GEER
Greater Everglades Ecosystem Restoration
April 21–24, 2025
Coral Springs, FL

Development of a Delft3D Hydrodynamic and Water Quality Model for Florida Bay in Support of the Groundwater Exchange Monitoring and Modeling (GEMM) Project

Kelin Hu & Ehab Meselhe, Tulane University
Matahel Ansar & Mirza Billah, South Florida Water Management District

4/24/2025

TULANE UNIVERSITY
SCHOOL of SCIENCE & ENGINEERING

SOUTH FLORIDA WATER MANAGEMENT DISTRICT
sfwmd.gov

LONI

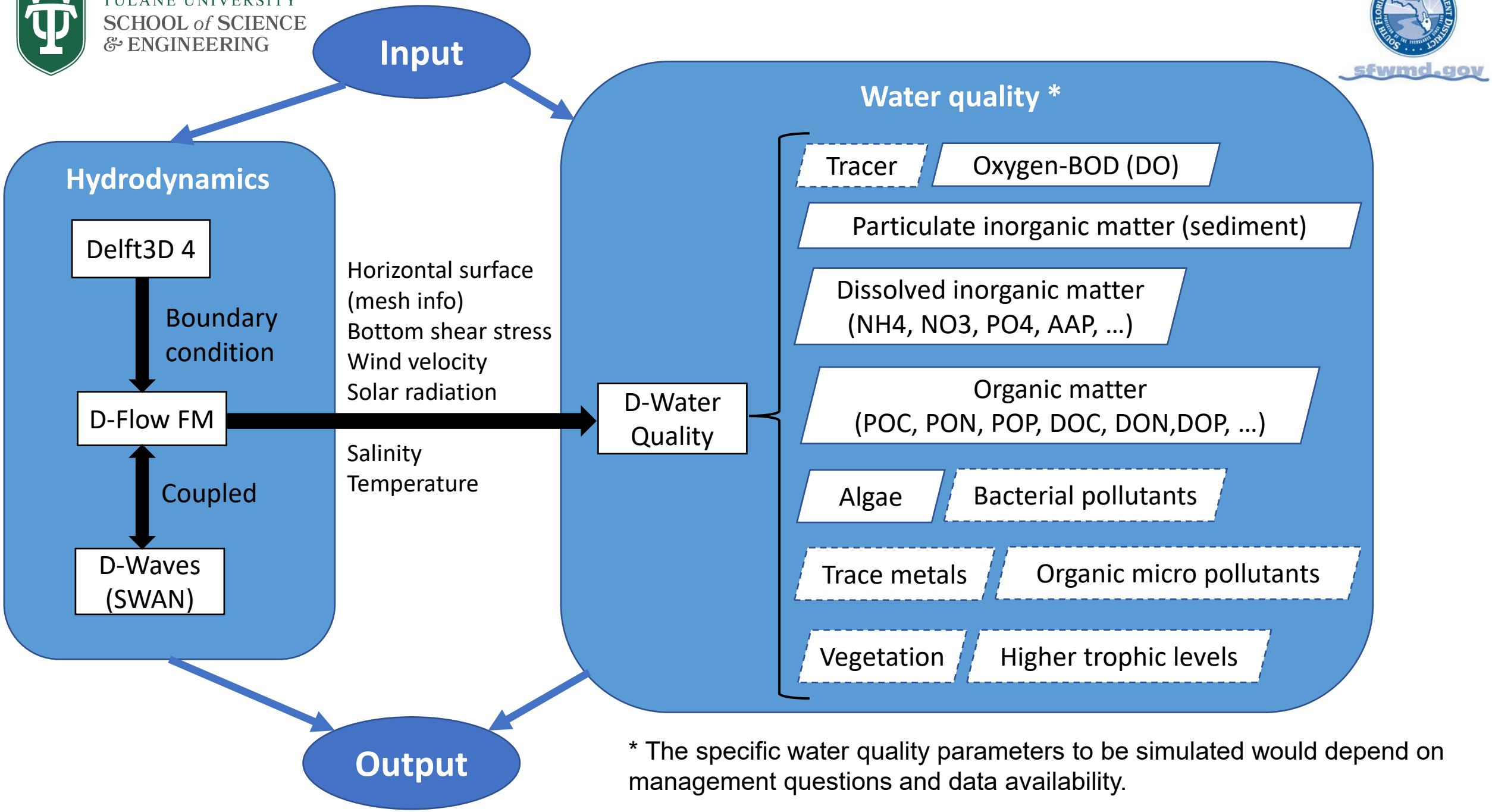
TULANE UNIVERSITY
SCHOOL of SCIENCE
& ENGINEERING

sfwmd.gov

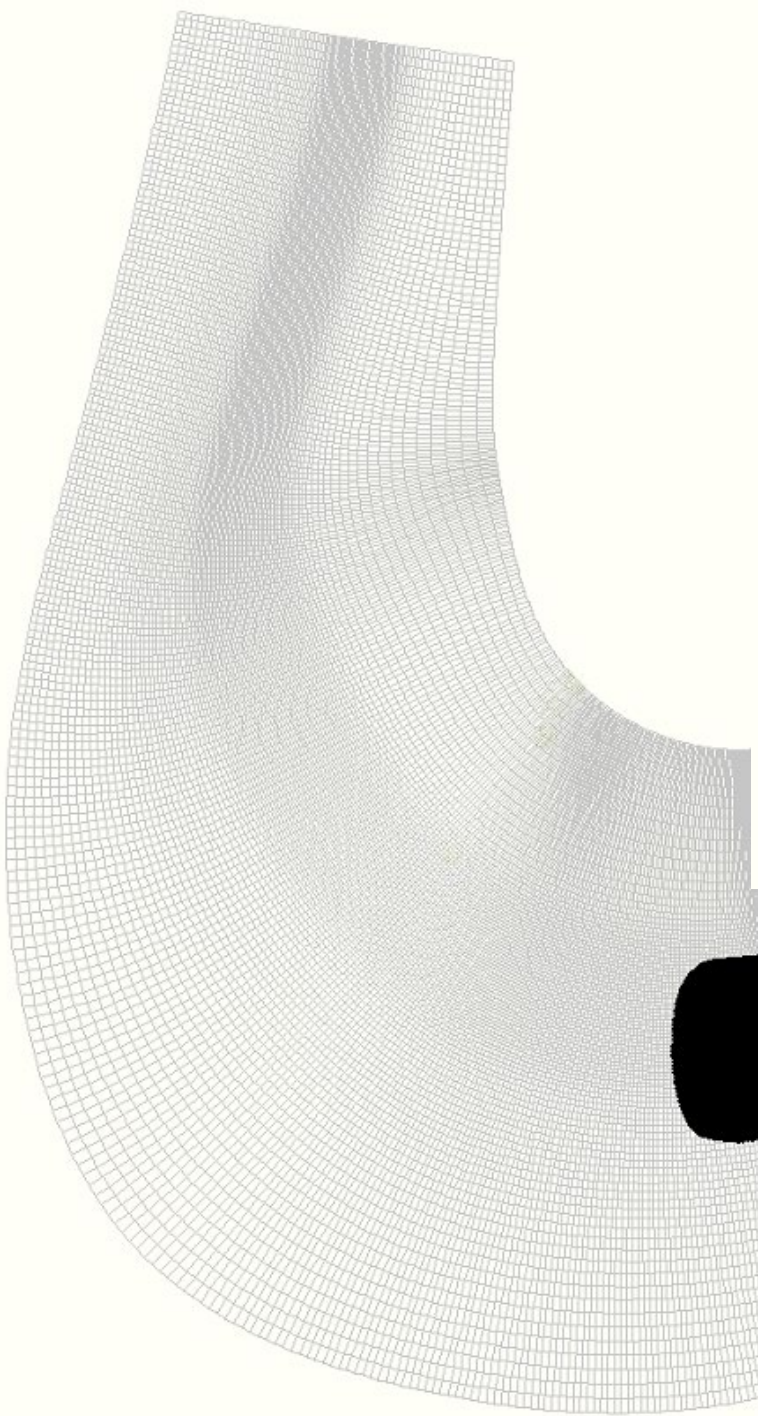
Objectives

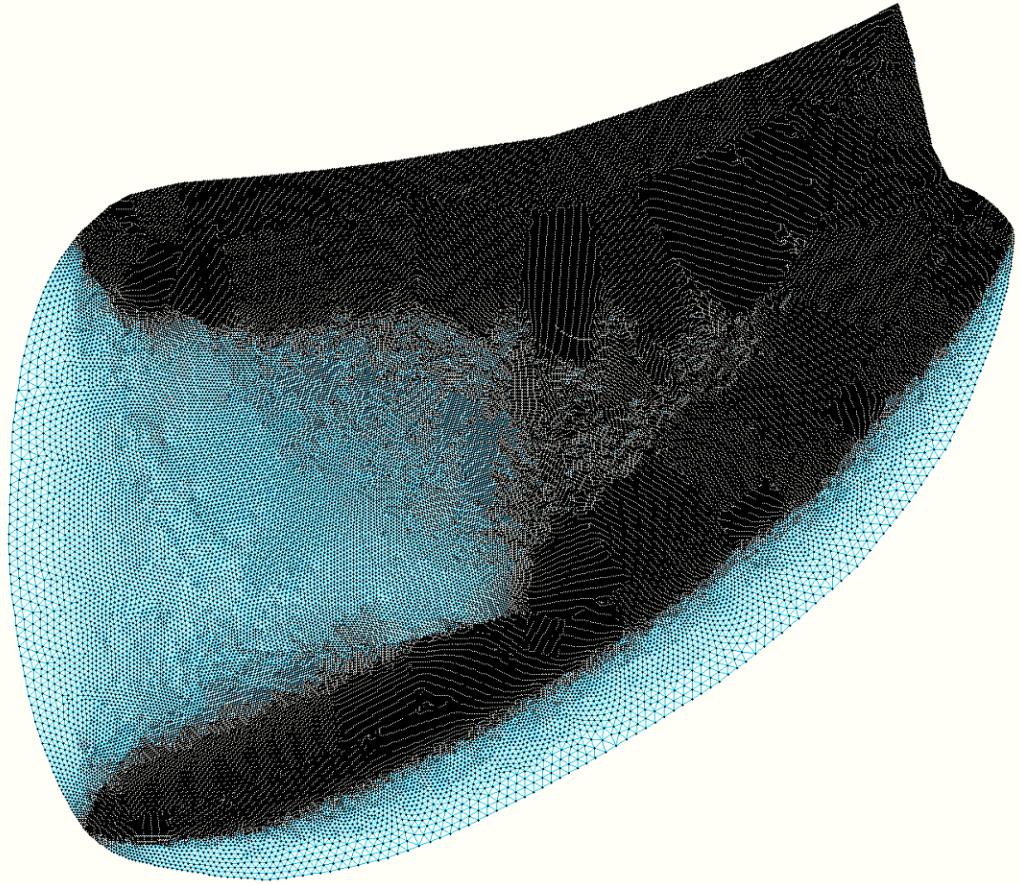
- Setup hydrodynamic and water quality model for Florida Bay
- Evaluate vertical barrier to lateral flow
- Evaluate current and future water management practices
- Assess impact of SLR on surface and groundwater hydrology

Parameter	Delft3D
Bathymetry & Topography	SFWMD Districtwide Digital Elevation Model (2023 Version)
Boundary Condition	Offshore water level/salinity/temperature: Nested from the regional southern Florida model; Surface water /Groundwater sources: RSMGL
Evapotranspiration	Calculated internally by D-Flow FM
Wind	NCEP/DOE Reanalysis II (T62 Gaussian grid, 6-hourly) https://psl.noaa.gov/data/gridded/data.ncep.reanalysis2.html * Other wind products or observations can be applied if needed
Rainfall	NCEP/DOE Reanalysis II (T62 Gaussian grid, 6-hourly) https://psl.noaa.gov/data/gridded/data.ncep.reanalysis2.html * Other rainfall products (e.g., NOAA Multi-Radar/Multi-Sensor System (MRMS)) or observations can be applied if needed

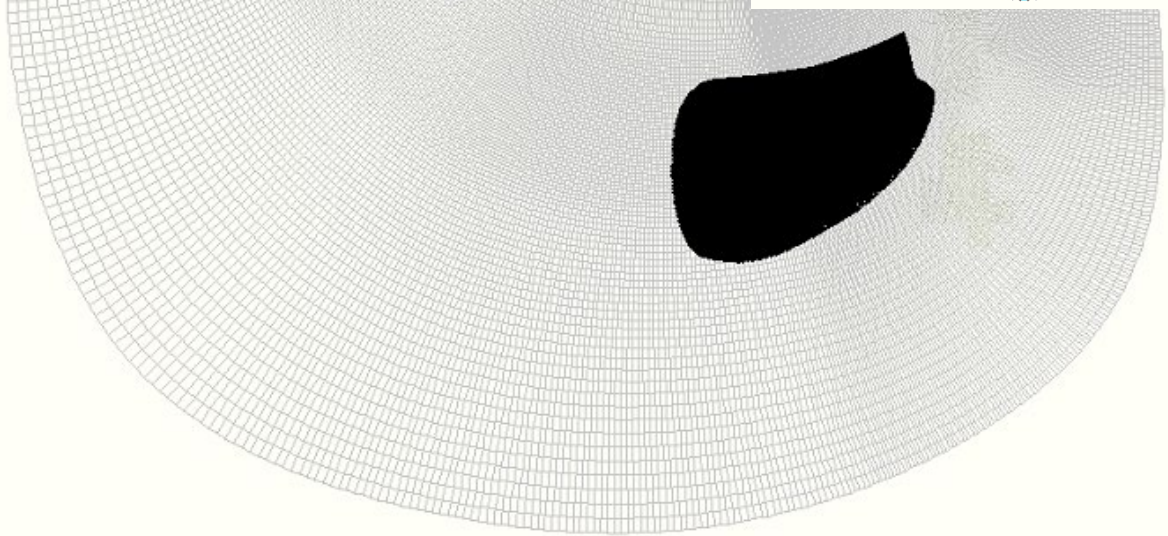


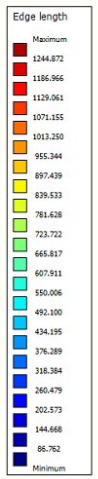
* The specific water quality parameters to be simulated would depend on management questions and data availability.

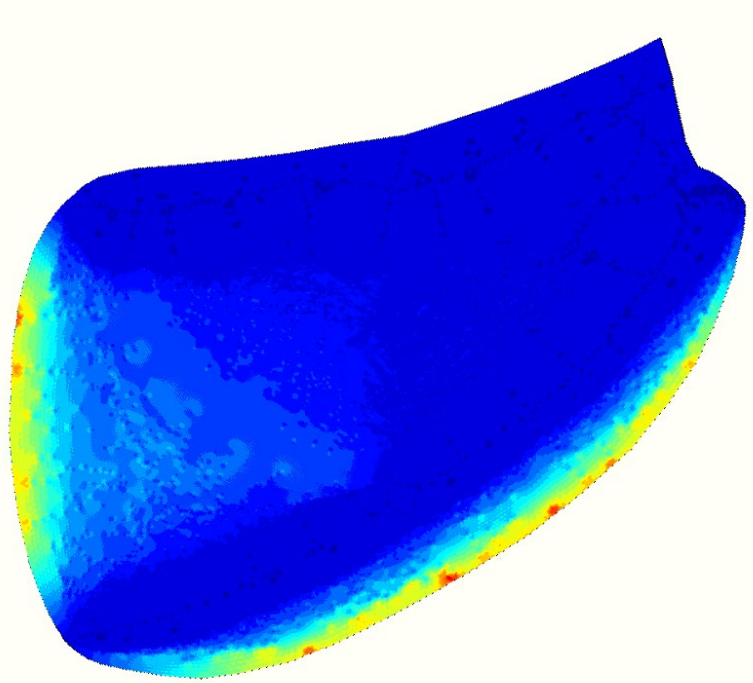




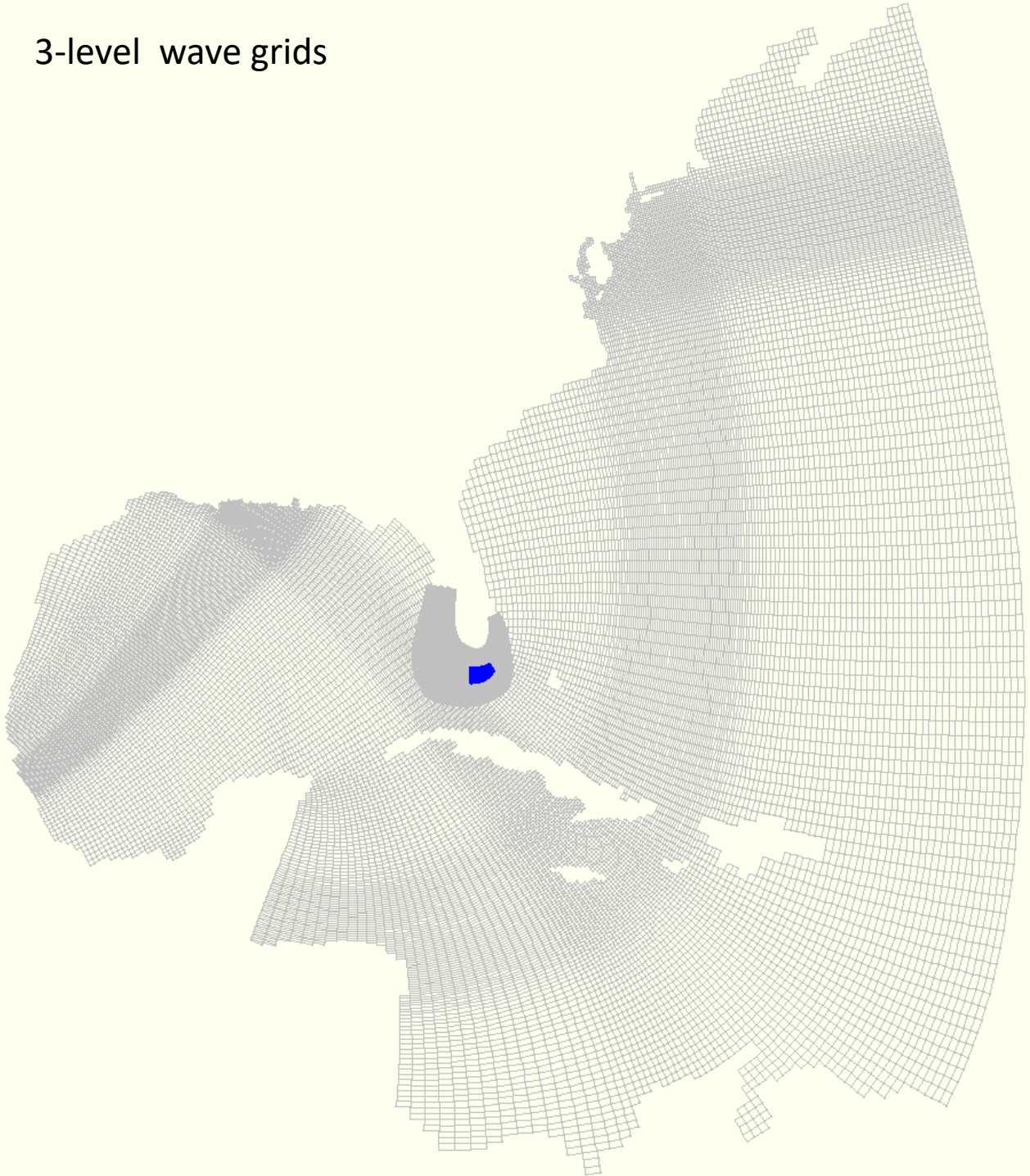
# of elements	274,012
# of nodes	137,454
Resolution	87 – 1,245 m

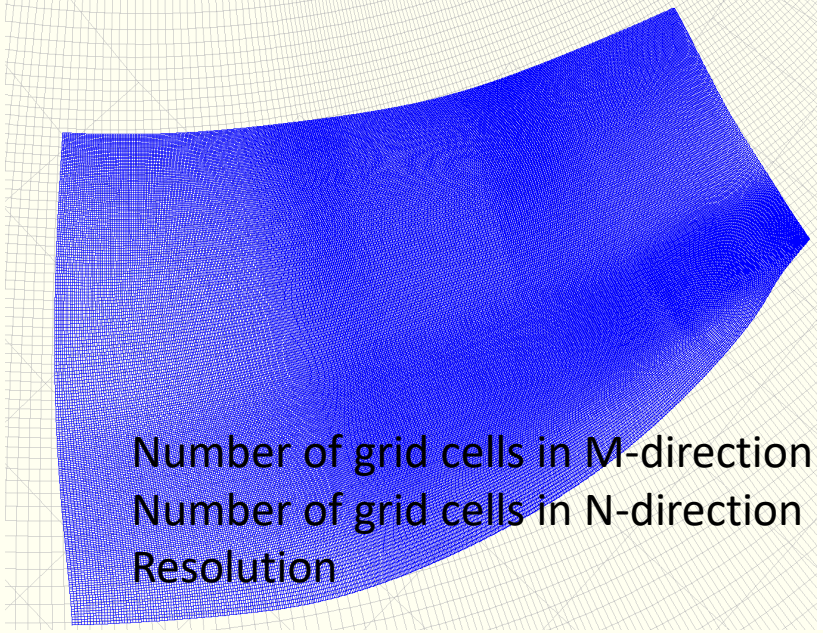




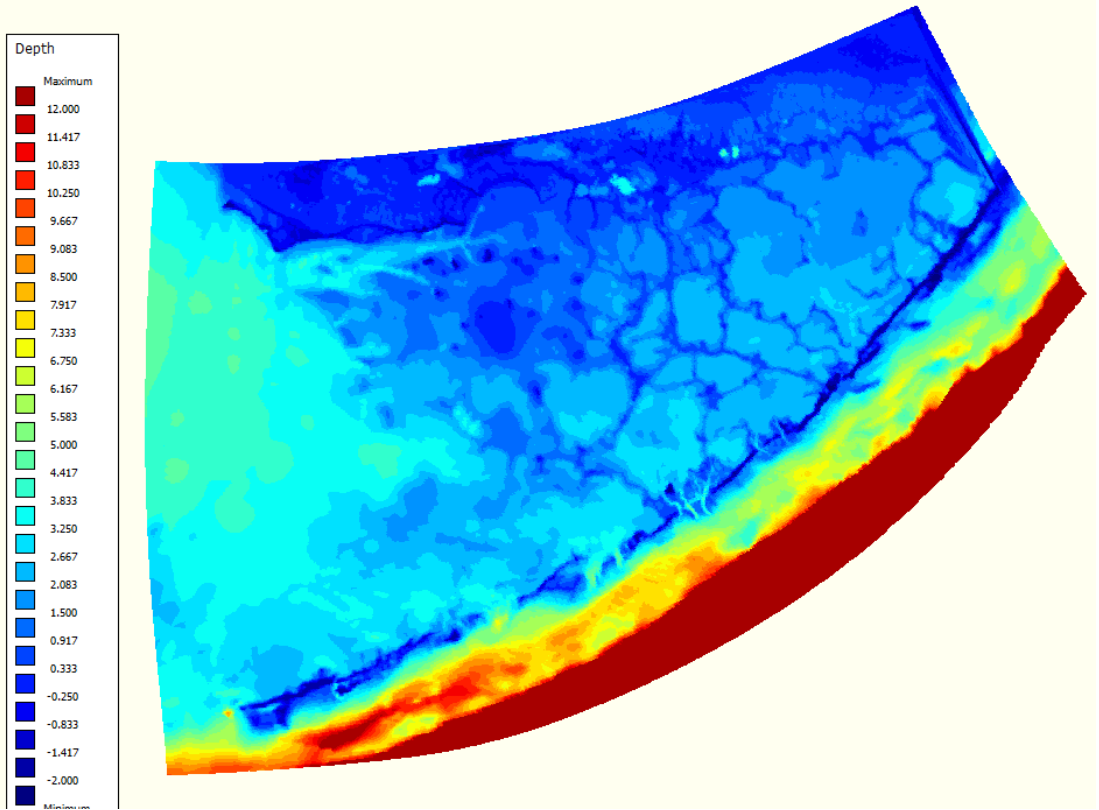


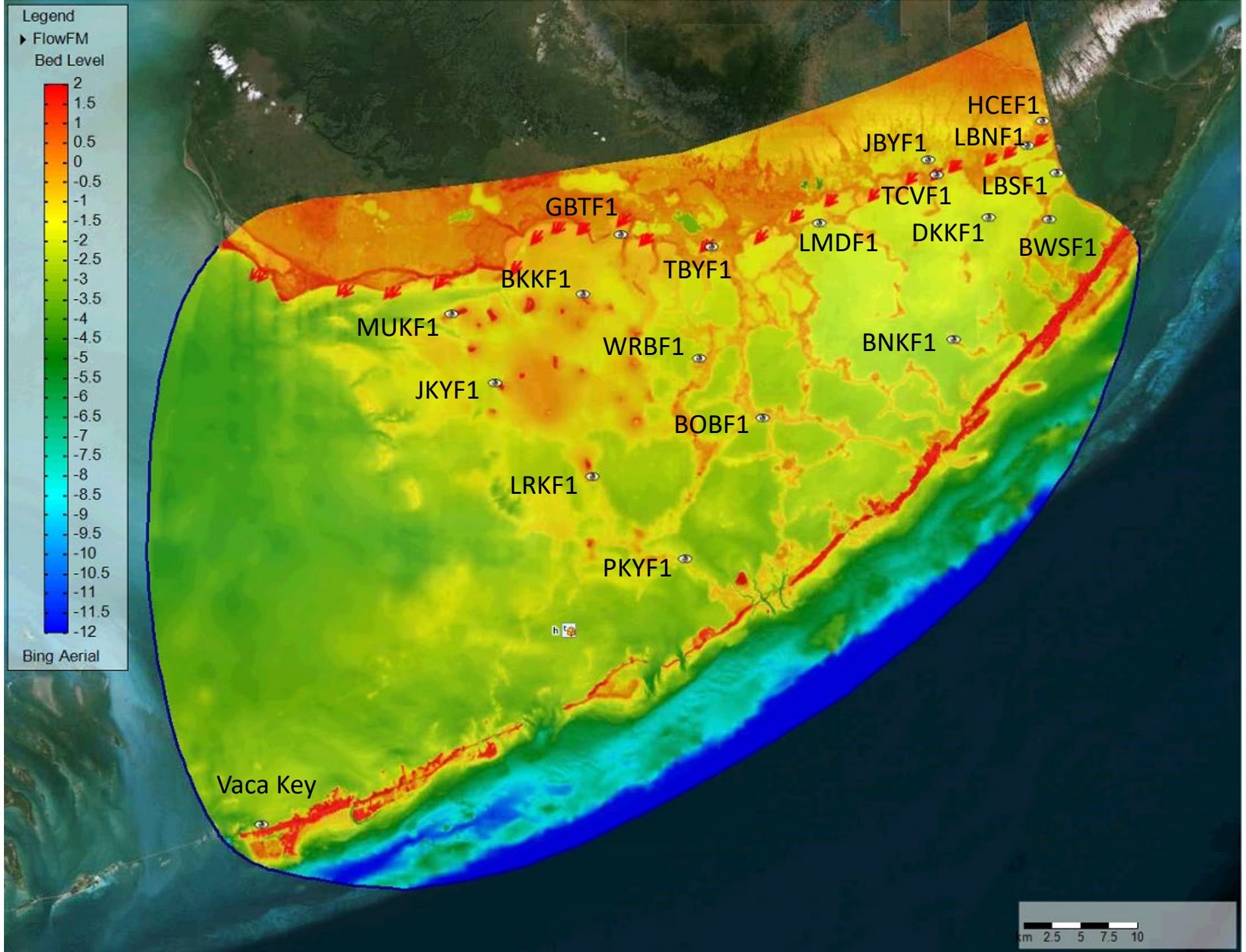
3-level wave grids



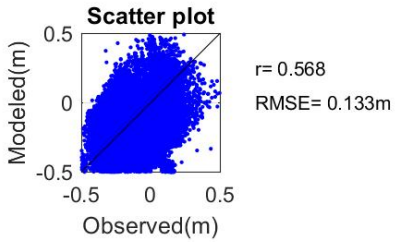


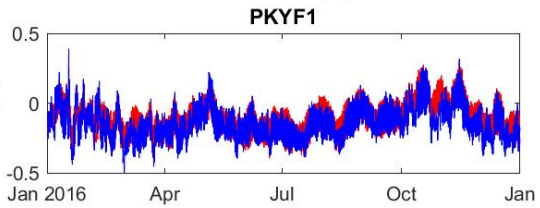
Number of grid cells in M-direction	600
Number of grid cells in N-direction	228
Resolution	80 – 360 m

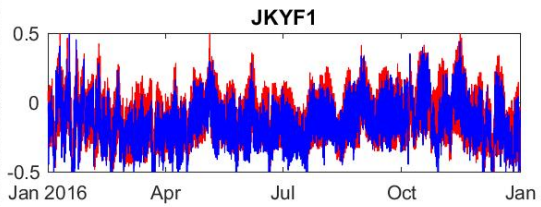


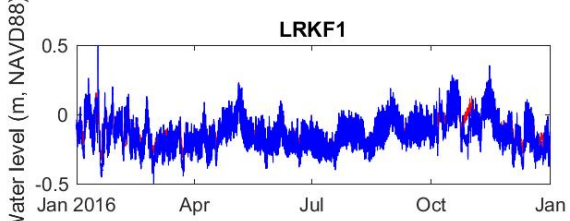

Legend
FlowFM
Bed Level
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
-5
-5.5
-6
-6.5
-7
-7.5
-8
-8.5
-9
-9.5
-10
-10.5
-11
-11.5
-12
Bing Aerial
HCEF1
JBYF1
LBNF1
LBSF1
TCVF1
GBTF1
LMDF1
DKKF1
BWSF1
TBYF1
BKKF1
MUKF1
WRBF1
BNKF1
JKYF1
BOBF1
LRKF1
PKYF1
Vaca Key
km 2.5 5 7.5 10

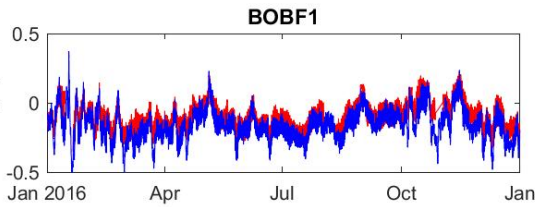
Hourly water level comparison

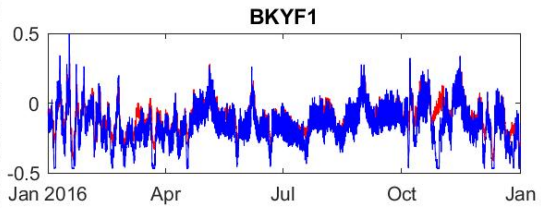


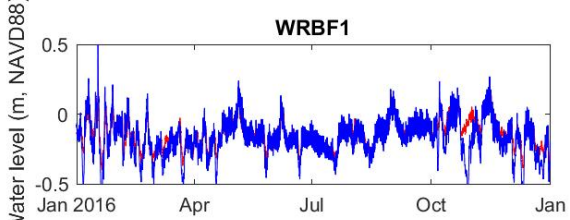


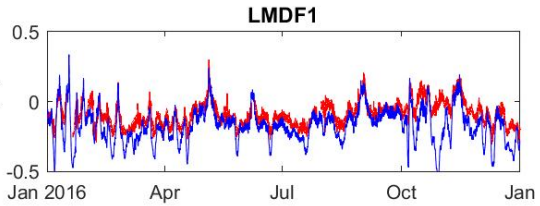


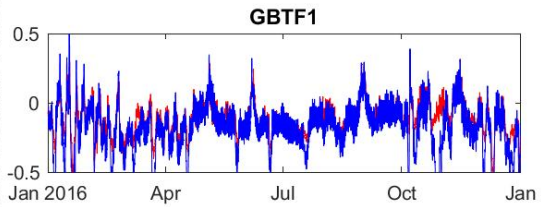


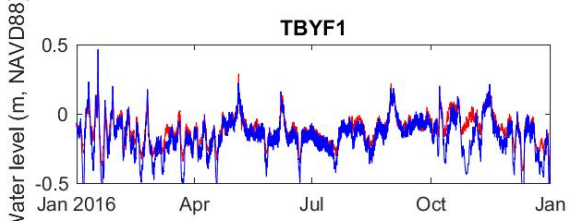


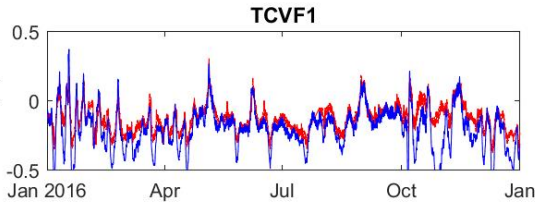


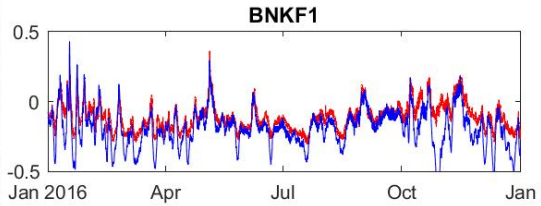


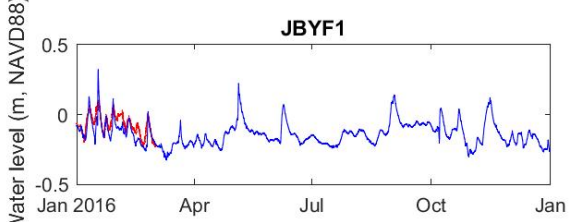


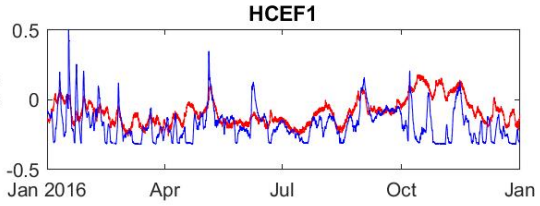


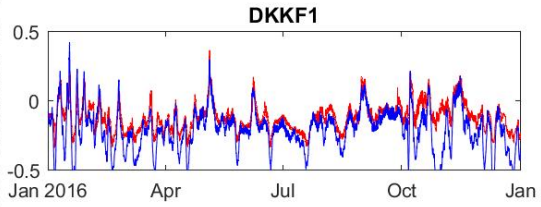


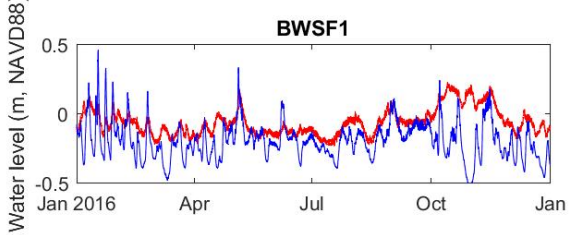


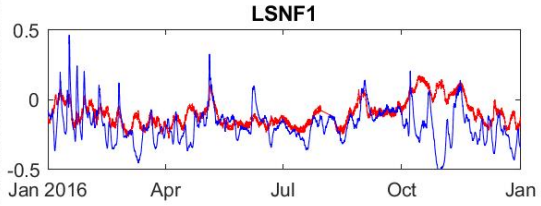


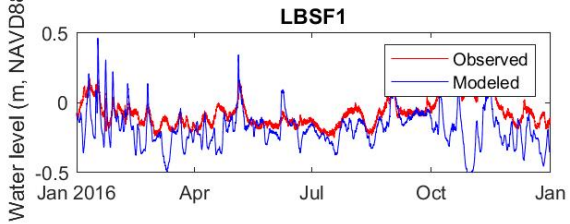


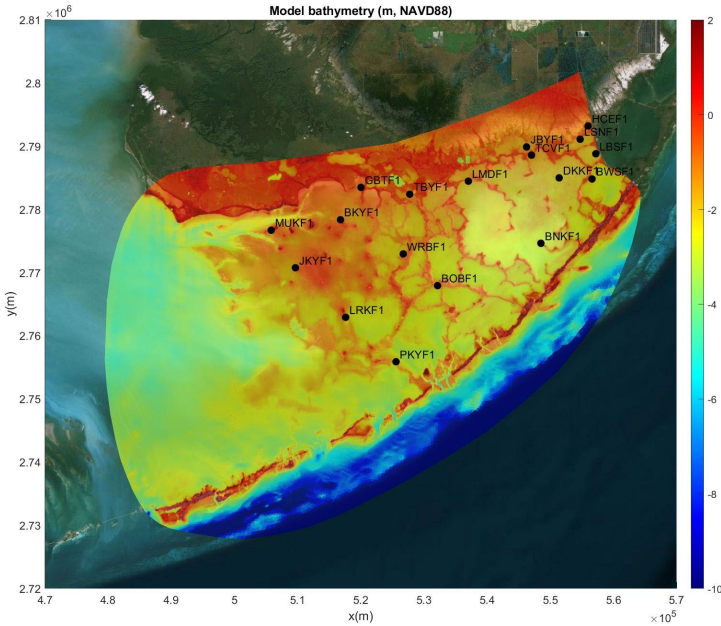




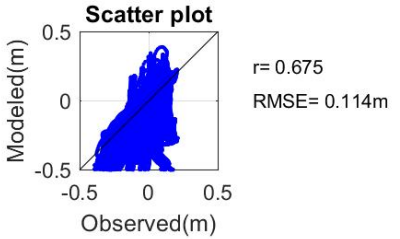


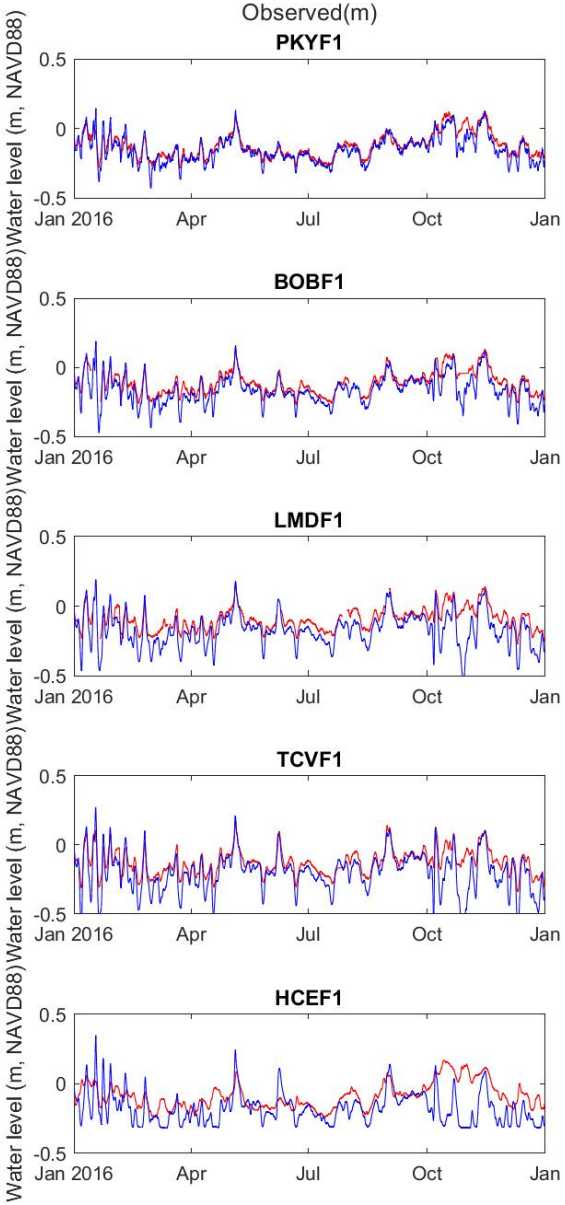


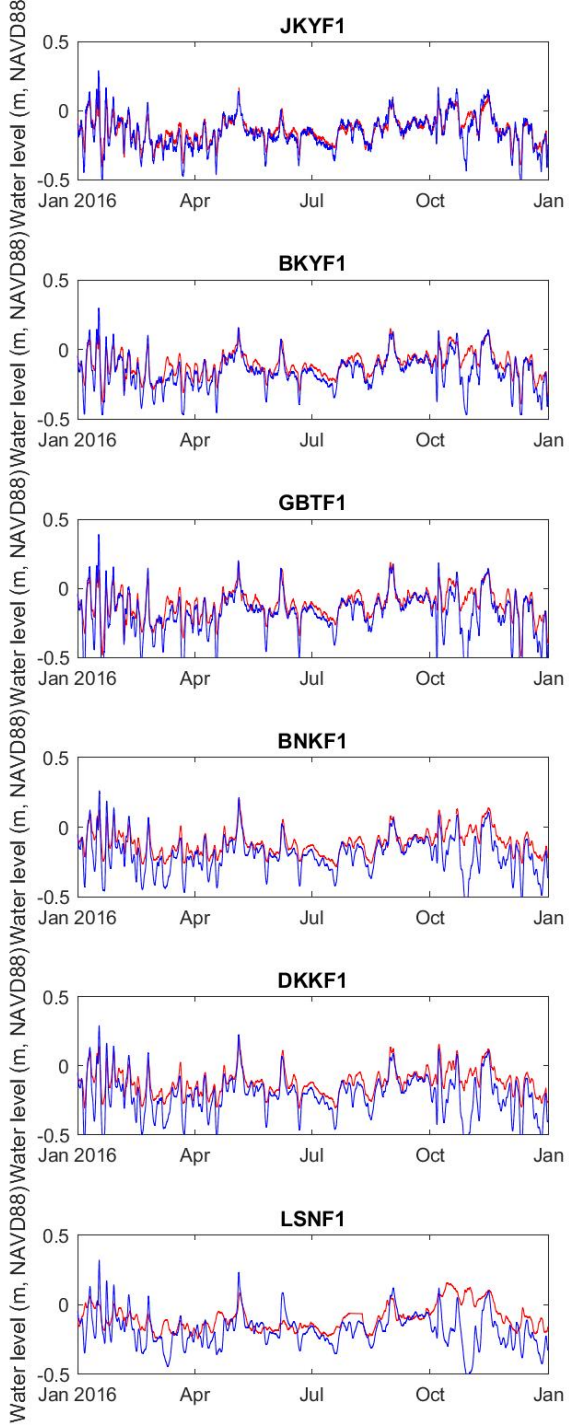


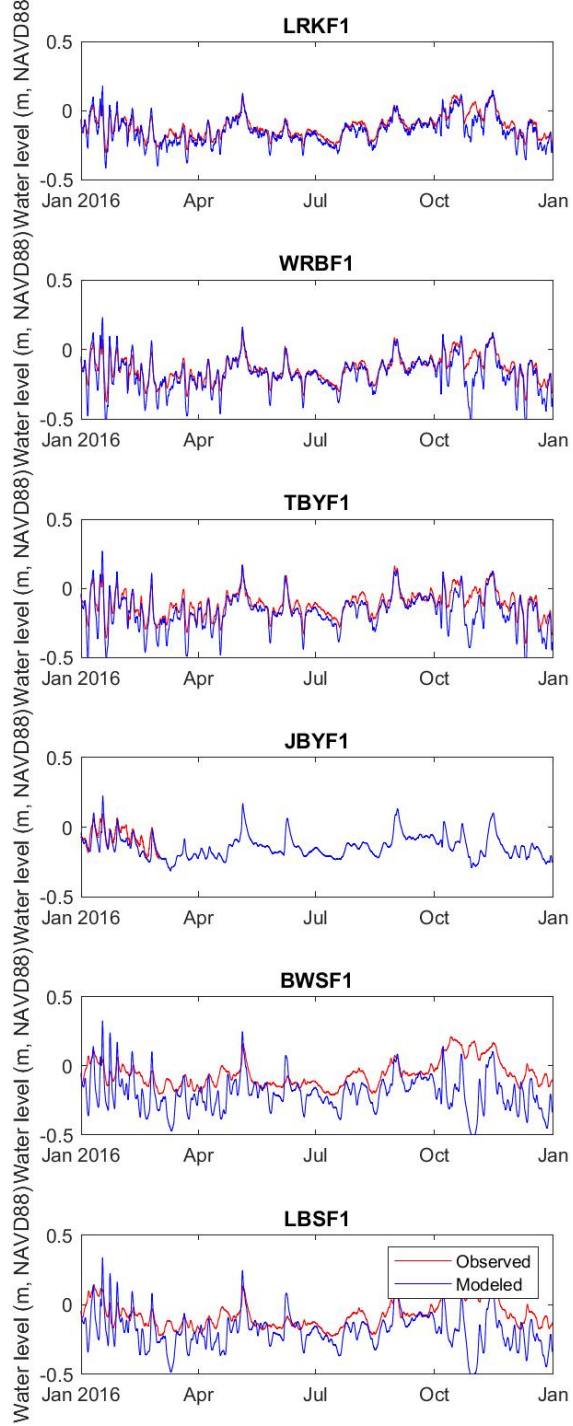


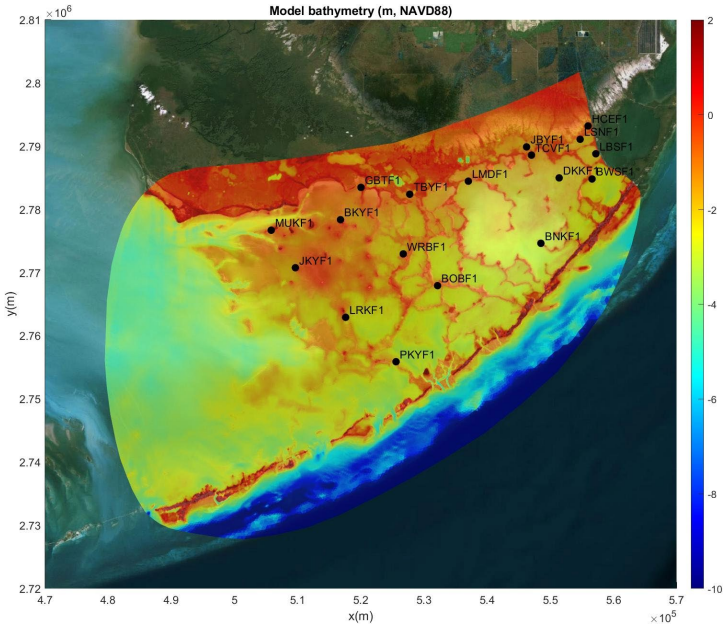
Daily water level comparison

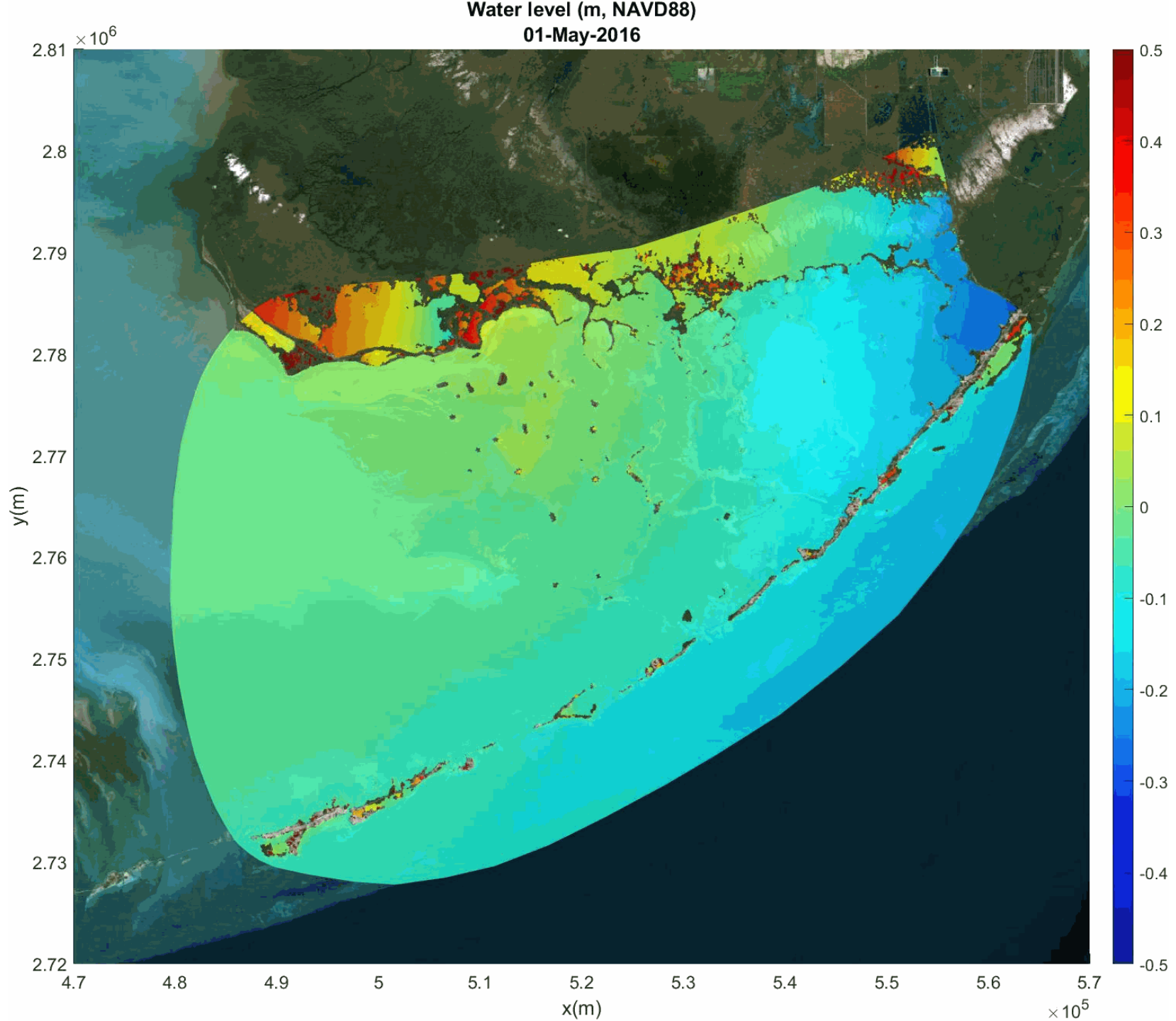


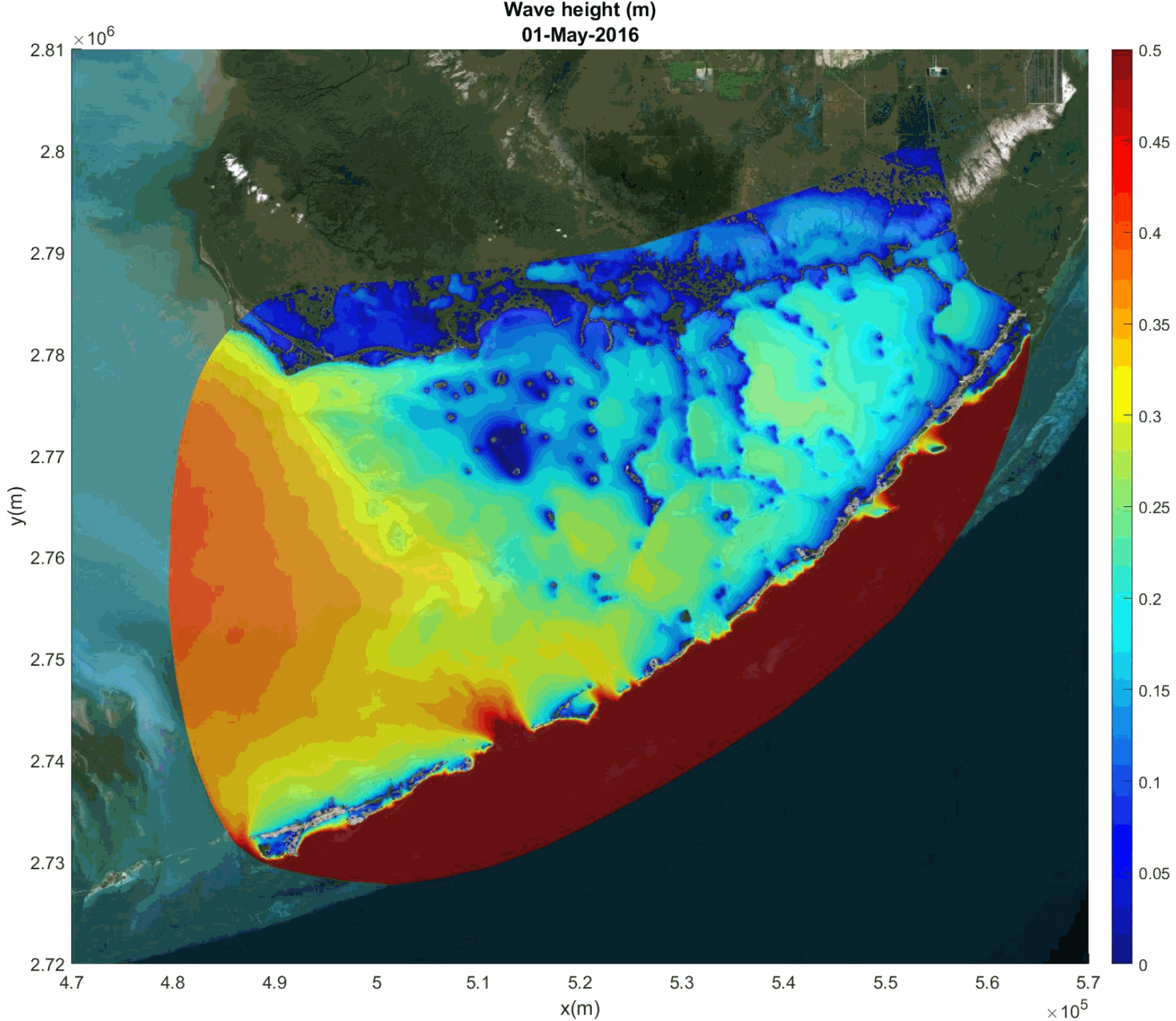


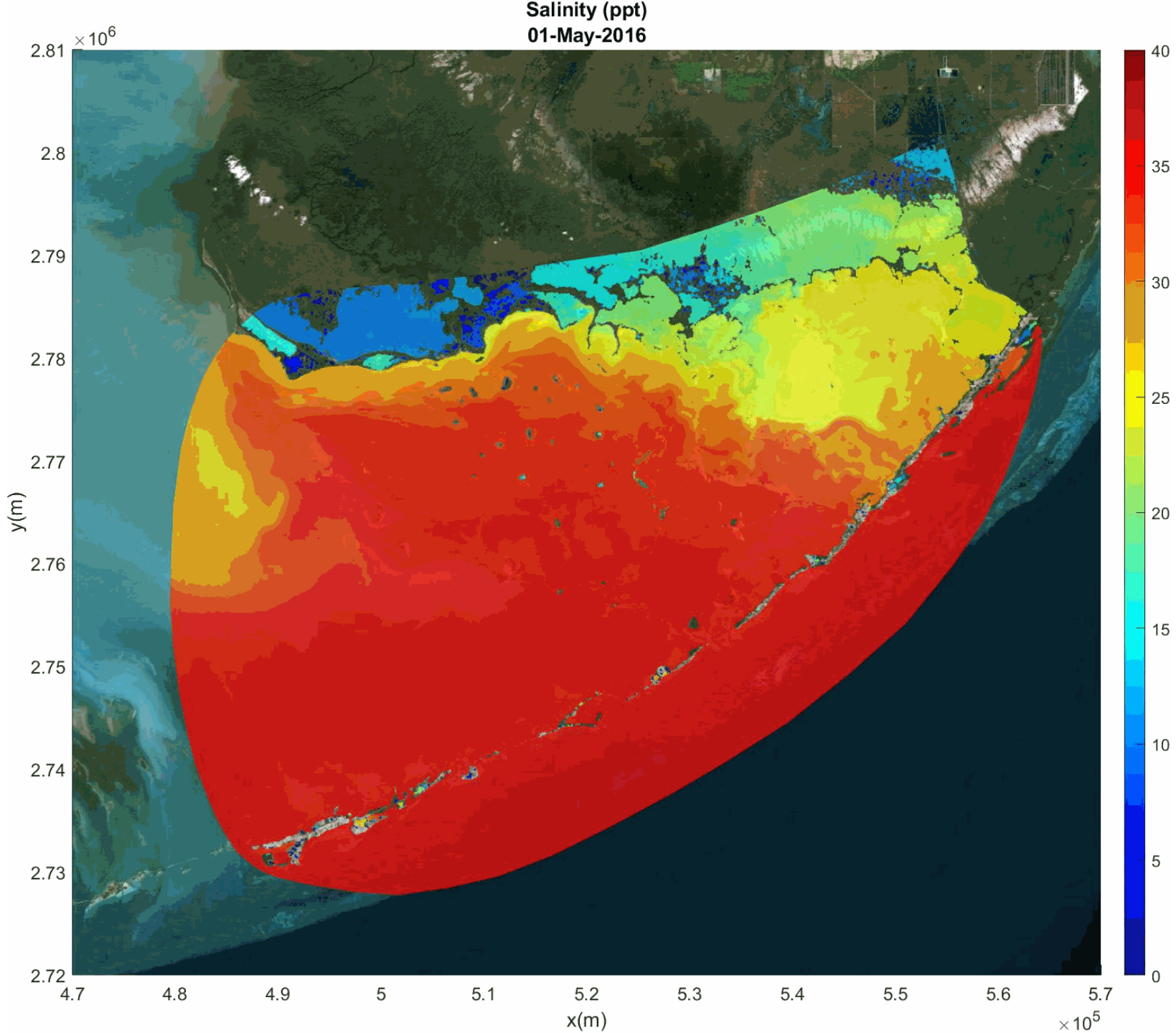


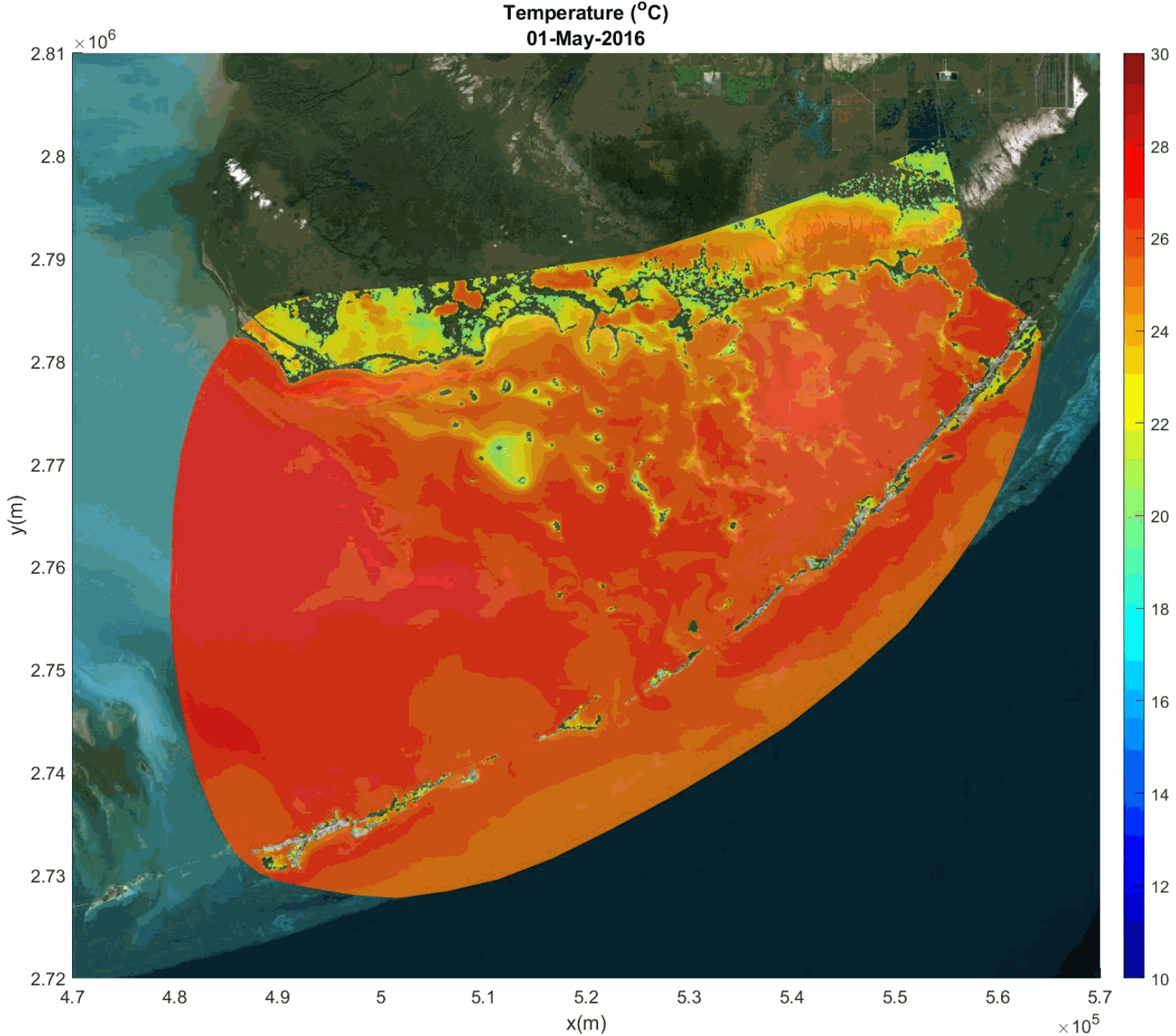





Water level (m, NAVD88)
01-May-2016
×10^6
2.81
2.8
2.79
2.78
2.77
2.76
2.75
2.74
2.73
2.72
y(m)
4.7
4.8
4.9
5
5.1
5.2
5.3
5.4
5.5
5.6
5.7
x(m)
×10^5
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5


Wave height (m)
01-May-2016
×10^6
2.81
2.8
2.79
2.78
2.77
2.76
2.75
2.74
2.73
2.72
y(m)
4.7
4.8
4.9
5
5.1
5.2
5.3
5.4
5.5
5.6
5.7
x(m)
×10^5
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0


Salinity (ppt)
01-May-2016
×10^6
2.81
2.8
2.79
2.78
2.77
2.76
2.75
2.74
2.73
2.72
y(m)
4.7
4.8
4.9
5
5.1
5.2
5.3
5.4
5.5
5.6
5.7
x(m)
×10^5
40
35
30
25
20
15
10
5
0


Temperature (°C)
01-May-2016
×10^6
2.81
2.8
2.79
2.78
2.77
2.76
2.75
2.74
2.73
2.72
y(m)
4.7
4.8
4.9
5
5.1
5.2
5.3
5.4
5.5
5.6
5.7
x(m)
×10^5
30
28
26
24
22
20
18
16
14
12
10

Summary of Model Features

- 2D and 3D modes available
- Surface/ground water inputs
- Following features can be considered:
  - Impact of sea grasses on bottom friction
  - Coupling with SWAN wave model (3-level nesting computation)
  - Salinity and temperature
  - Integrated WQ processes for parameters such as DO, Chlfa, NH4, NO3, PO4, etc.
  - Major storm events
- Run time (1 year):
  - 2D: Flow + Sal + temp: 5 hours [+WQ: 10 hours]
  - 3D (10 layers): Flow + Sal + temp: 2 days [+WQ: 4 hours]
  - Multiple scenarios can run simultaneously