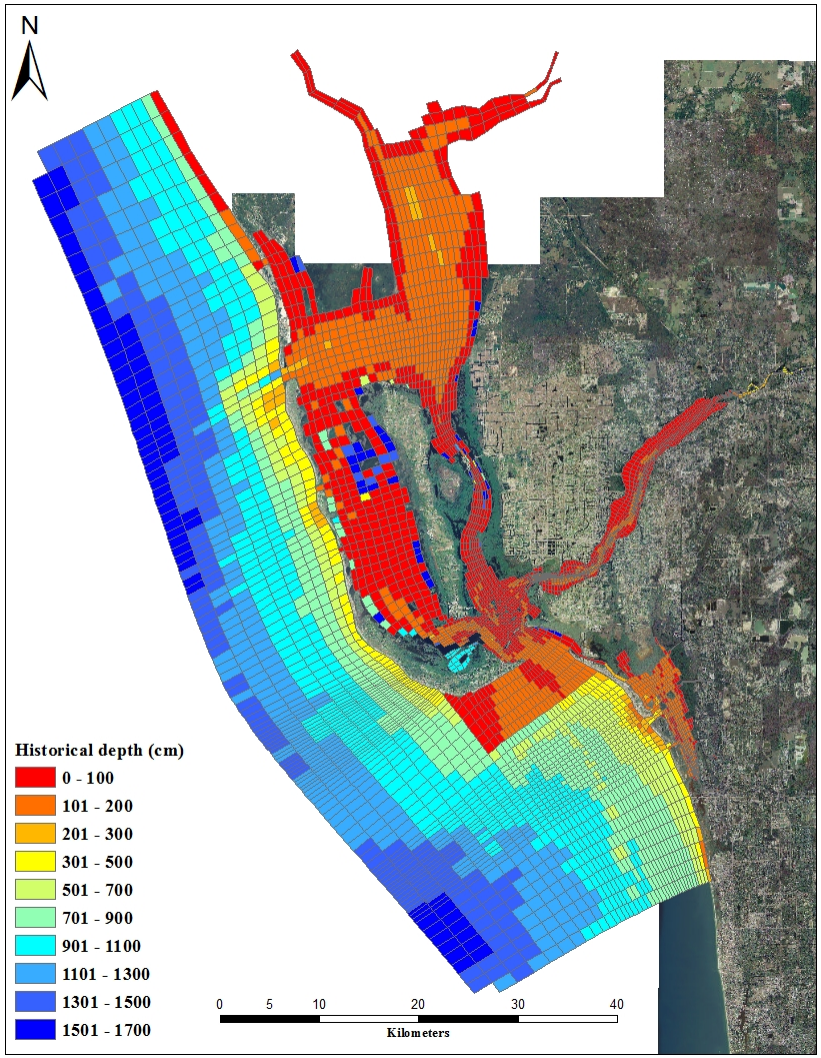
Five model runs

- Removal of S-79
- Removal of Sanibel Causeway
- Oyster Bar
- Refill of the navigation channel
- Pre-development condition

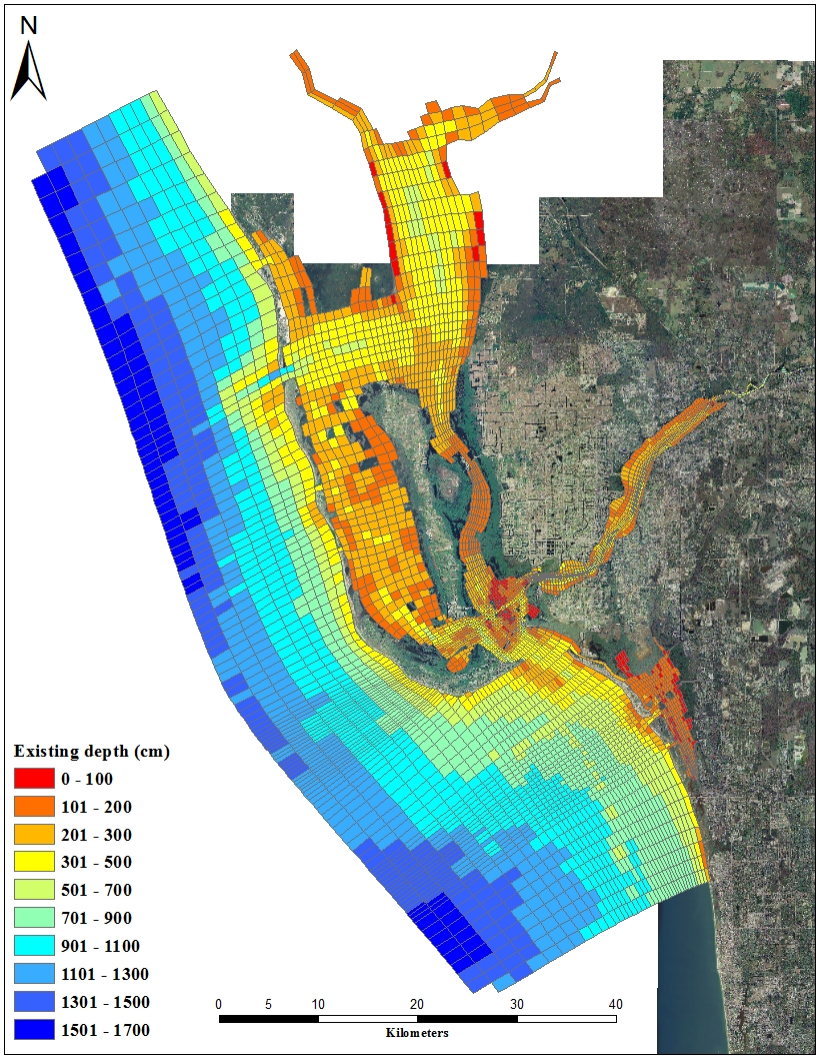



0 2.25 4.5 9 13.5 18
Kilometers
N
S-79
Text
Oyster bar
Causeway

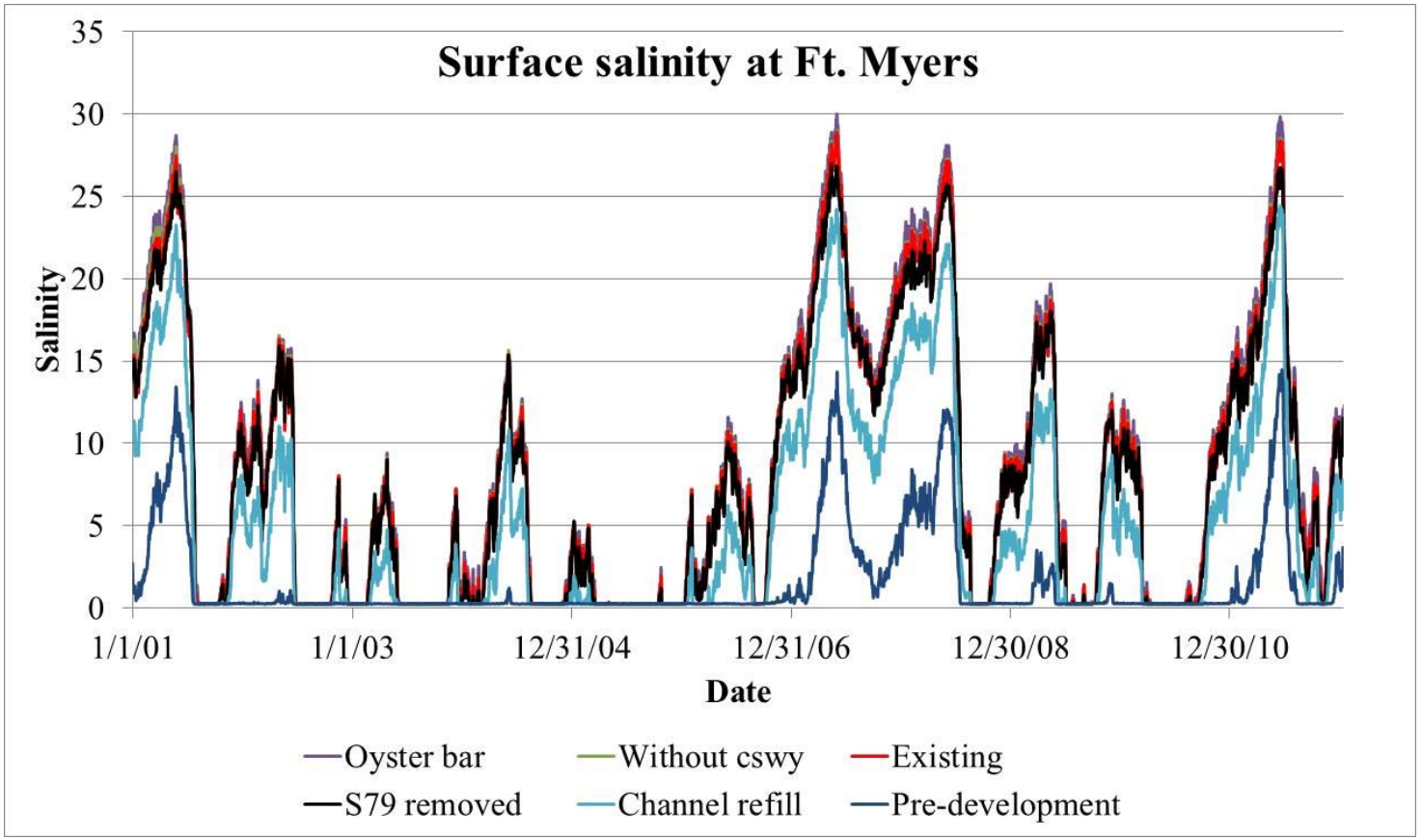
Depth, Capt. Black, 1887



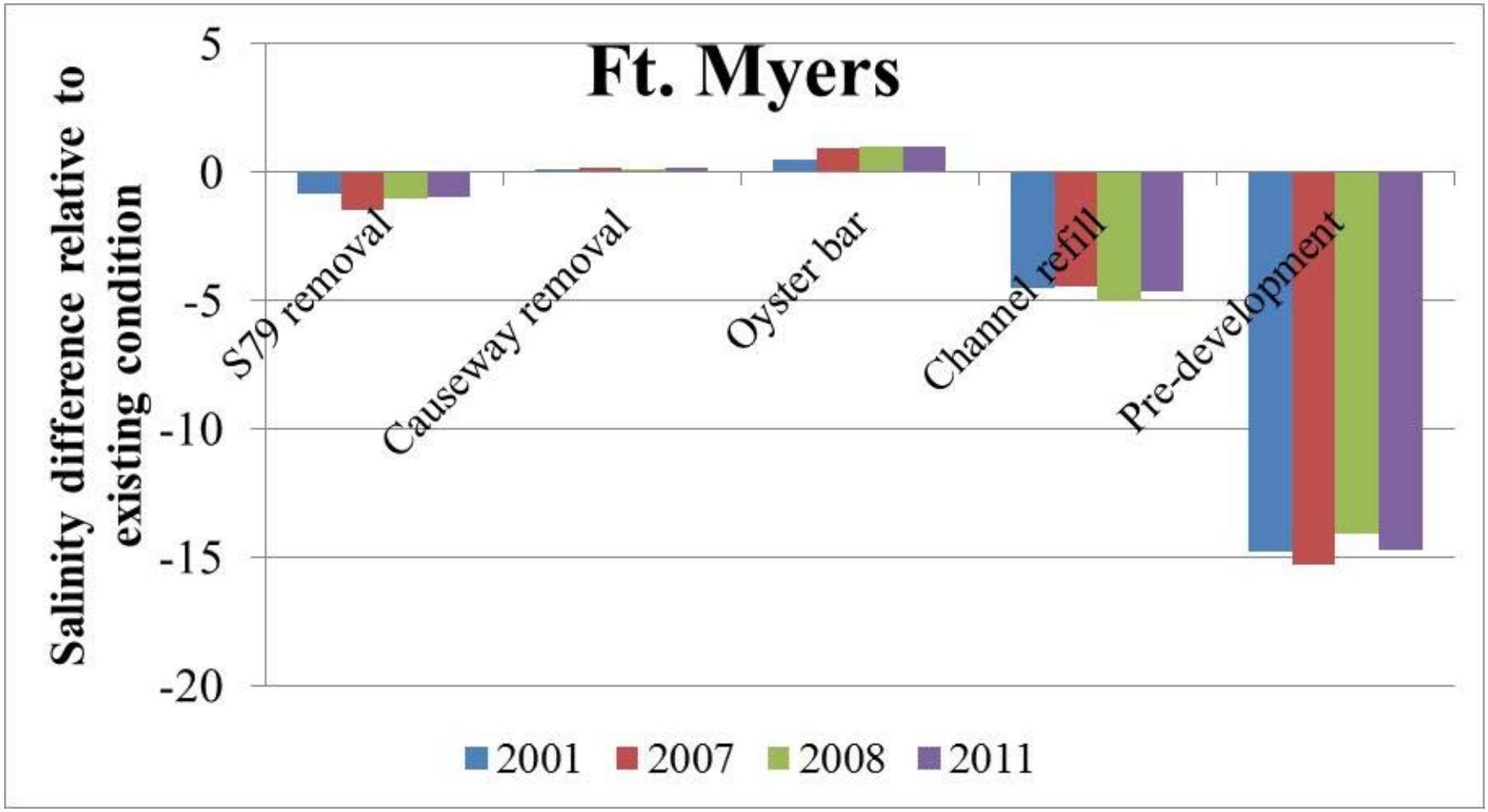
Depth, existing condition

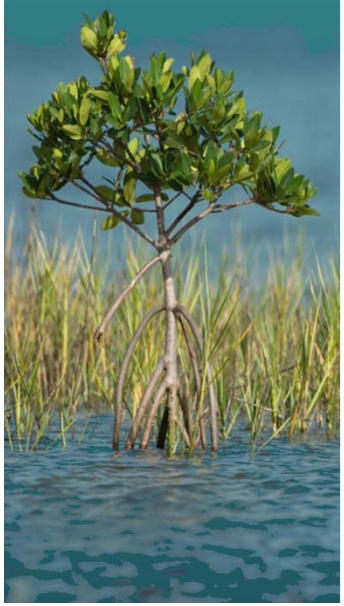


Modeling of Physical Alterations



Modeling of Physical Alterations





Theoretical Analysis

$$A=A_0\exp(-x/L_a)$$

$$L_{max} = \frac{D_0 A_0}{K Q_r}$$

$$D_0 \sim 1400 \widehat{u_0} h_0$$

Conclusions

- Physical alterations likely have had significant impact on salt intrusion
- Dredging and deepening are the primary cause of salinity increase
- Theoretical analysis supports numerical model simulation
- Implications: The impact of physical alterations should be carefully considered in the development of environmental flow target and associated rule making

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