GEER
Greater Everglades Ecosystem Restoration
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Biscayne Bay Water Quality Model Development and Applications

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SOUTH FLORIDA WATER MANAGEMENT DISTRICT
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Outlines

- Project introduction
- Model development
- Model calibration & validation
- Model application (scenarios)
- Summary

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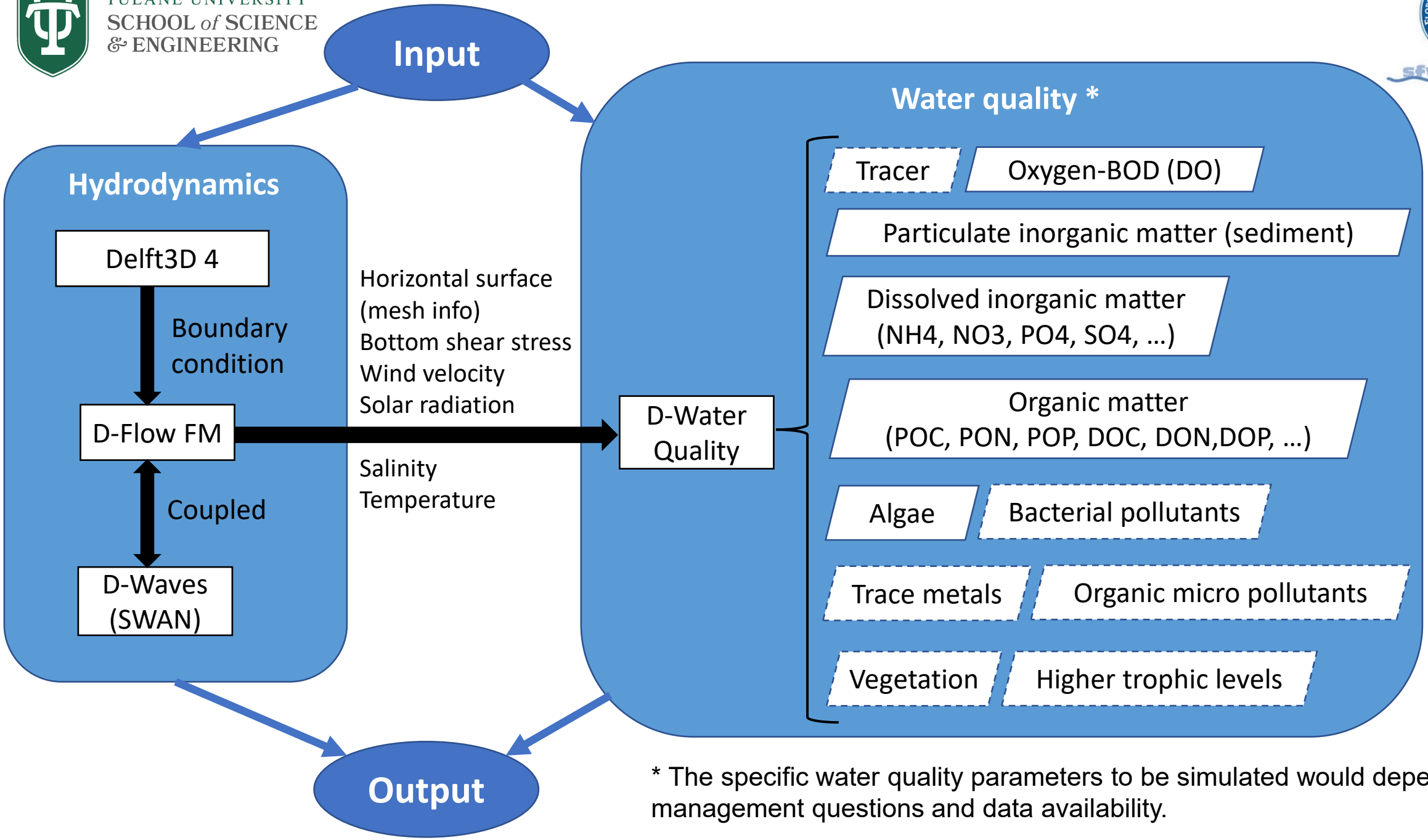
Biscayne Bay Water Quality Model Development and Application – Brief Overview

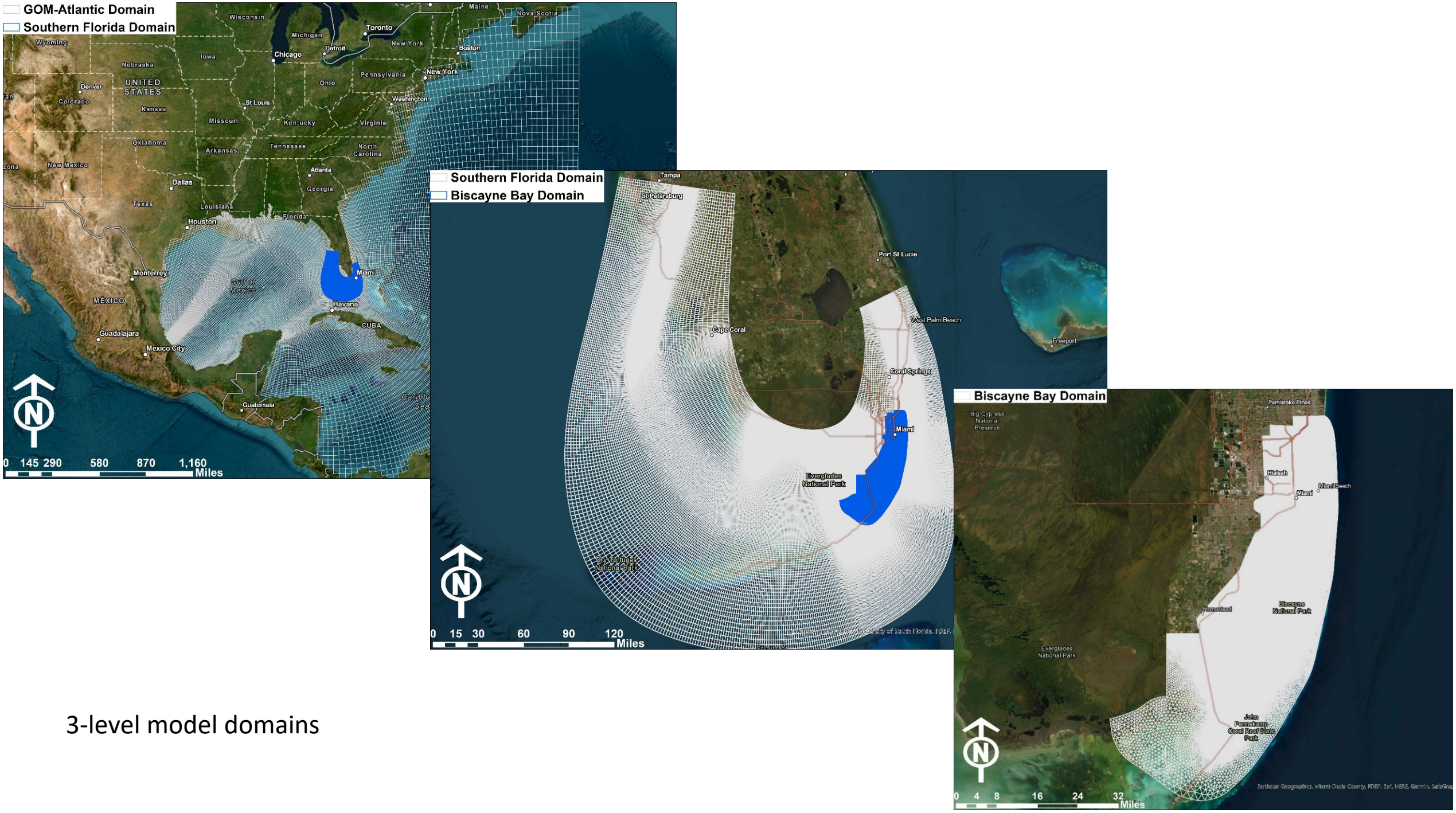
Goals

- Develop fully coupled hydrodynamic and water quality models spanning and linking coastal estuaries with inland/interior hydrologic systems;

- Perform modeling scenarios to quantitatively address management questions.



* The specific water quality parameters to be simulated would depend on management questions and data availability.



3-level model domains

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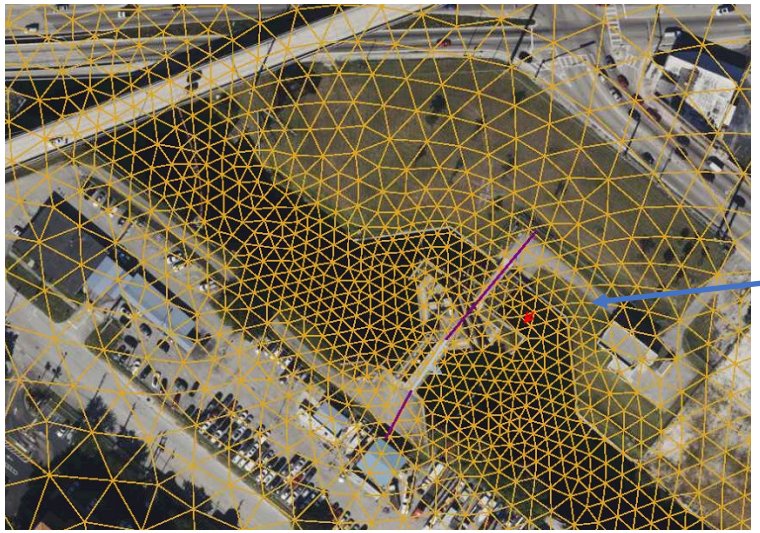
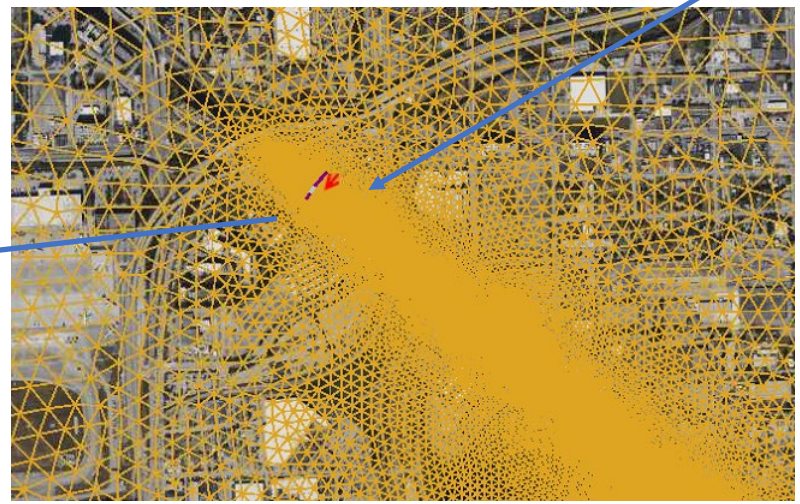
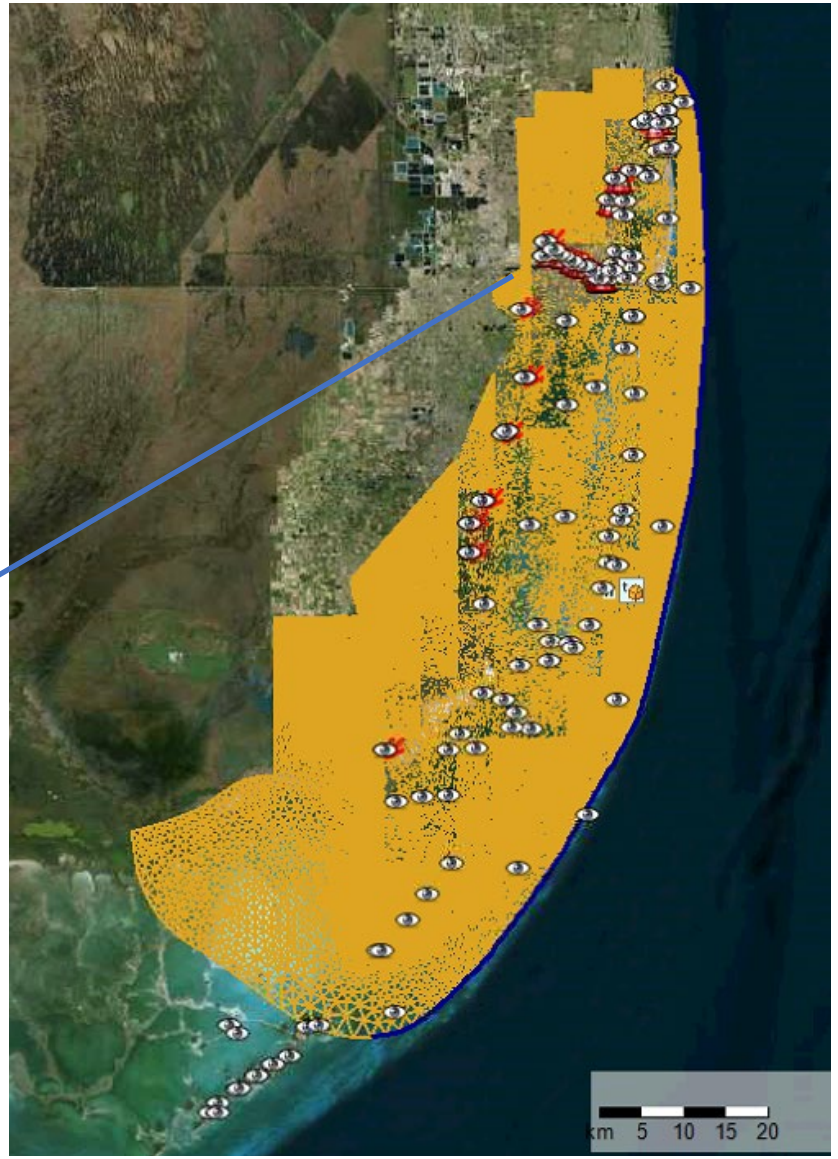
- Software Delft3D FM suite
- Mesh Unstructured mesh with 1.8M elements and 940k nodes
- Resolution 3m (inland) to 2.6 km (offshore)
- 3D simulation with 7 vertical sigma layers
- Same mesh for both hydro and water quality modules







WQ model setup

File-based D-Water Quality versus D-Water Quality process in D-Flow FM

Model type	Pro	Con
File based	- run hydrodynamics once - simple models could be faster - aggregation is possible	- big coupling files - complex models could be slower
Integrated	- no coupling files - no coupling mistakes - use D-Flow FM's MPI capability	- rerun hydrodynamics every scenario - no aggregation possible - can't reuse old water quality setups

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Salinity and Temperature (2018 calibration)

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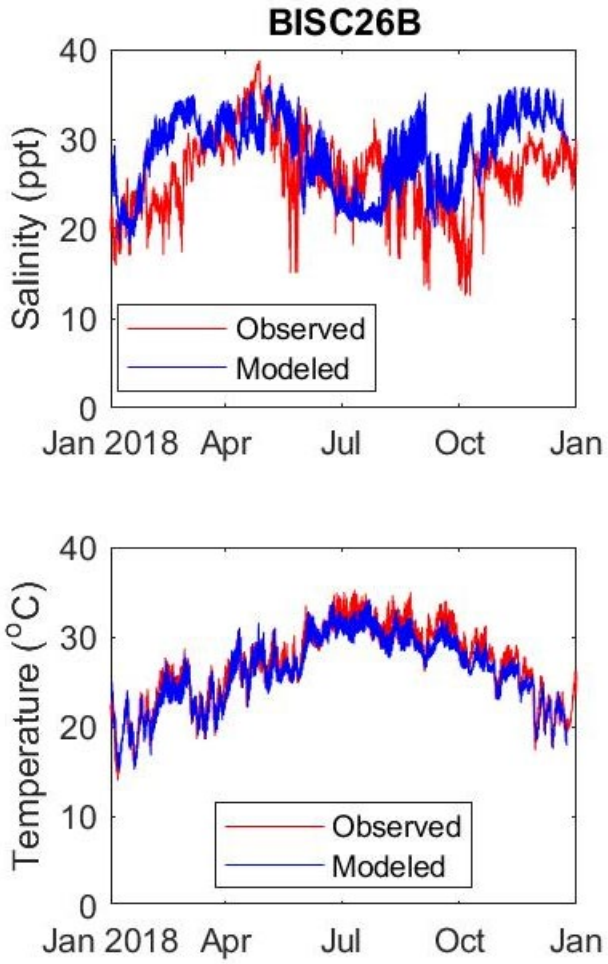

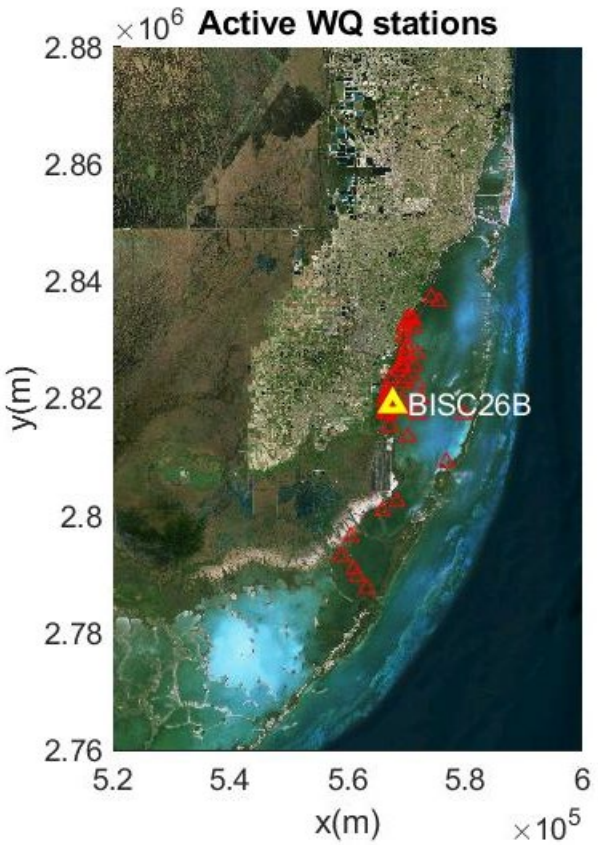

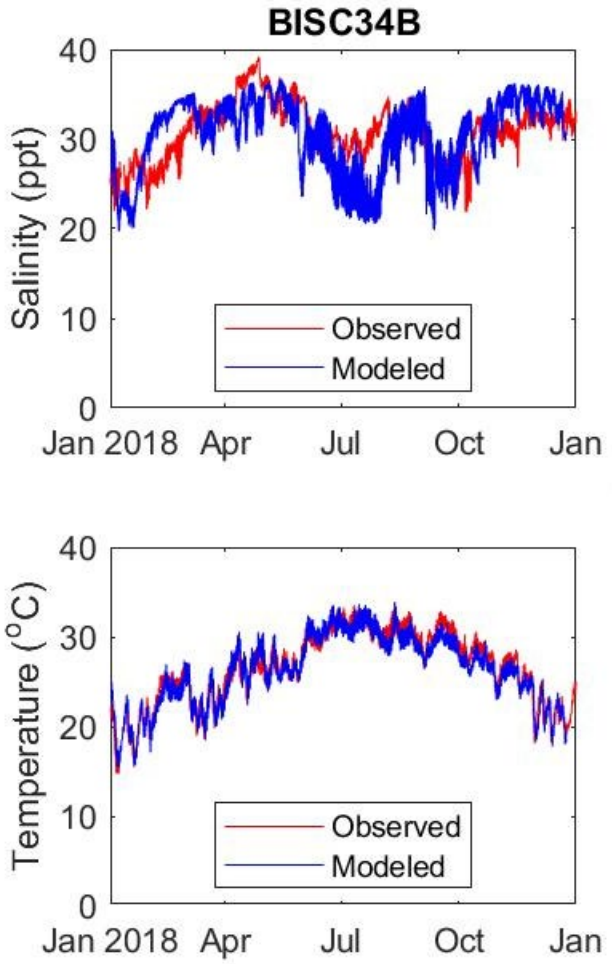

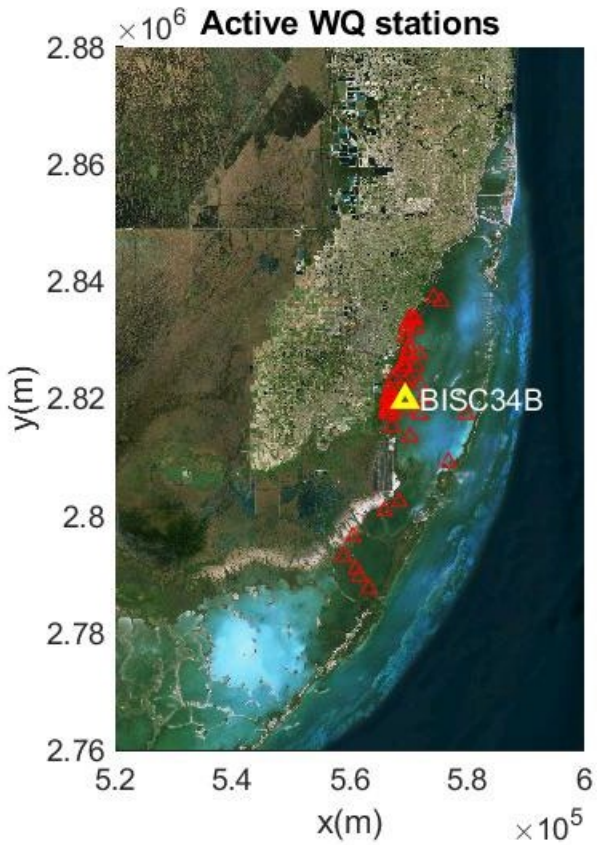

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Salinity and Temperature (2016 validation)

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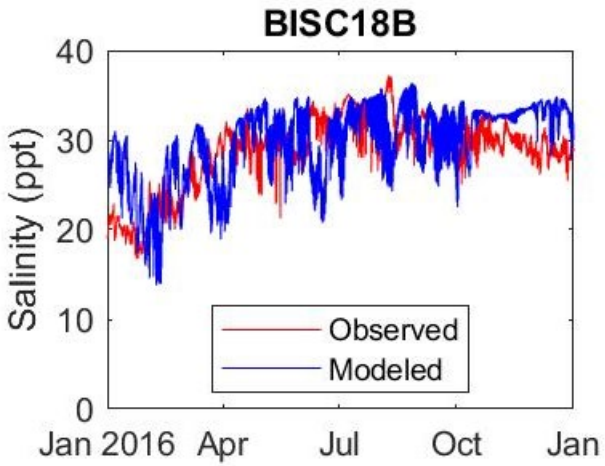

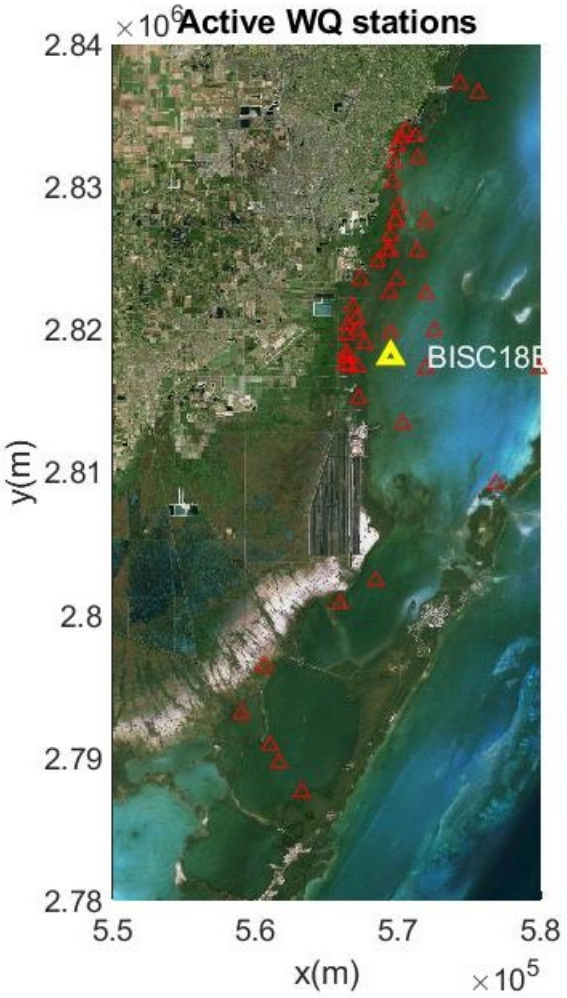

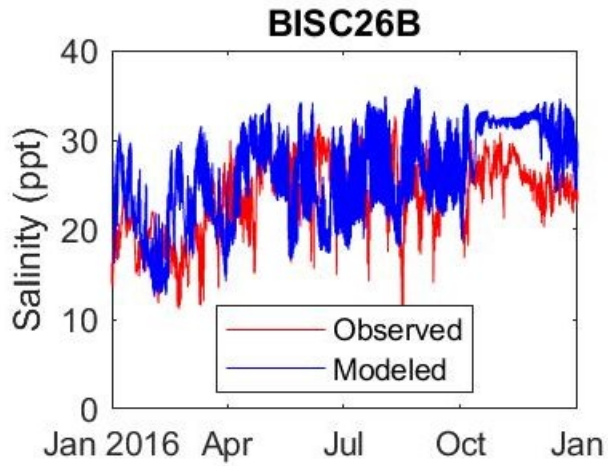

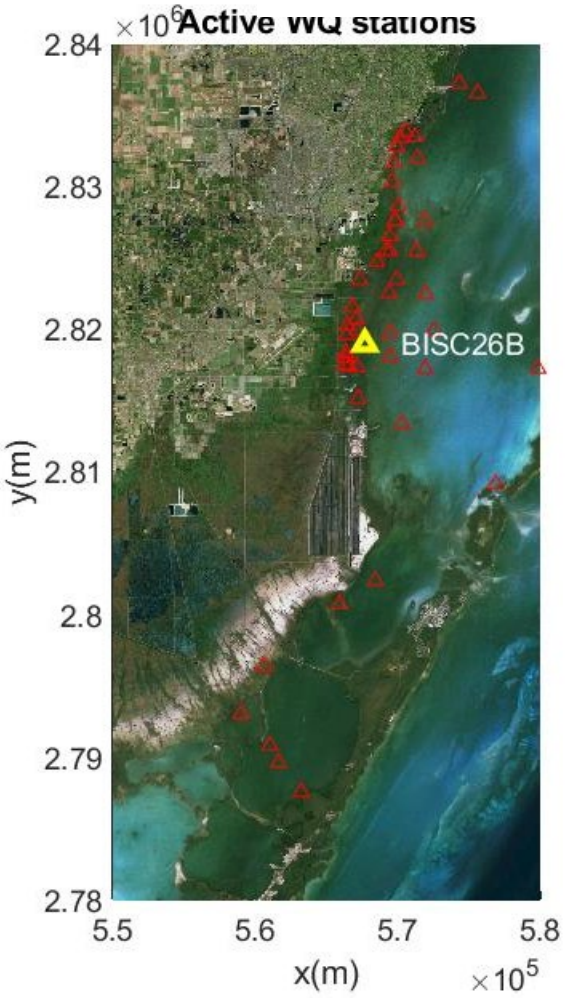

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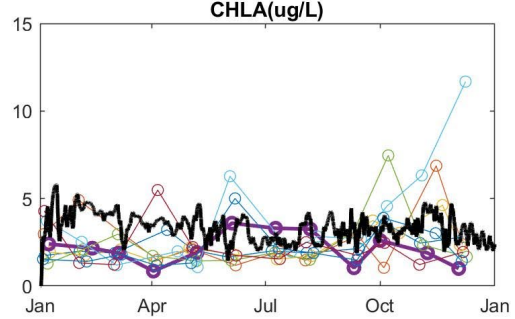
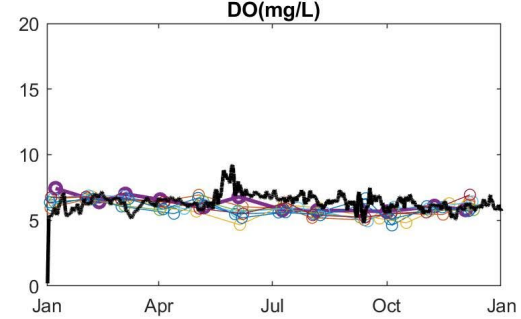
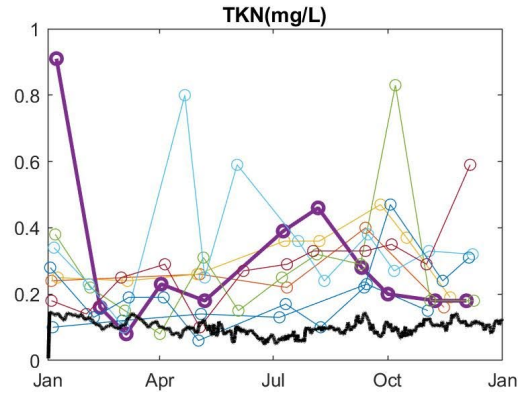
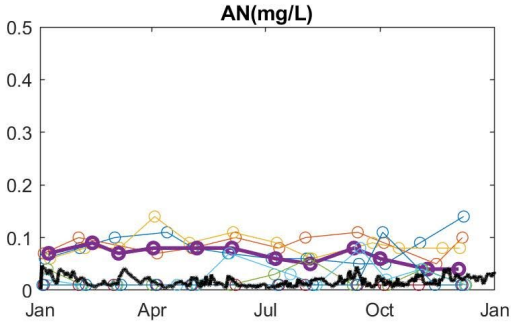
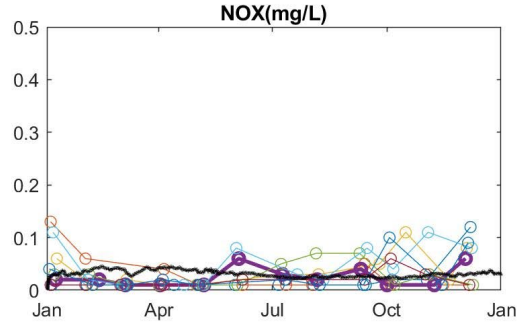
WQ results
(2018 calibration)

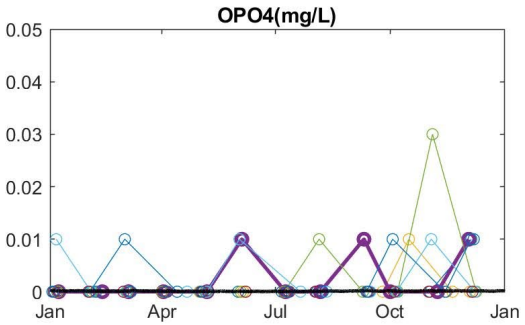


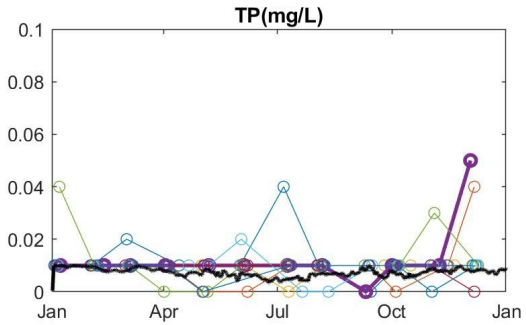


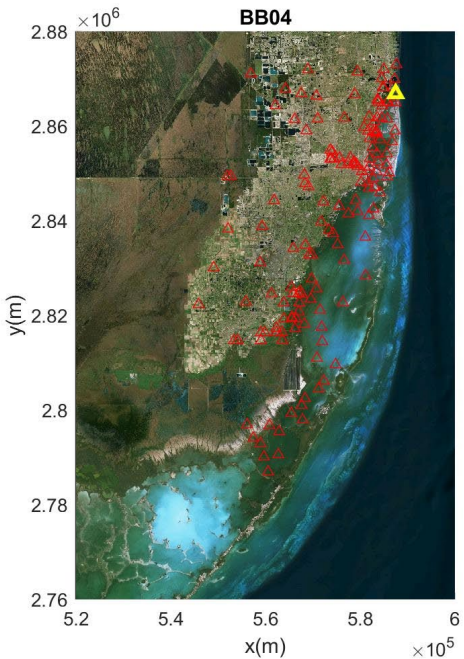


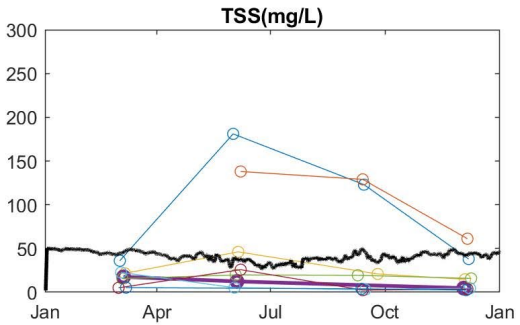


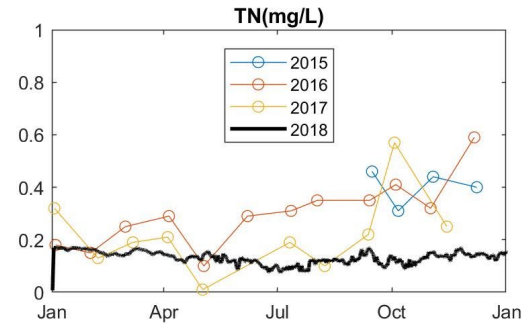












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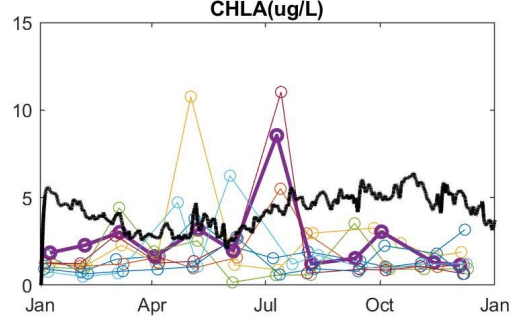
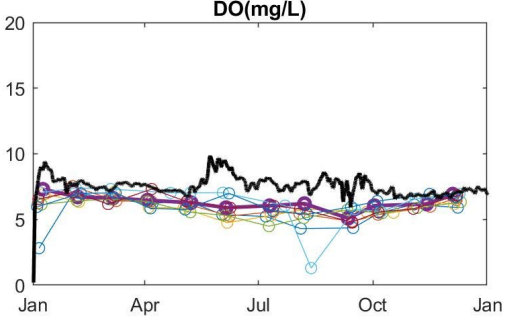
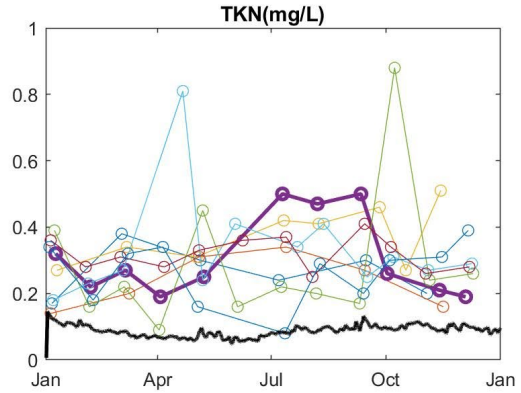
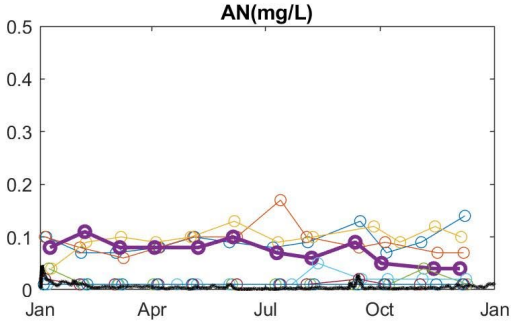
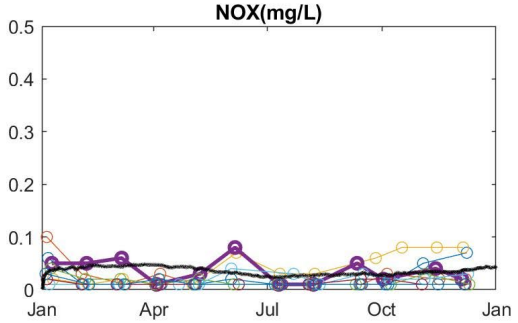
WQ results
(2018 calibration)

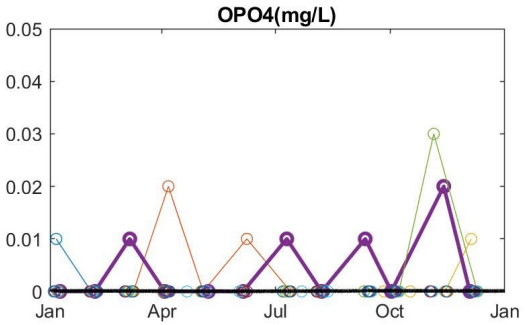


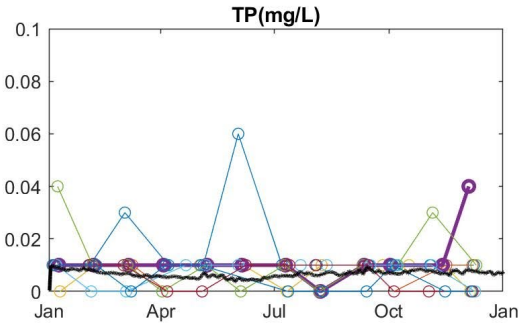


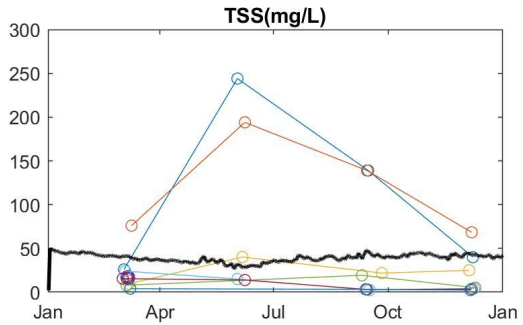


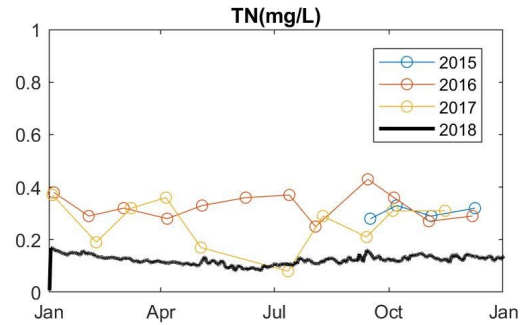


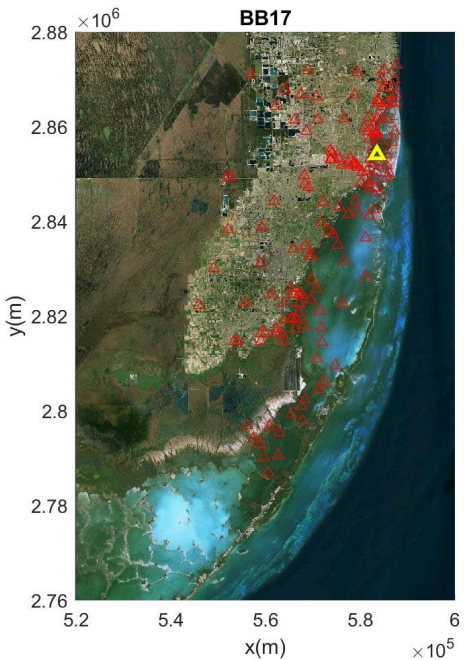












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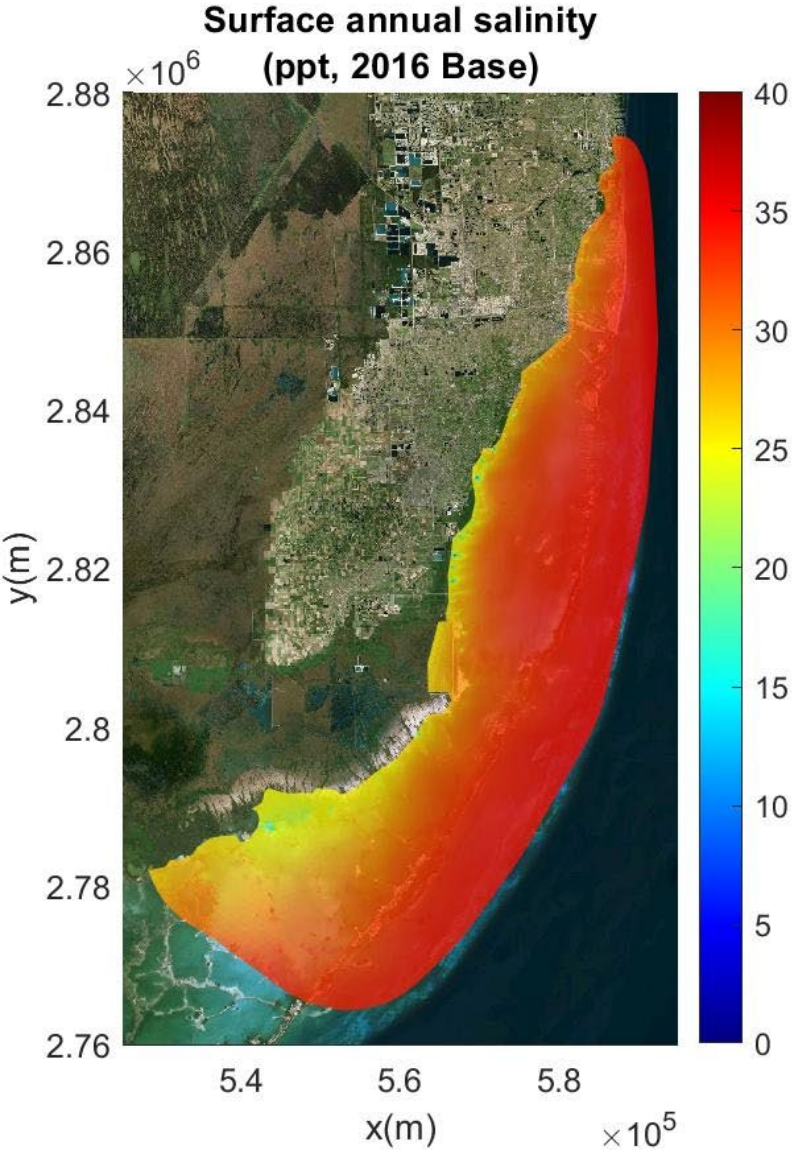
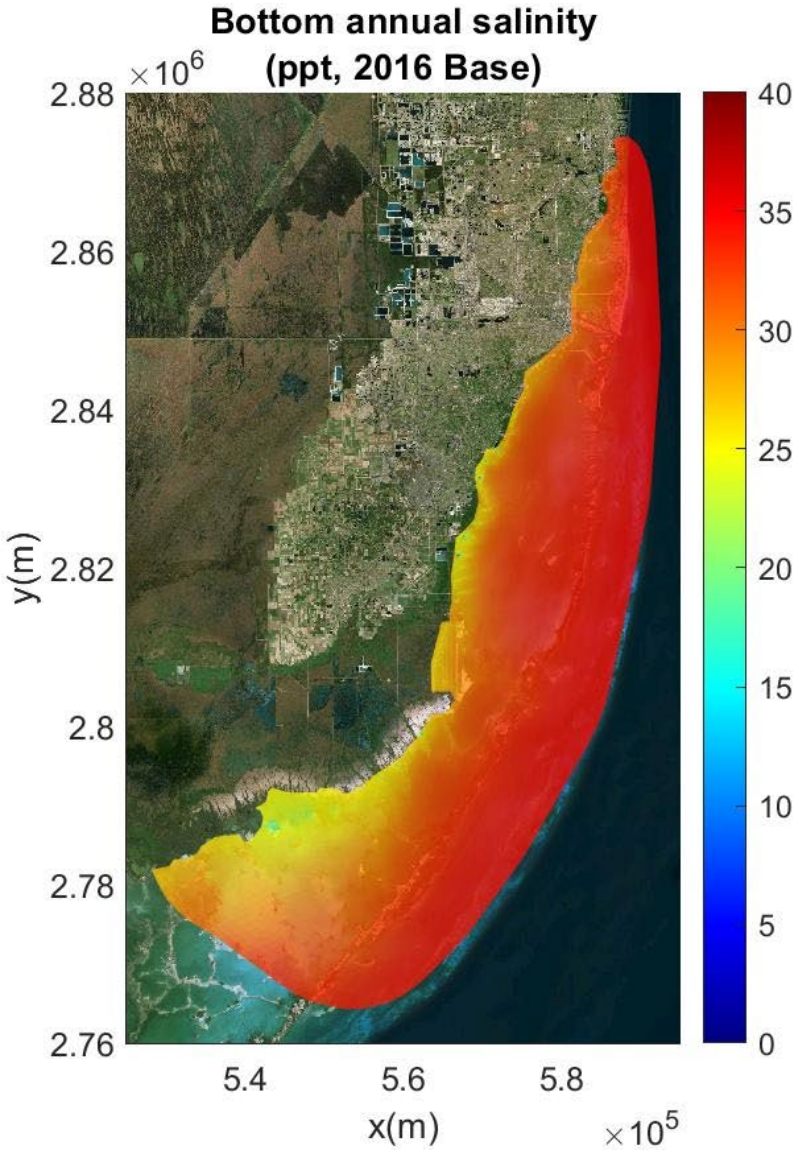
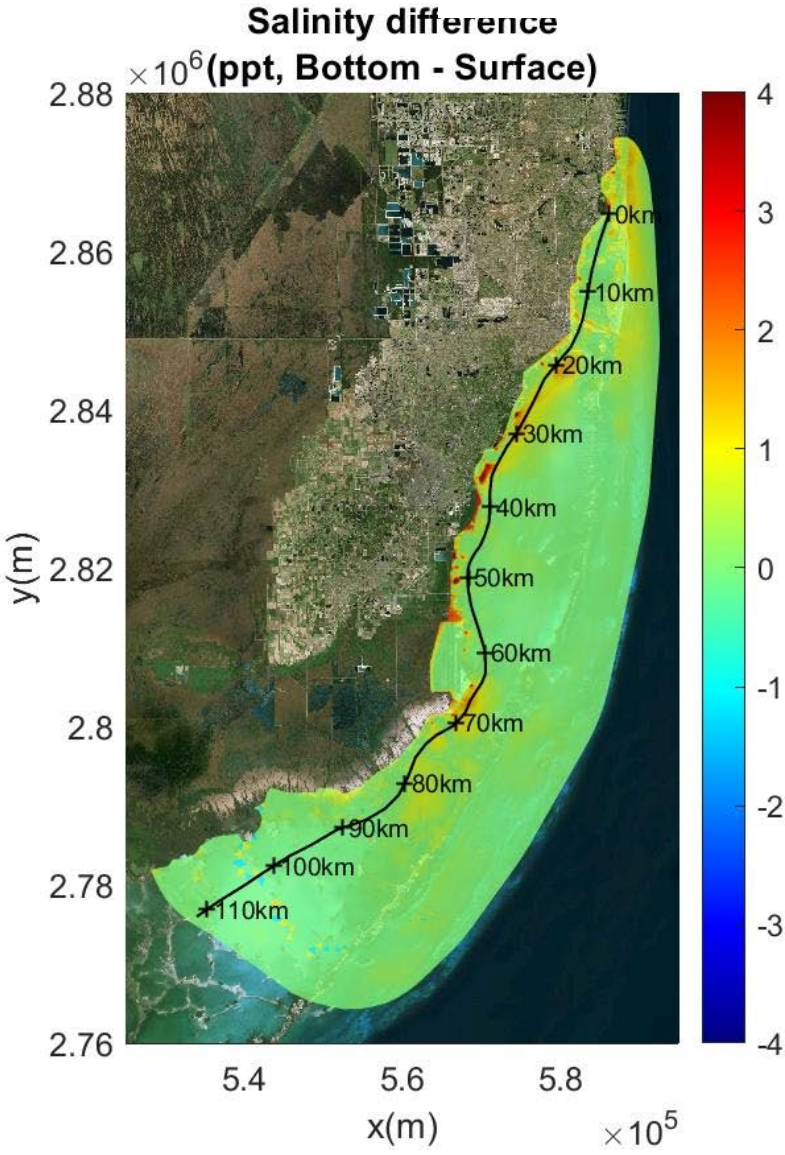
3D model results







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Salinity profile (2D vs. 3D)

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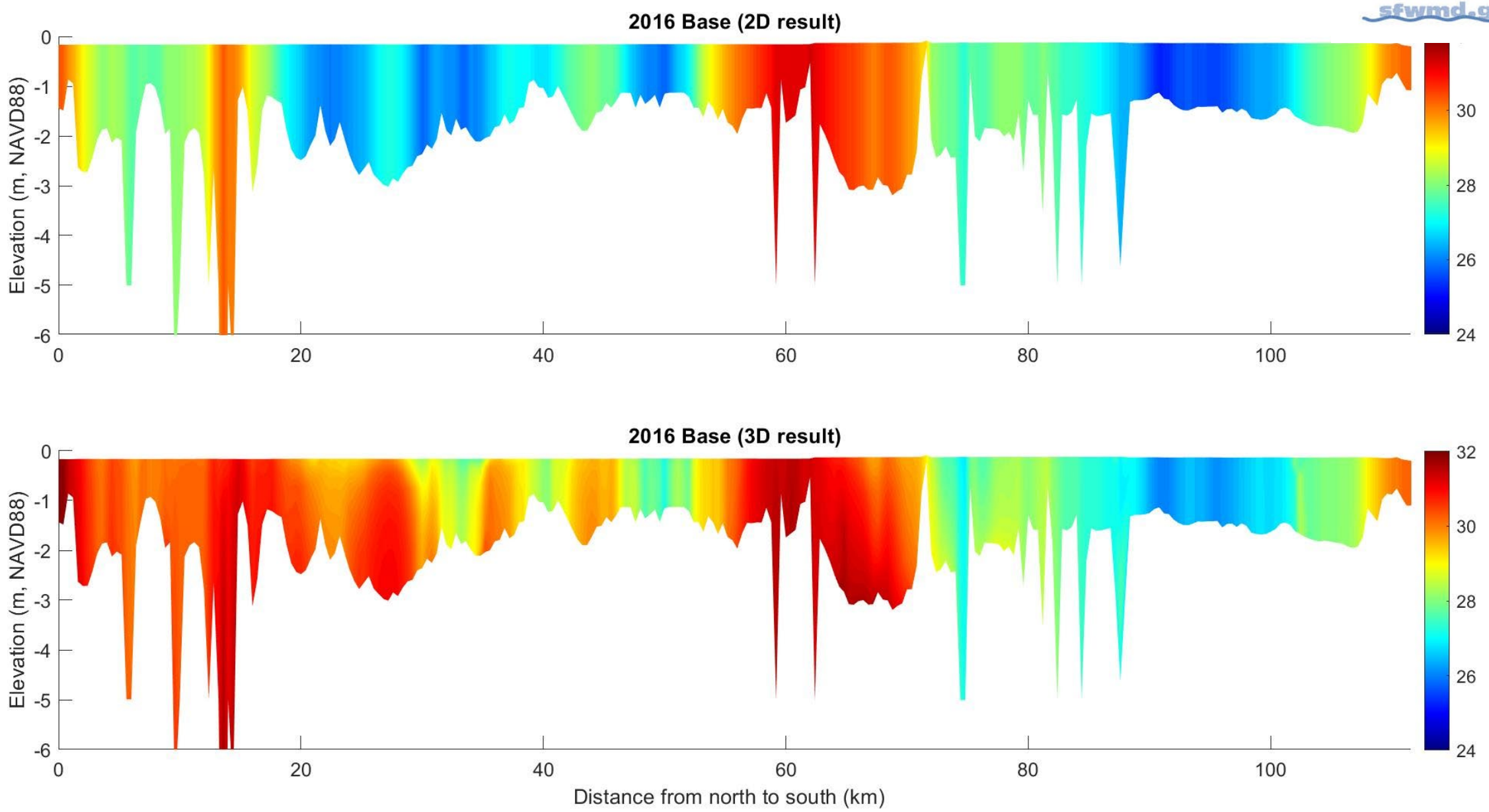

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Groundwater

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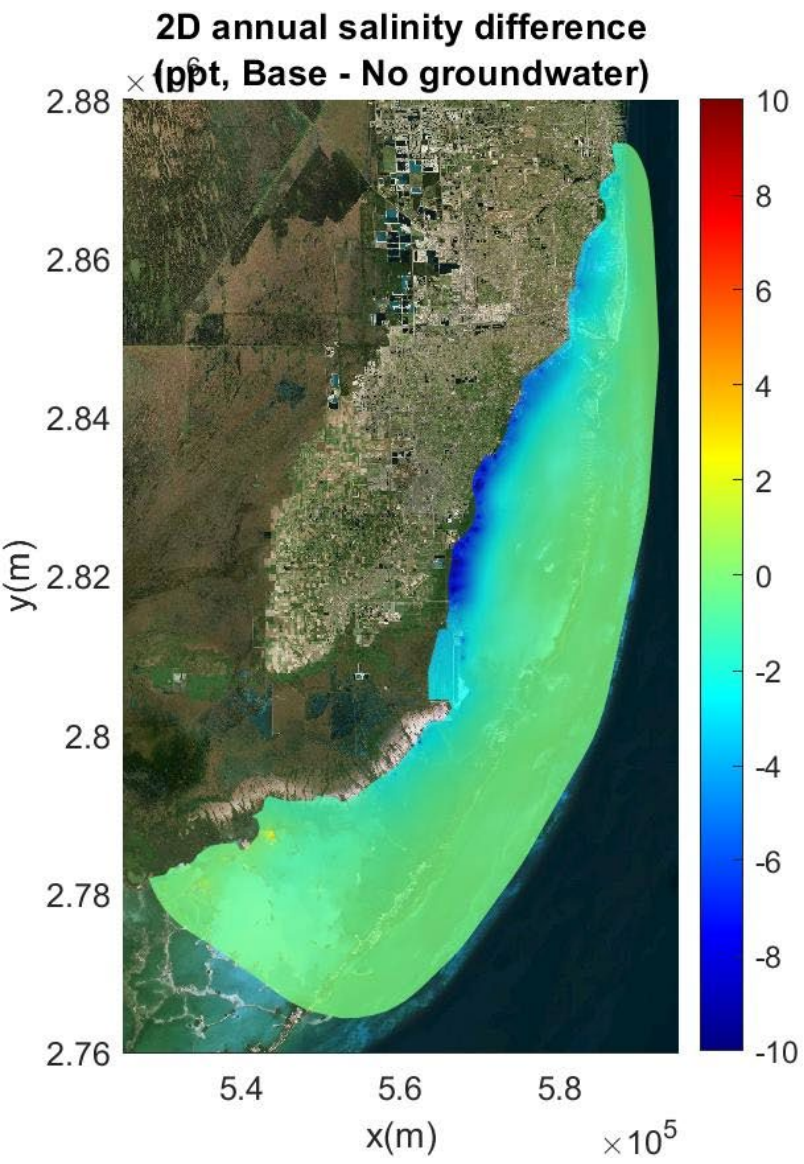
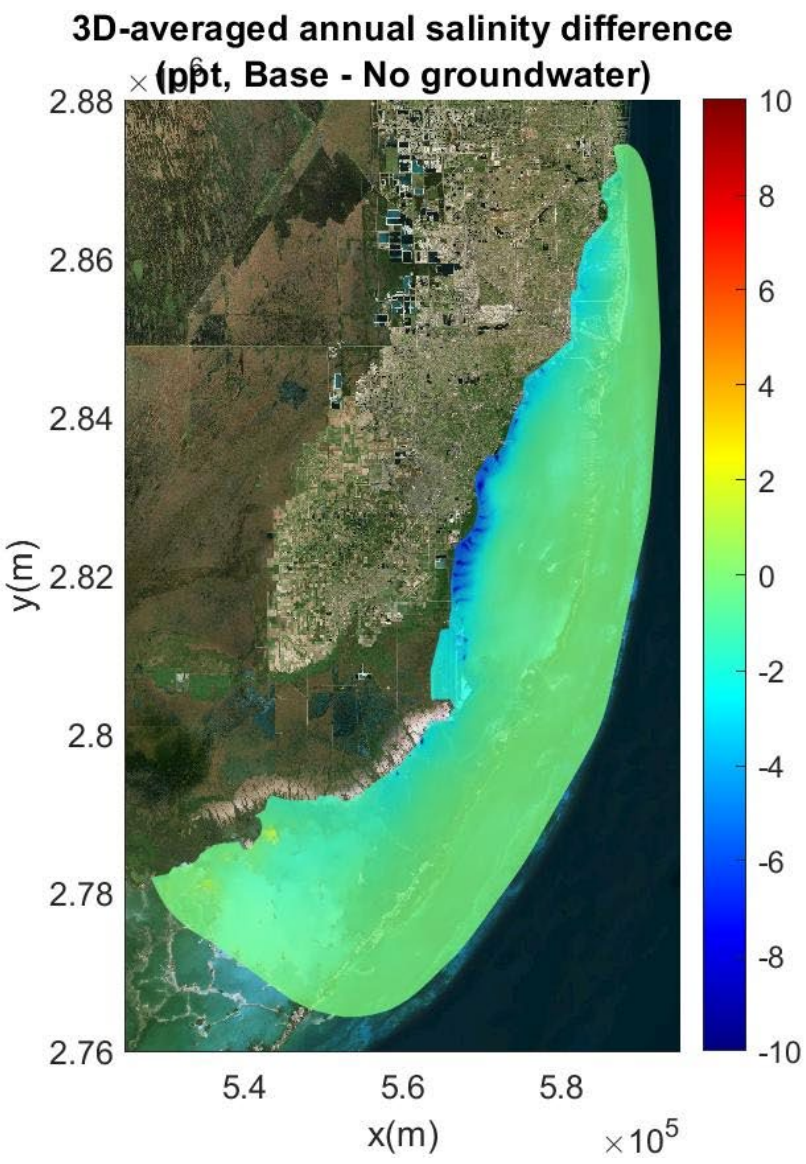
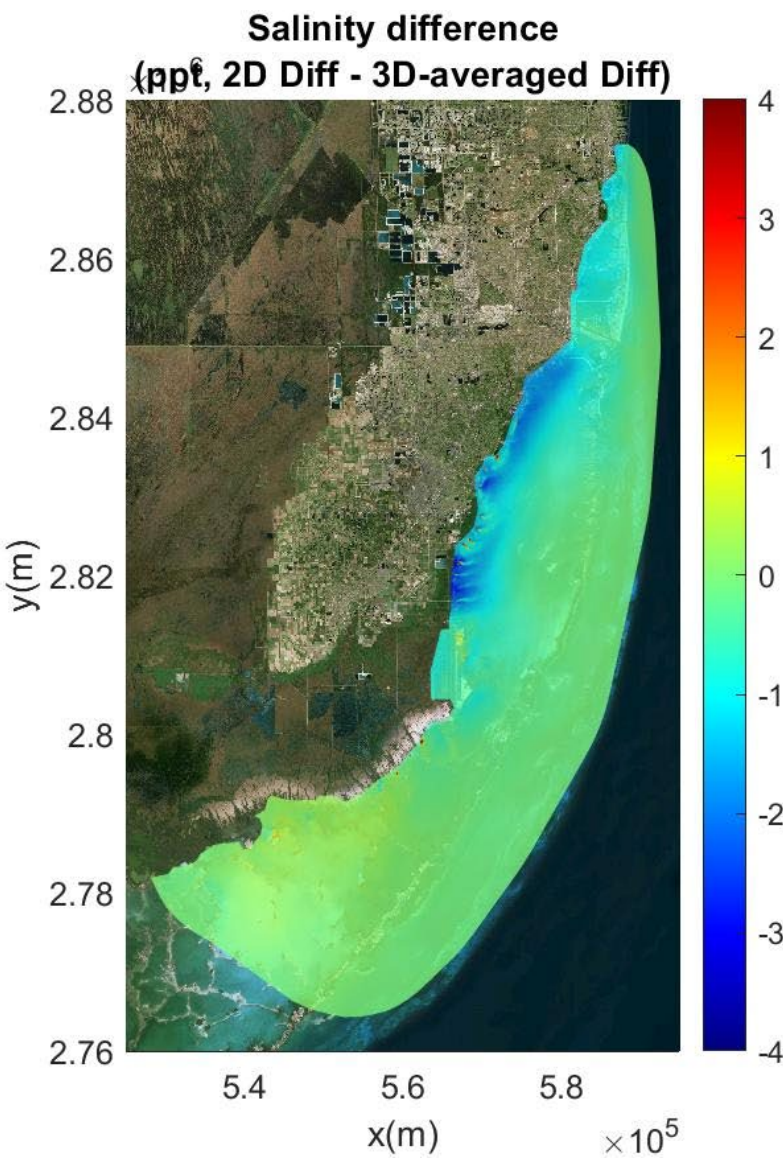
2D calculation



3D calculation





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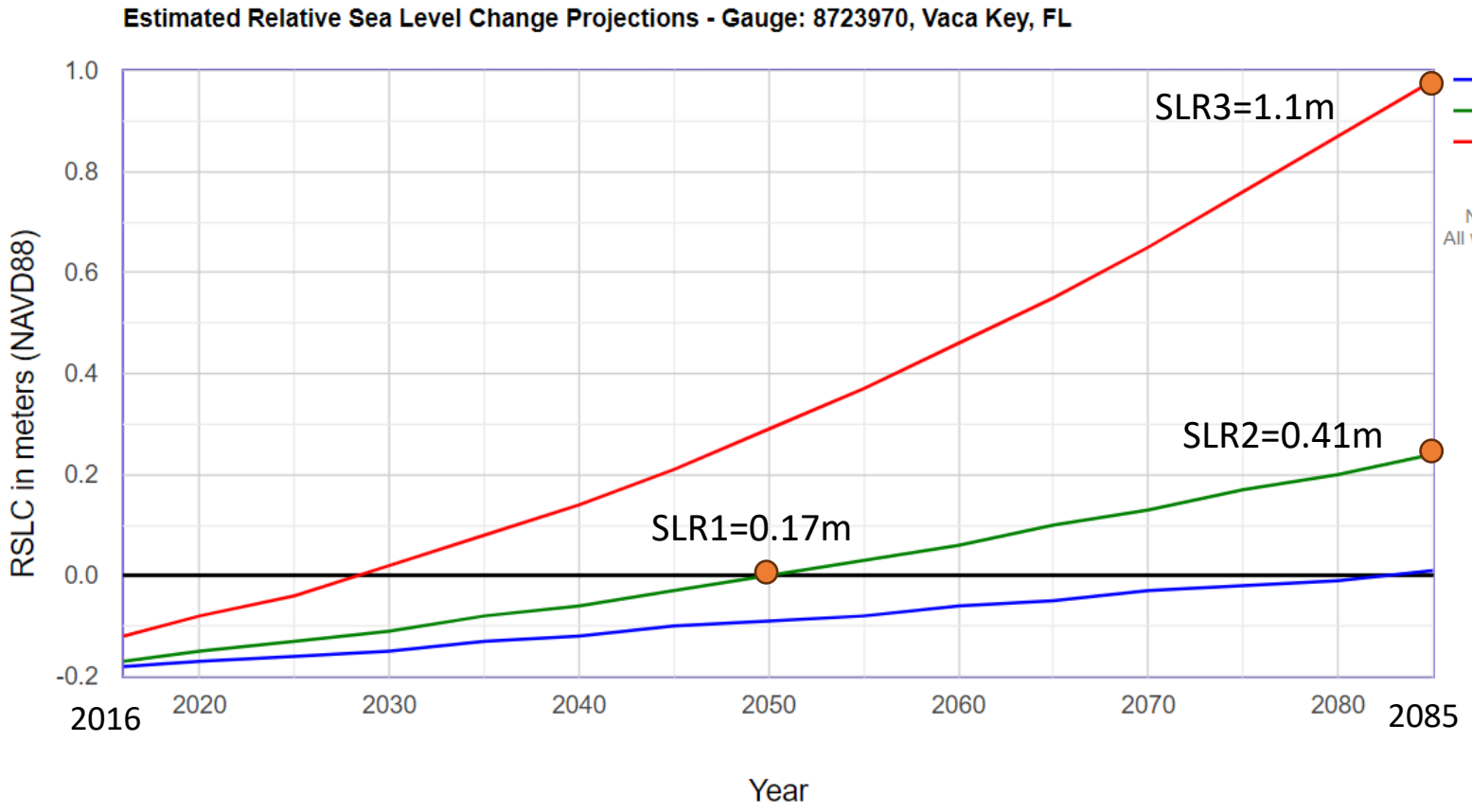
SLR scenarios



8723970, Vaca Key, FL
NOAA's 2006 Published Rate: 0.00278 meters/yr
All values are expressed in meters relative to NAVD88
Gauge Status: Compliant

Year	USACE Low	USACE Int	USACE High
2016	-0.18	-0.17	-0.12
2020	-0.17	-0.15	-0.08
2025	-0.16	-0.13	-0.04
2030	-0.15	-0.11	0.02
2035	-0.13	-0.08	0.08
2040	-0.12	-0.06	0.14
2045	-0.10	-0.03	0.21
2050	-0.09	0.00	0.29
2055	-0.08	0.03	0.37
2060	-0.06	0.06	0.46
2065	-0.05	0.10	0.55
2070	-0.03	0.13	0.65
2075	-0.02	0.17	0.76
2080	-0.01	0.20	0.87
2085	0.01	0.24	0.98

SLR1
SLR2
SLR3

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SLR3=1.1 m (2D vs. 3D)

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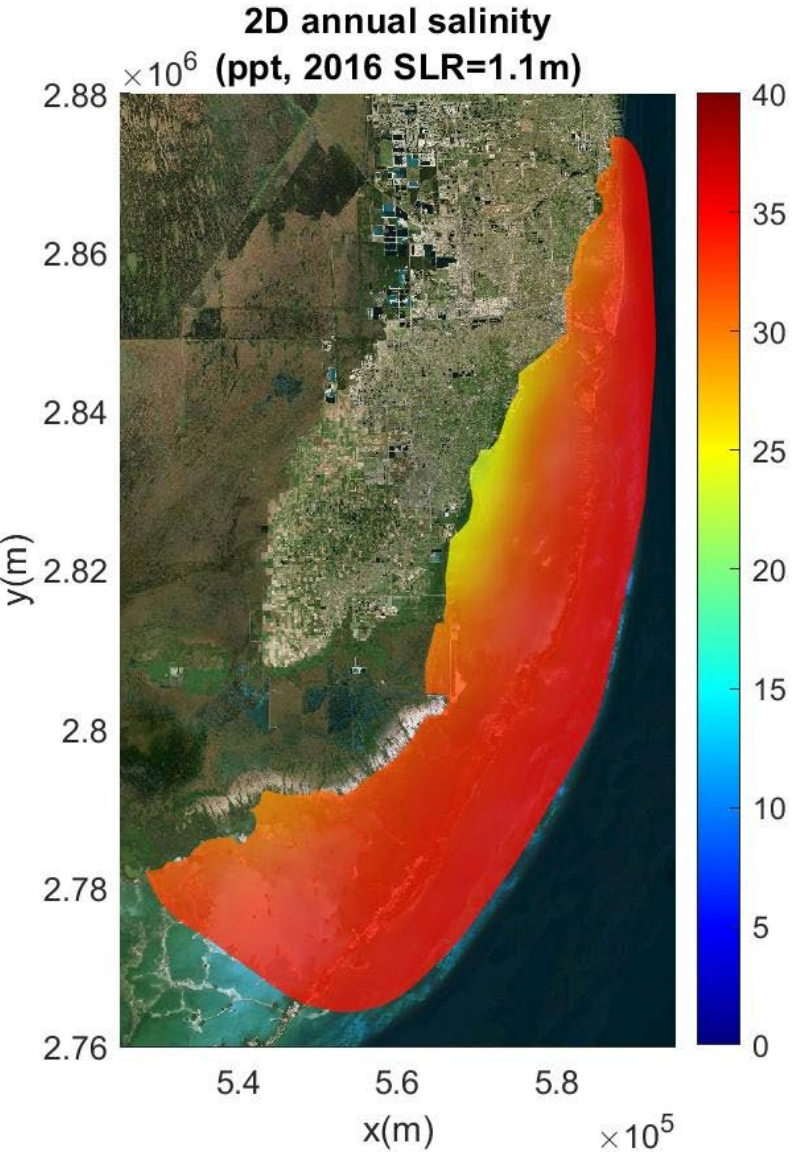
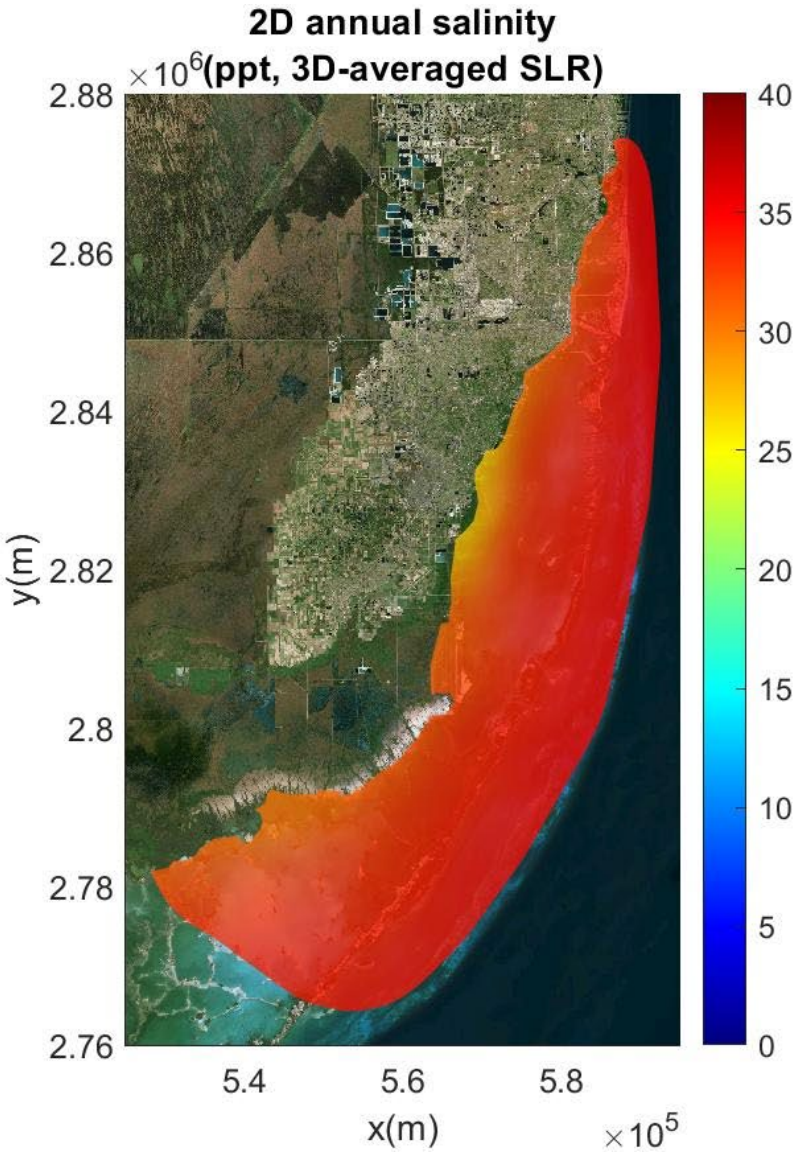
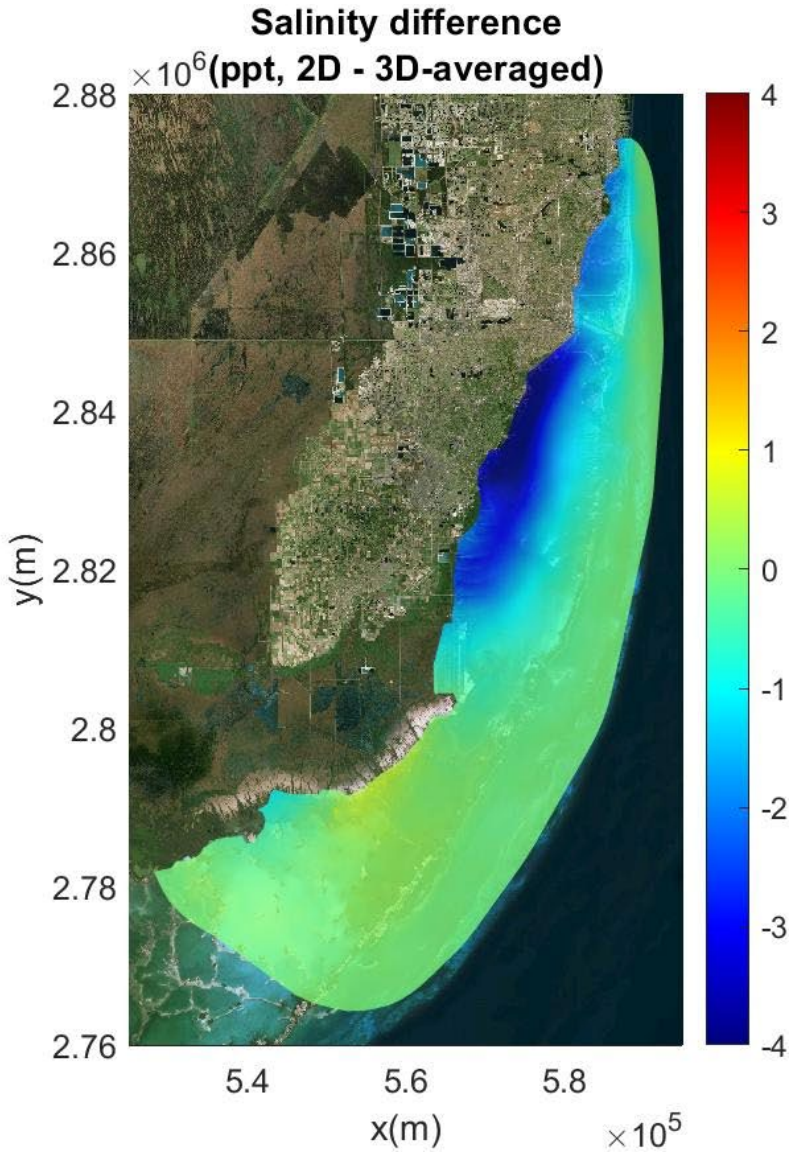
2D calculation



3D calculation





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SLR3=1.1 m (3D results)

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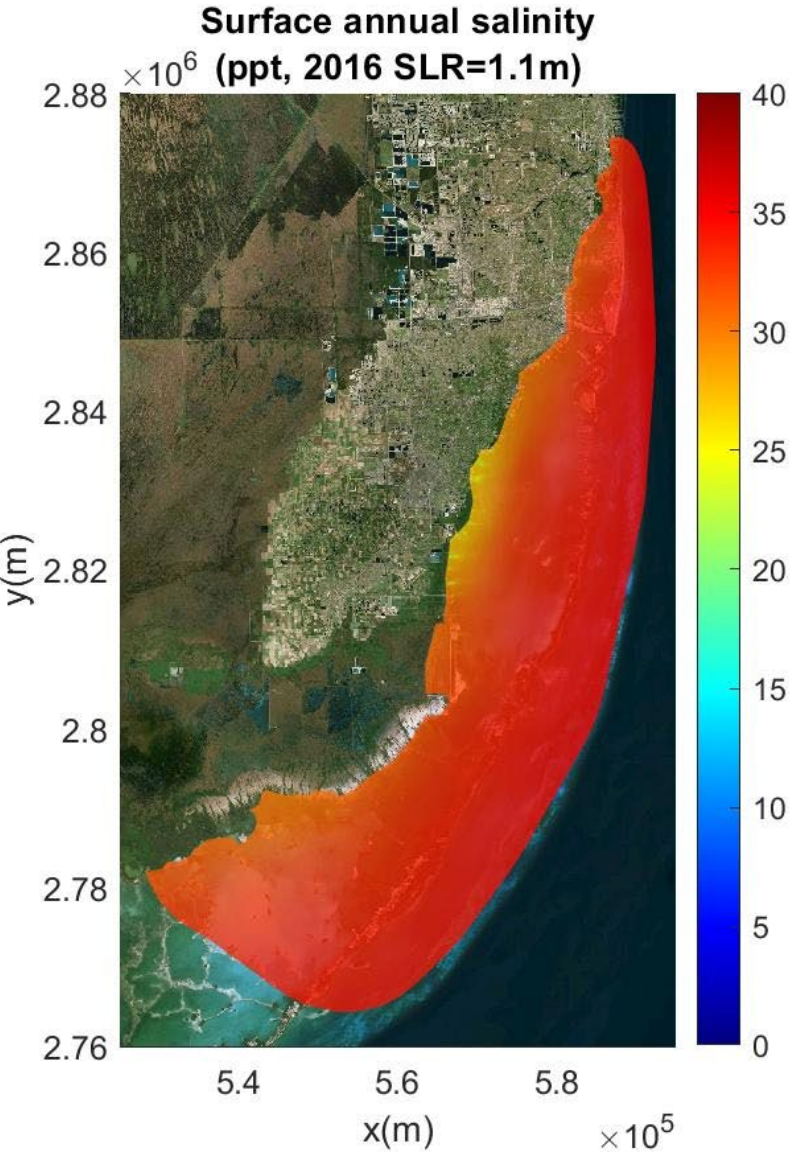

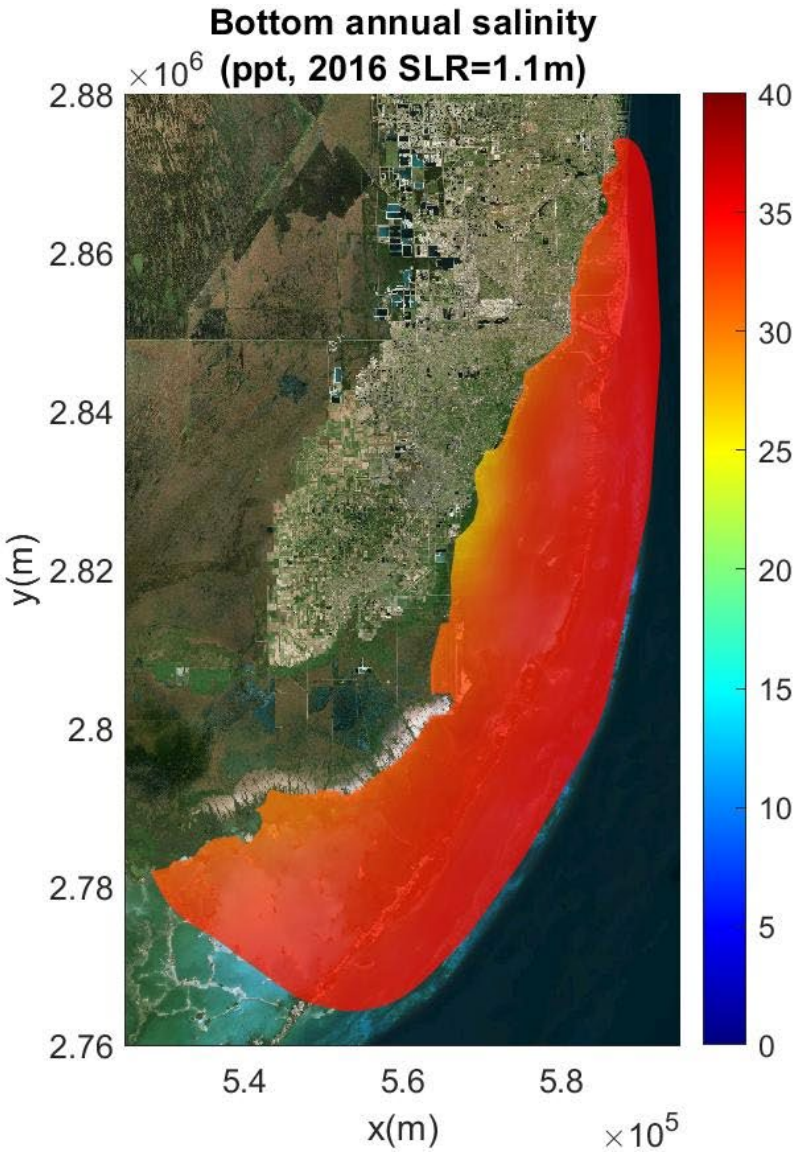

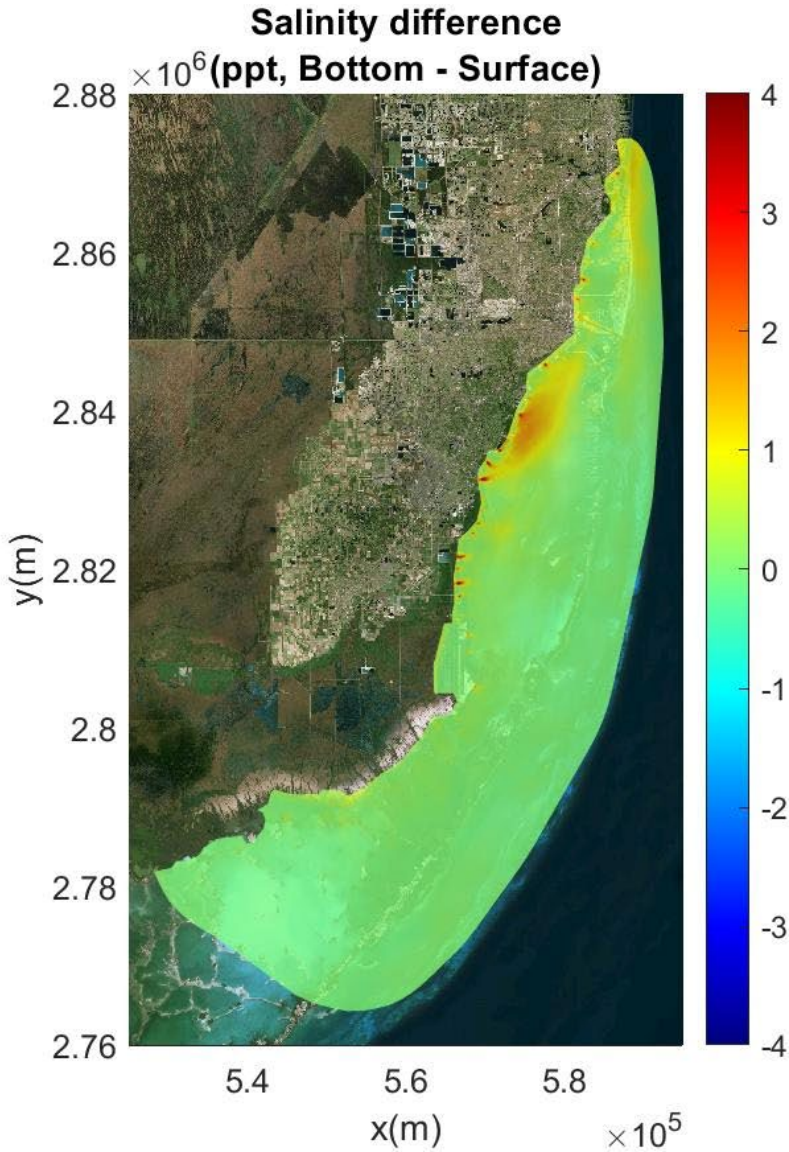

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SLR3 – Base (annual)

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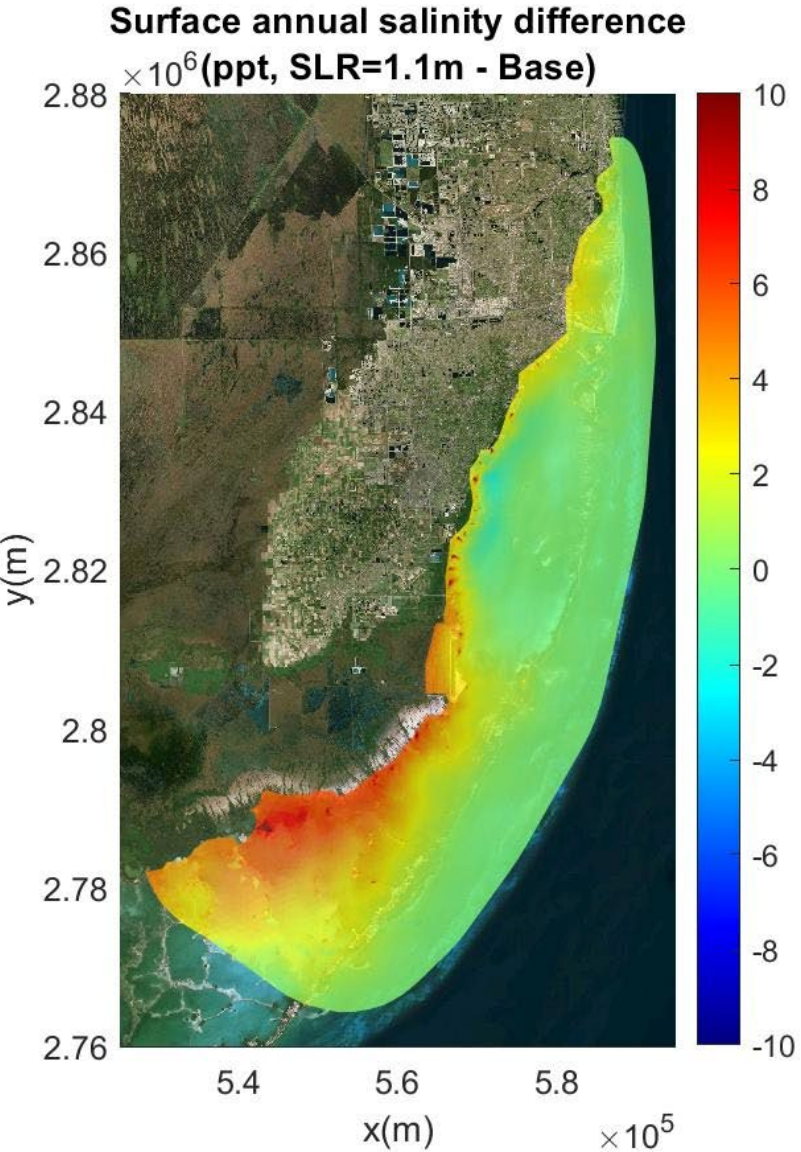

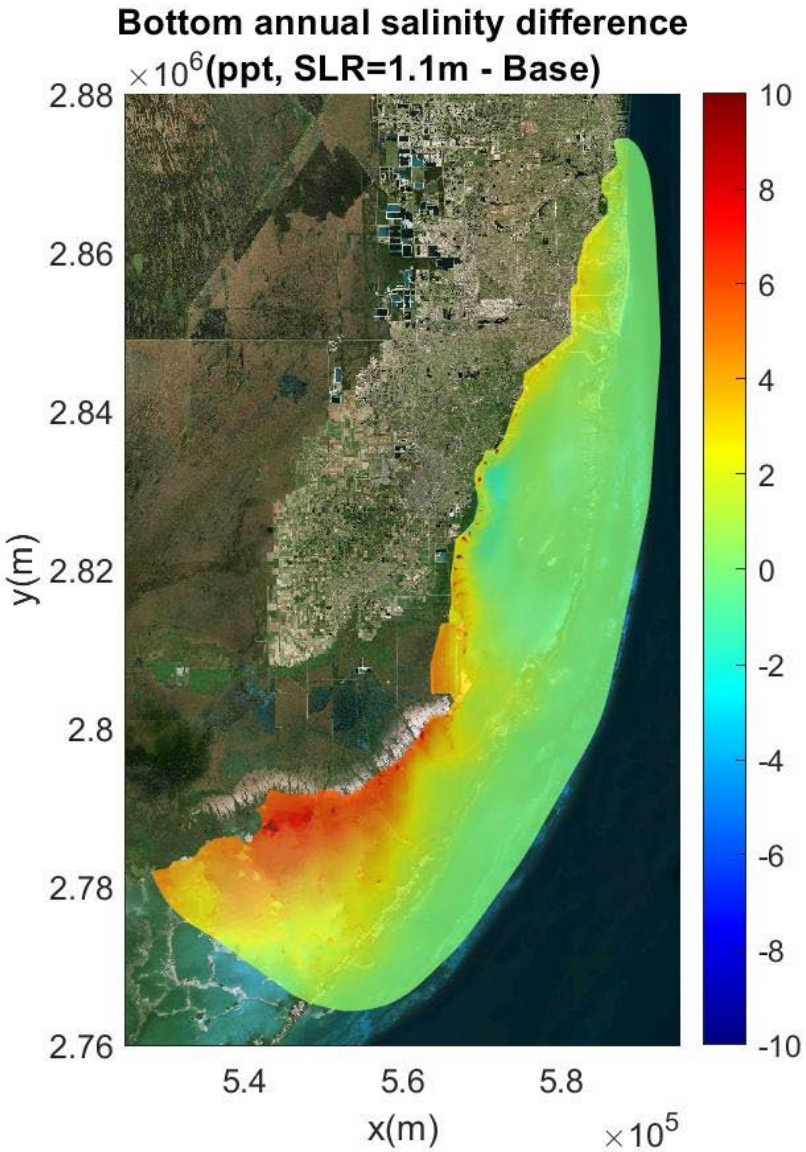

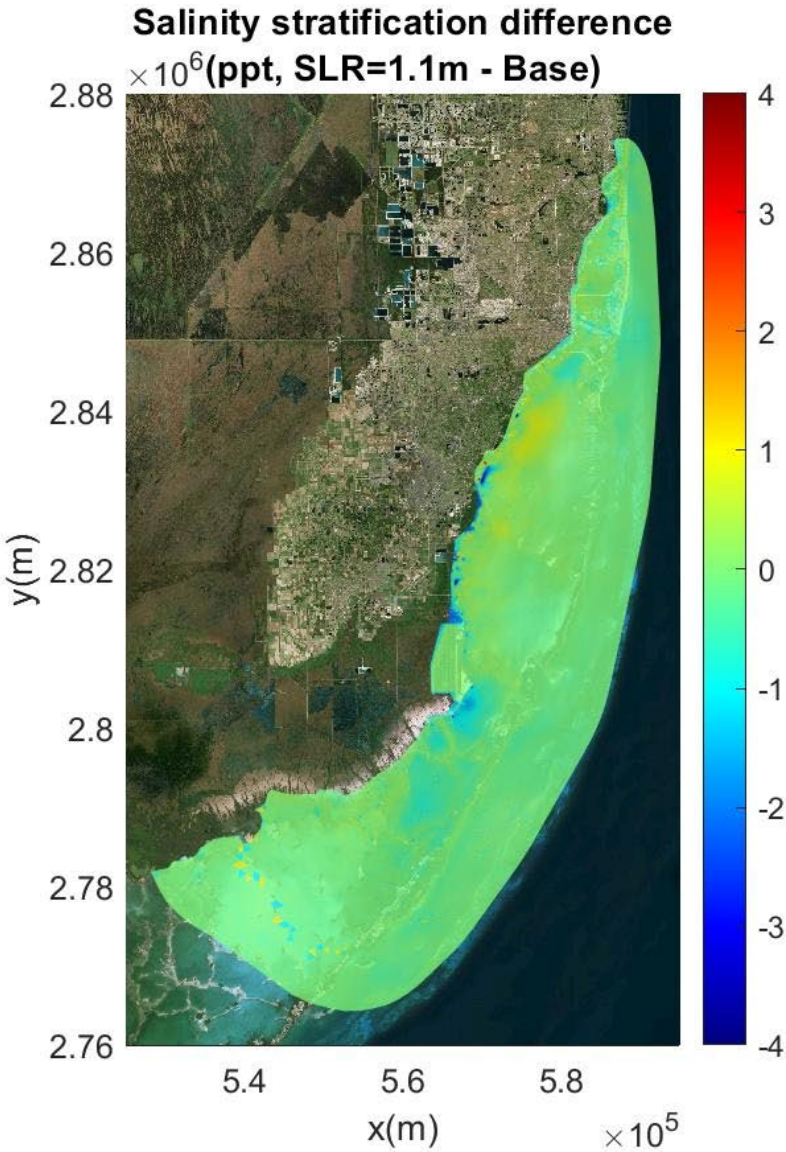

Summary

- Temperature results agree well with measurements
- Salinity results are good at offshore stations; The coastal/nearshore results are very sensitive to groundwater input
  - Our results are better in these areas after including GW – additional adjustments might be needed
- DO results are reasonable; Chlfa results are fairly good at north stations, while show overestimation offshore; Model results show an overall underestimation of N
- Further WQ calibration is needed

Summary

- 2D simulations could exaggerate the impact of freshwater input; 3D settings are important for accurate salinity simulations in Biscayne Bay
- The groundwater contributes significantly (up to 10 ppt) to near-shore salinity distributions, especially in central Biscayne Bay
- The SLR (1.1 m, USACE High) could cause salinity increase (~10 ppt) in the southern part (e.g., Florida Bay), a small increase (~1.5 ppt) in North Bay, and surprisingly minor decrease (~ 1 ppt) in Central Bay