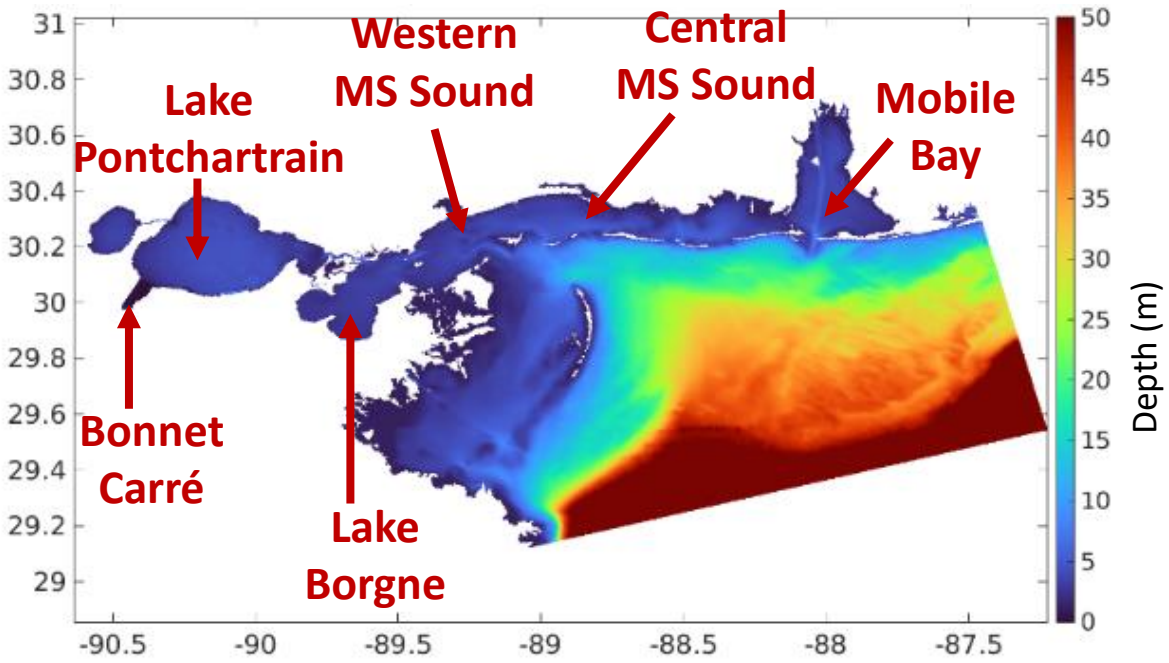
Continued Development of a Daily Operational Model for the Mississippi Sound and Bight

M. Kemal Cambazoglu
Brandy Armstrong
Jerry Wiggert

Division of Marine Science
School of Ocean Science and Engineering
The University of Southern Mississippi

9th COSS-TT: International Coordination Meeting
Theme II: Coastal and Regional (pre-)operational ocean forecasting systems and applications
May 2-4, 2023 – Hybrid from Montreal, Quebec, Canada

Motivation



In 2019 Bonnet Carré Spillway was **operated twice in the same calendar year for the first time ever.**

1) Opened late February and closed in mid-April
2) Reopened in mid-May and closed at the end of July

2019 openings combined introduced the largest cumulative freshwater volume from the Mississippi River.

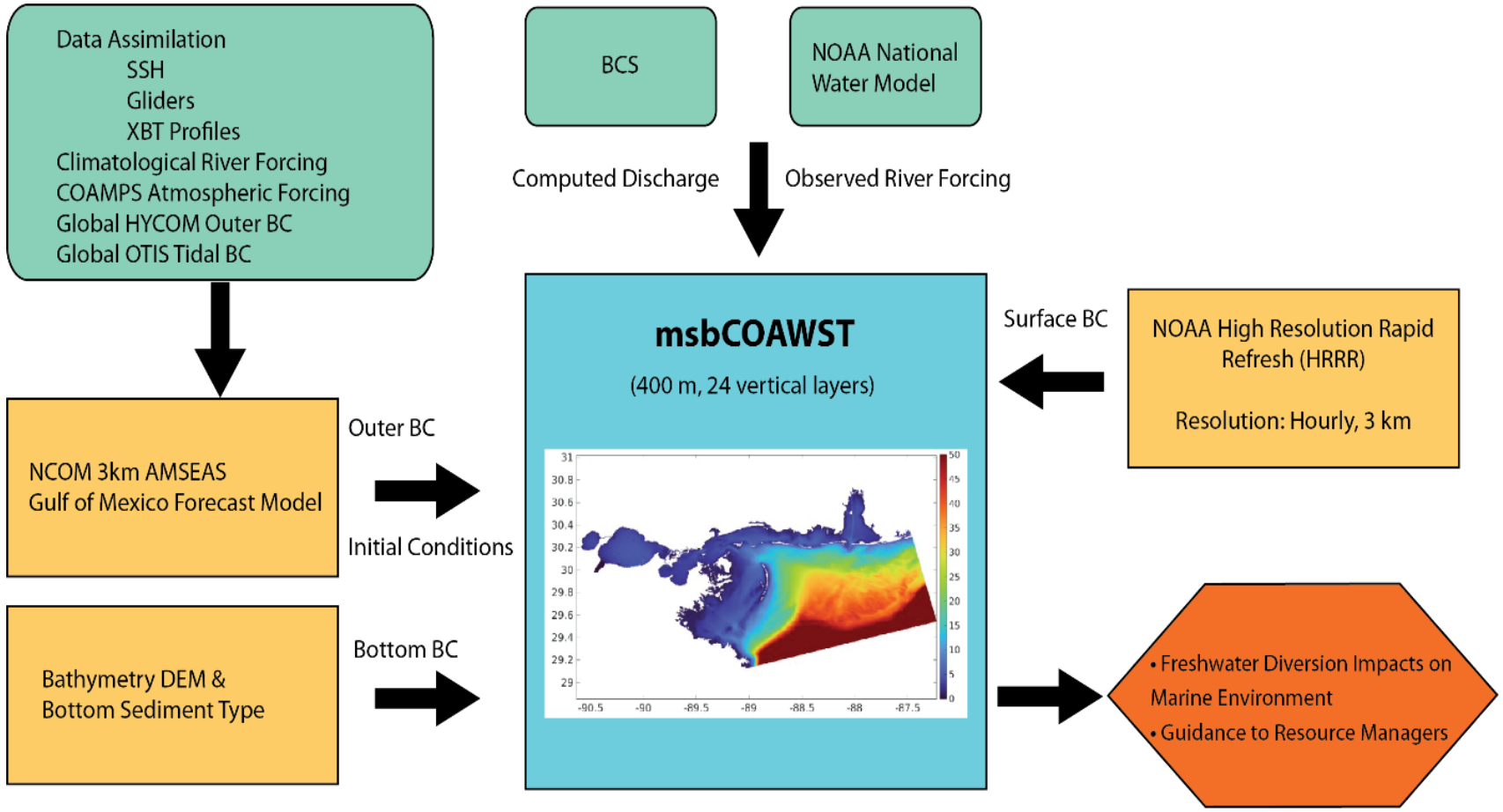
This event caused;
Water quality issues within the shallow estuarine systems; HAB formations; Onset of Hypoxia; Marine mammal mortalities; Beach closures; Fisheries sustainability issues specifically on shellfisheries/oysters

Bonnet Carré Spillway was **operated for three years in a row in 2018, 2019 and 2020 for the first time ever.**

Because of the 2019 double opening and recent change in frequency and duration of openings due to climate change has initiated the efforts on developing a daily operational forecast modeling system for MS Sound and Bight

Daily Operational Modeling System

Application of **COAWST** (Coupled Ocean Atmosphere Wave Sediment Transport Modeling System) to MS Bight (**msb-COAWST**)

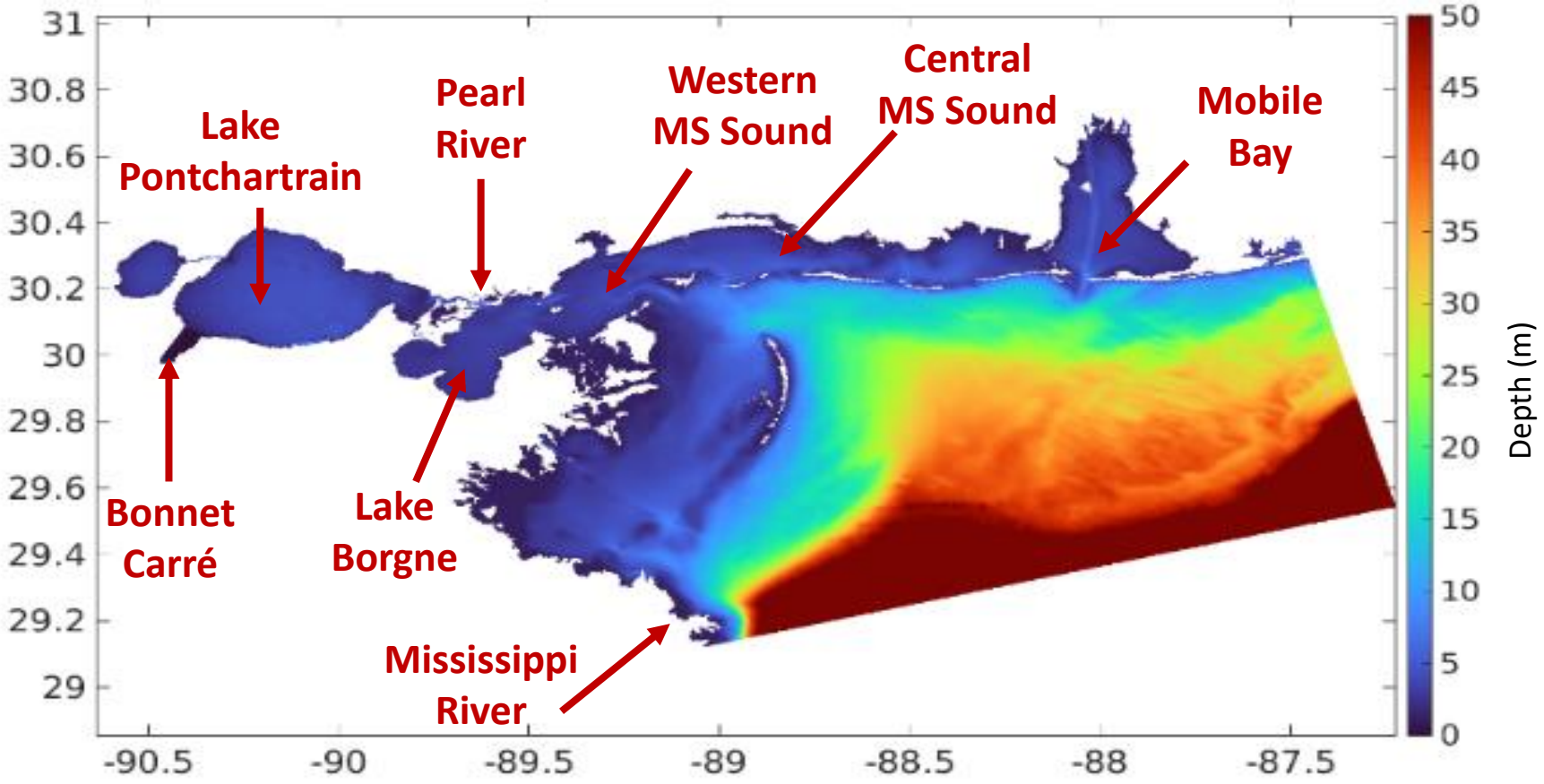


Modeling system configuration:

- Circulation model: ROMS
- Hourly river forcing from National Water Model forecasts (24-hr forecast)
- Open Boundary Conditions from NCOM-AMSEAS (3-hrly, 1/30°) for temperature, salinity, velocities and sea surface height
- Surface atmospheric forcing from NOAA-HRRR (WRF) (hourly, 3-km)
- Data assimilation within NWM, HRRR and NCOM-AMSEAS

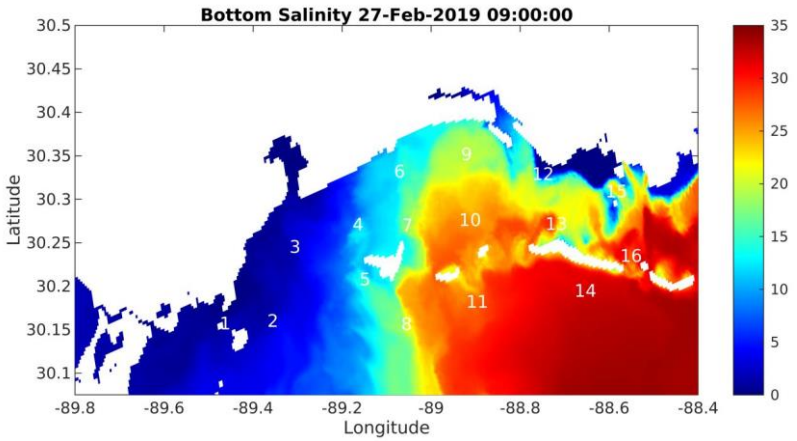
Daily Operational Modeling System

Application of **COAWST** (Coupled Ocean Atmosphere Wave Sediment Transport Modeling System) to MS Bight (**msb-COAWST**)

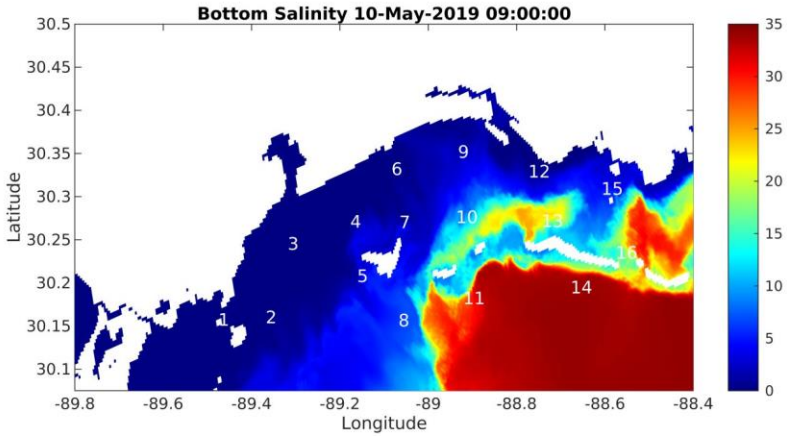


Model results– Bottom Salinity at Mississippi Sound

Beginning of 1st opening

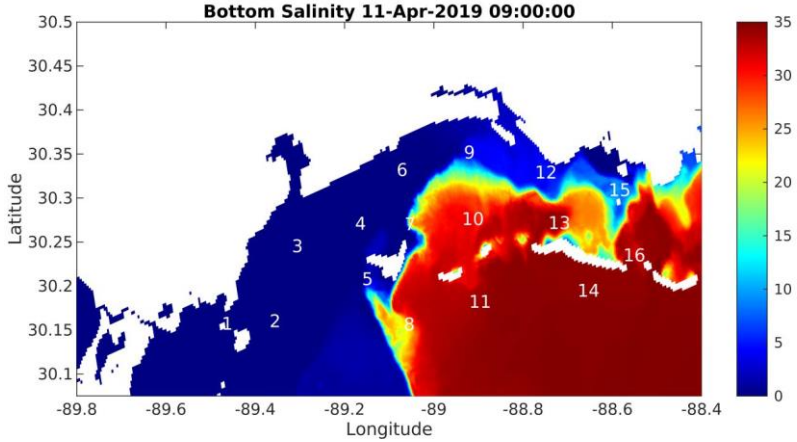


Beginning of 2nd opening

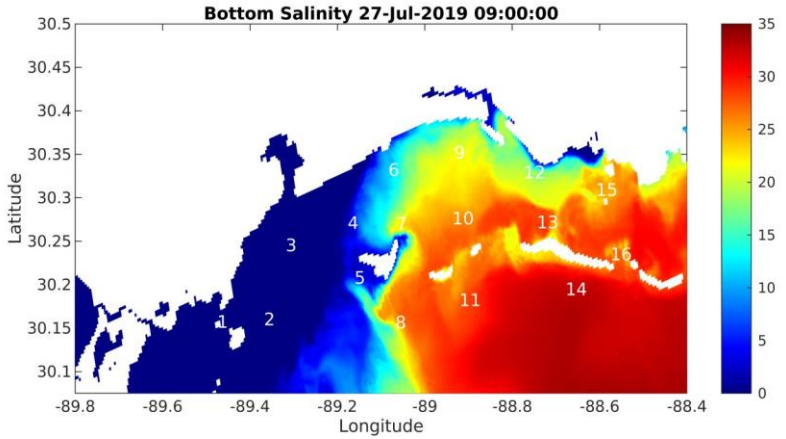


Bottom salinity predictions affect the growth, success and mortality of oysters. Low salinity is a significant stressor for oyster habitat in Mississippi Sound.

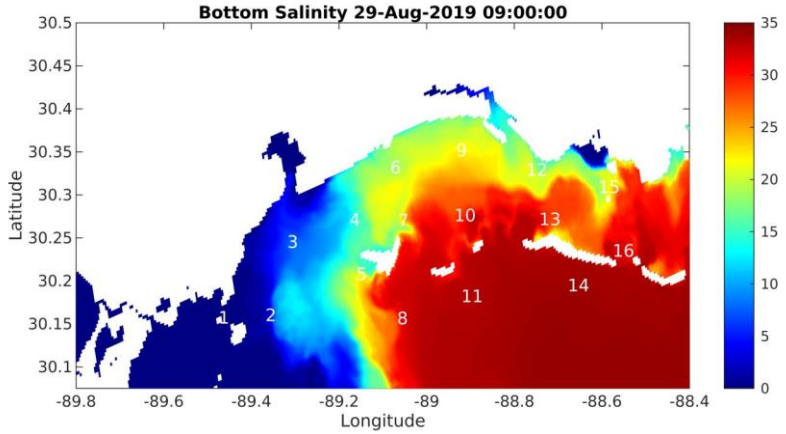
End of 1st opening



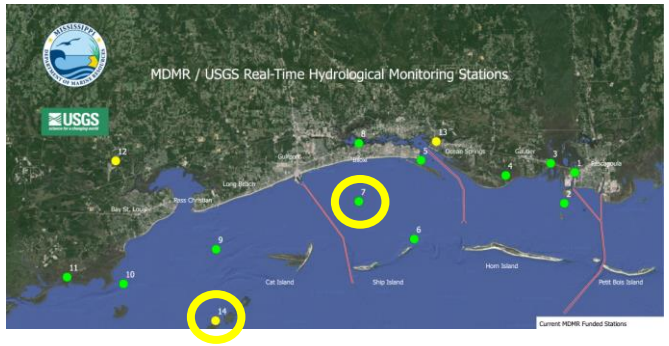
End of 2nd opening



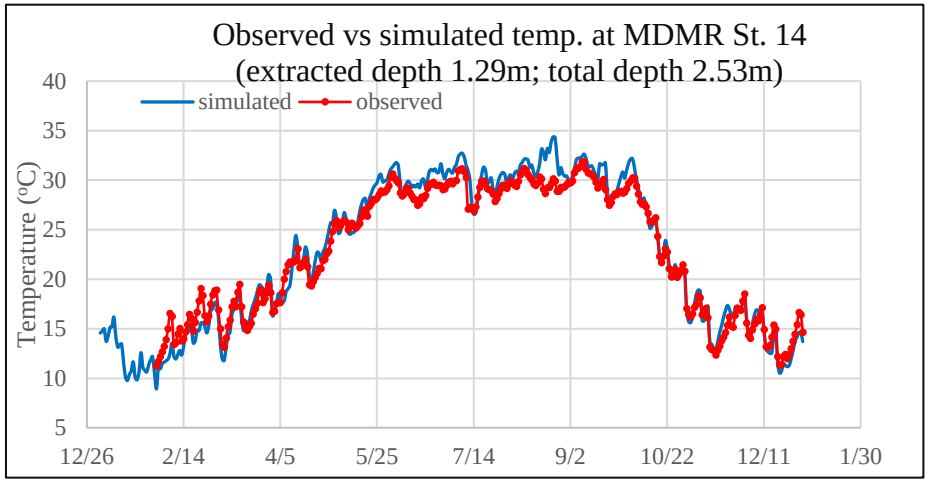
One month after closure of 2nd opening



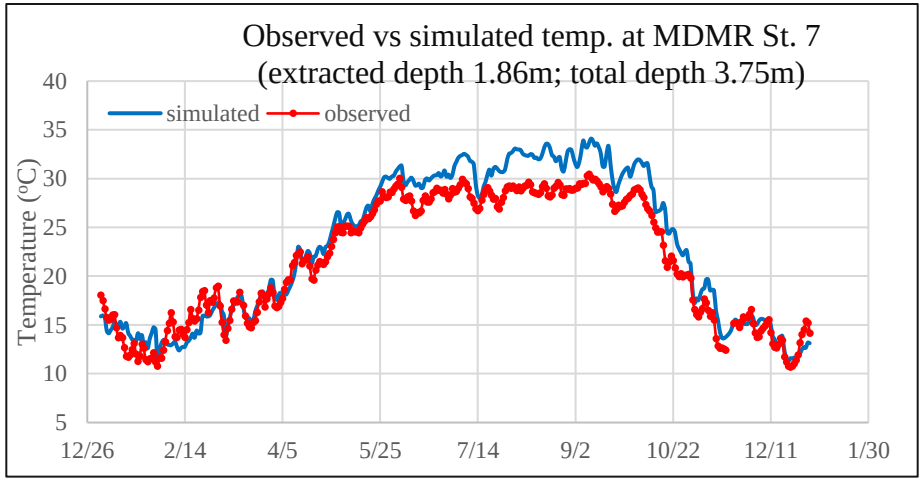
Model validation: Temperature



Station 14



Station 7

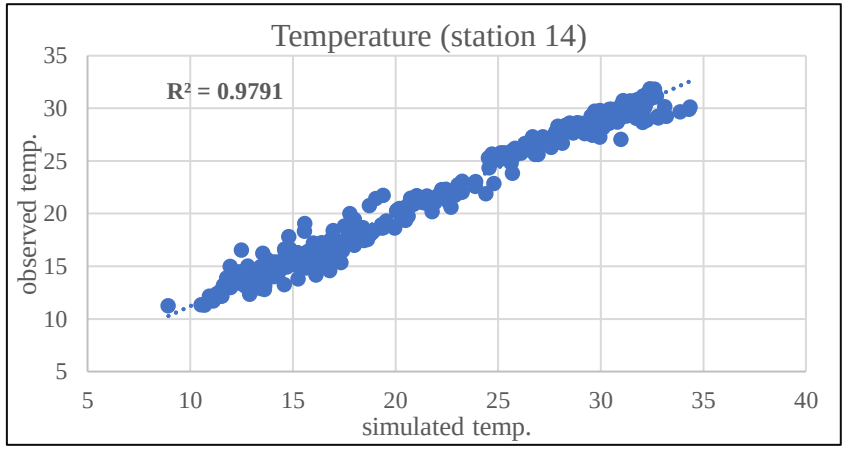


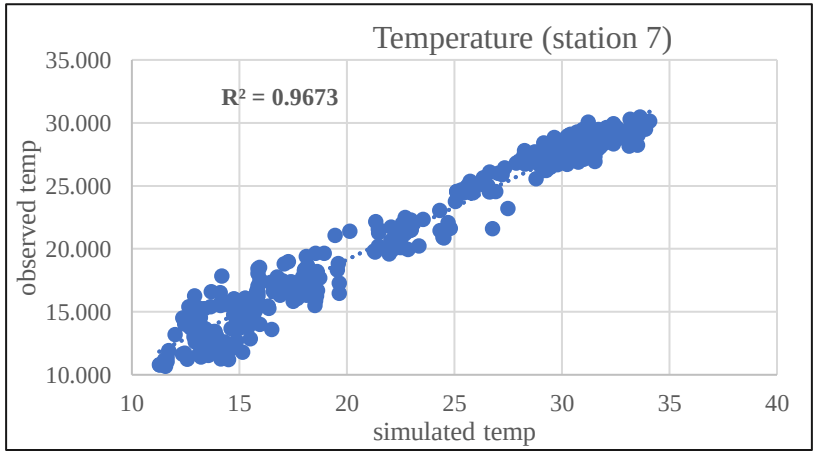
- Model temperature is in line with measurements and variability at all MDMR station locations with very high model correlations:

0.97 in Central MSS

0.98 in Western MSS

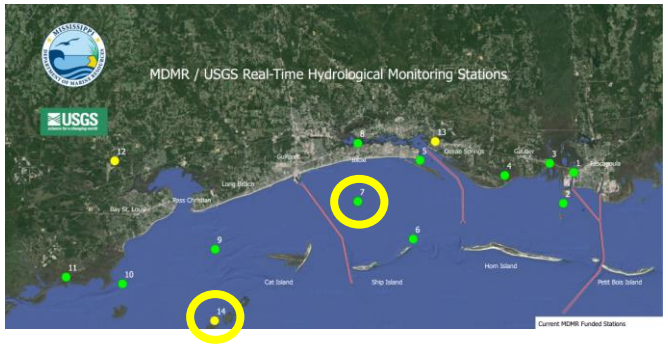
-



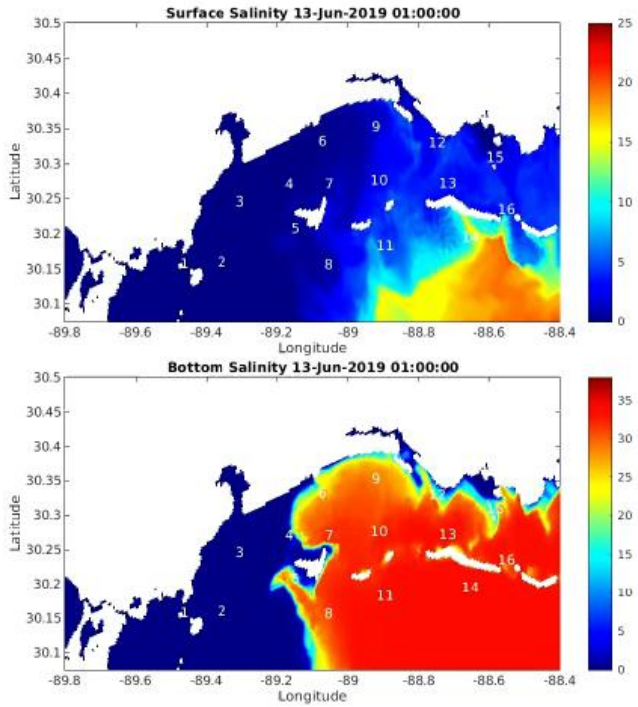


- Seasonal temperature patterns with warmer summer (>25 from May to September) and colder winter temperatures (<20 from November to February) are observed at all stations

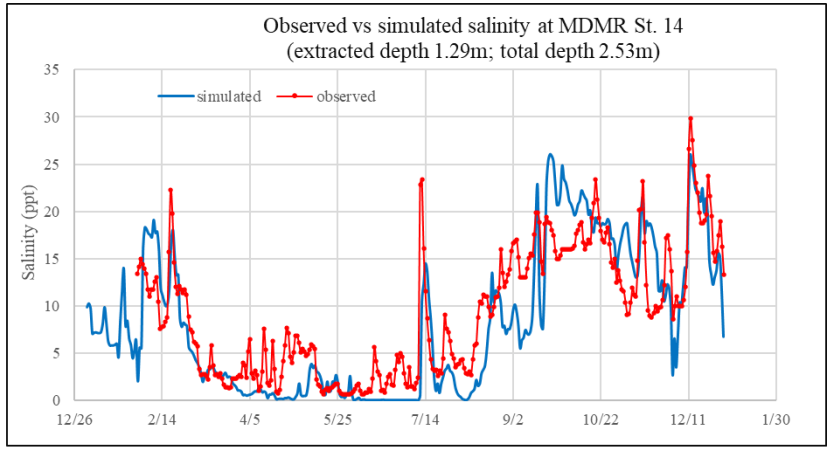
Model validation: Salinity

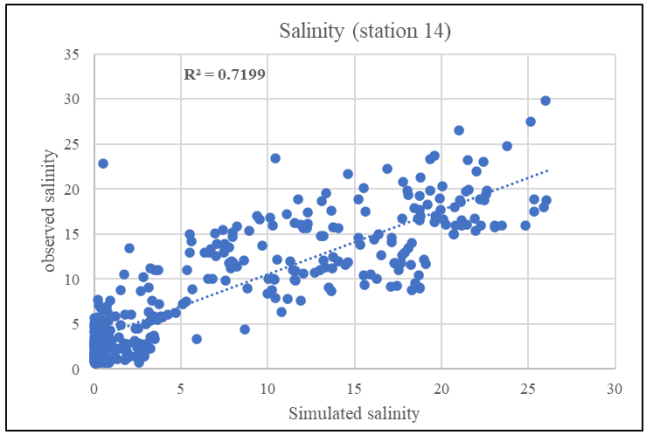


Model salinity captures the observed salinity variability with reasonably high correlations.

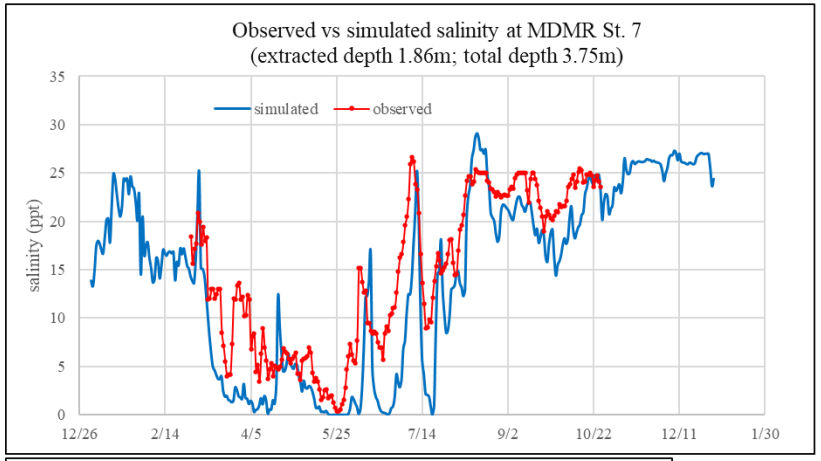


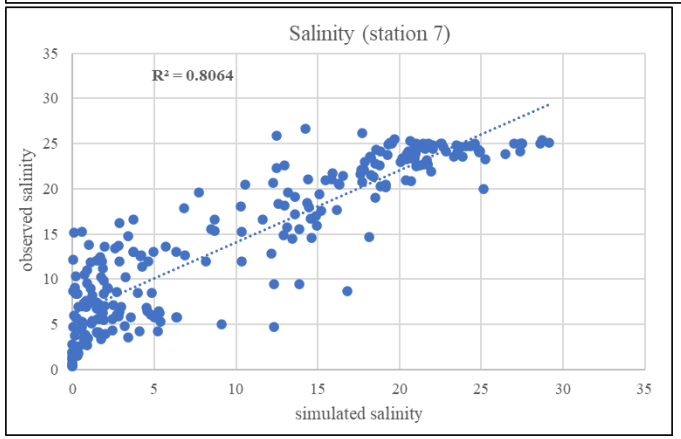
Station 14





Station 7



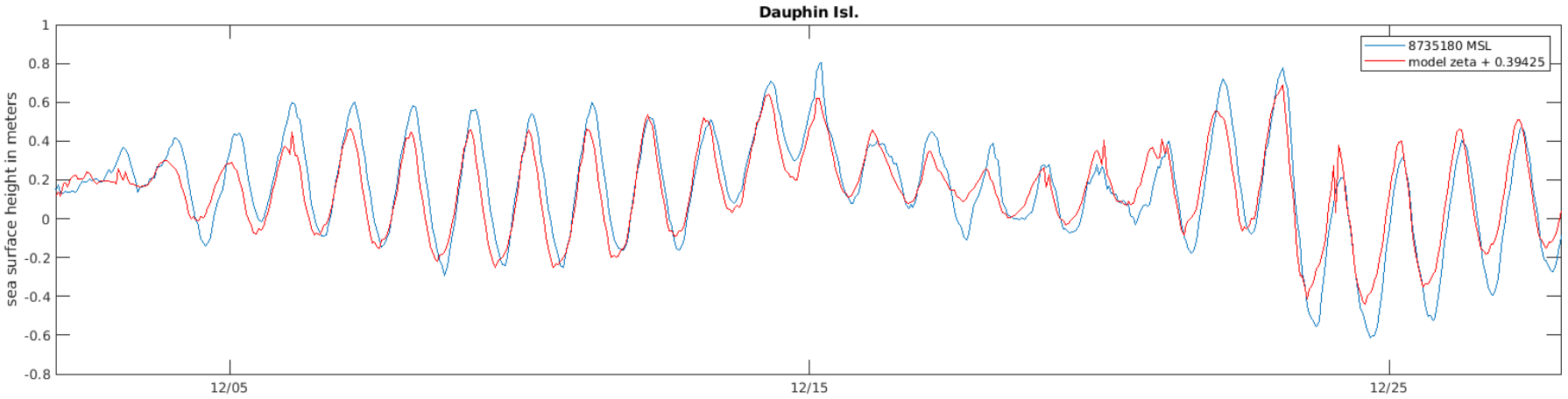


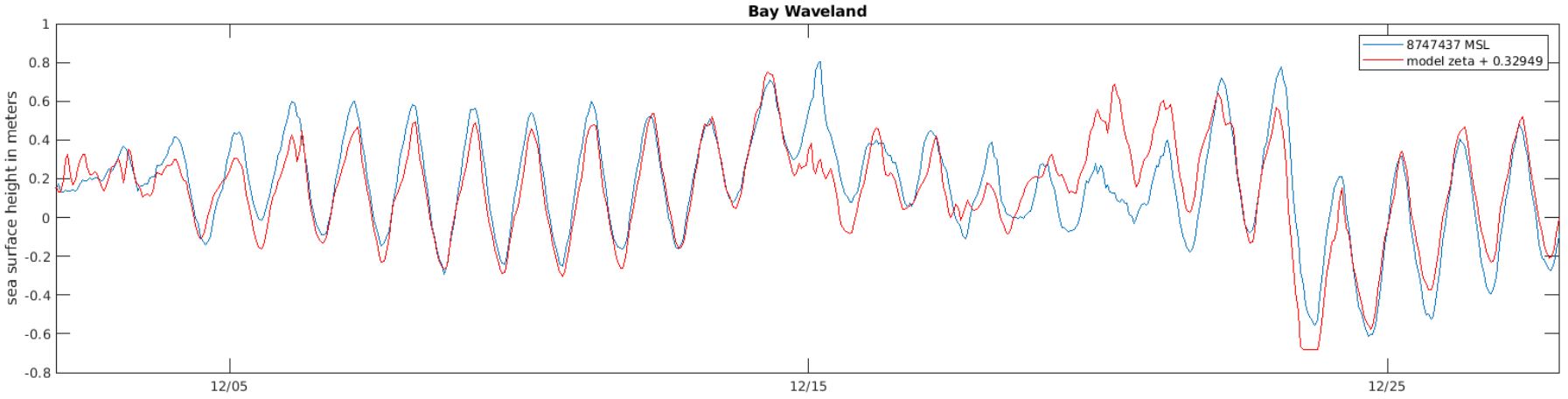
- System under the influence of freshwater and low salinities from March till August

- A very brief but weak rebound back from the first opening 2 weeks after closure on 04/25

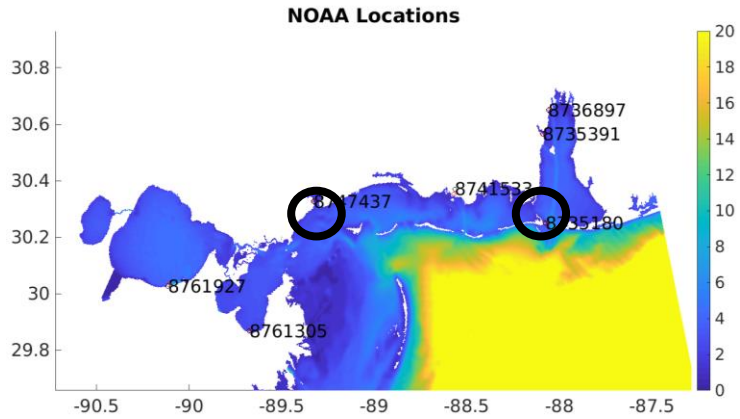
- Western Mississippi Sound under freshwater influence until August

Model validation: Water levels



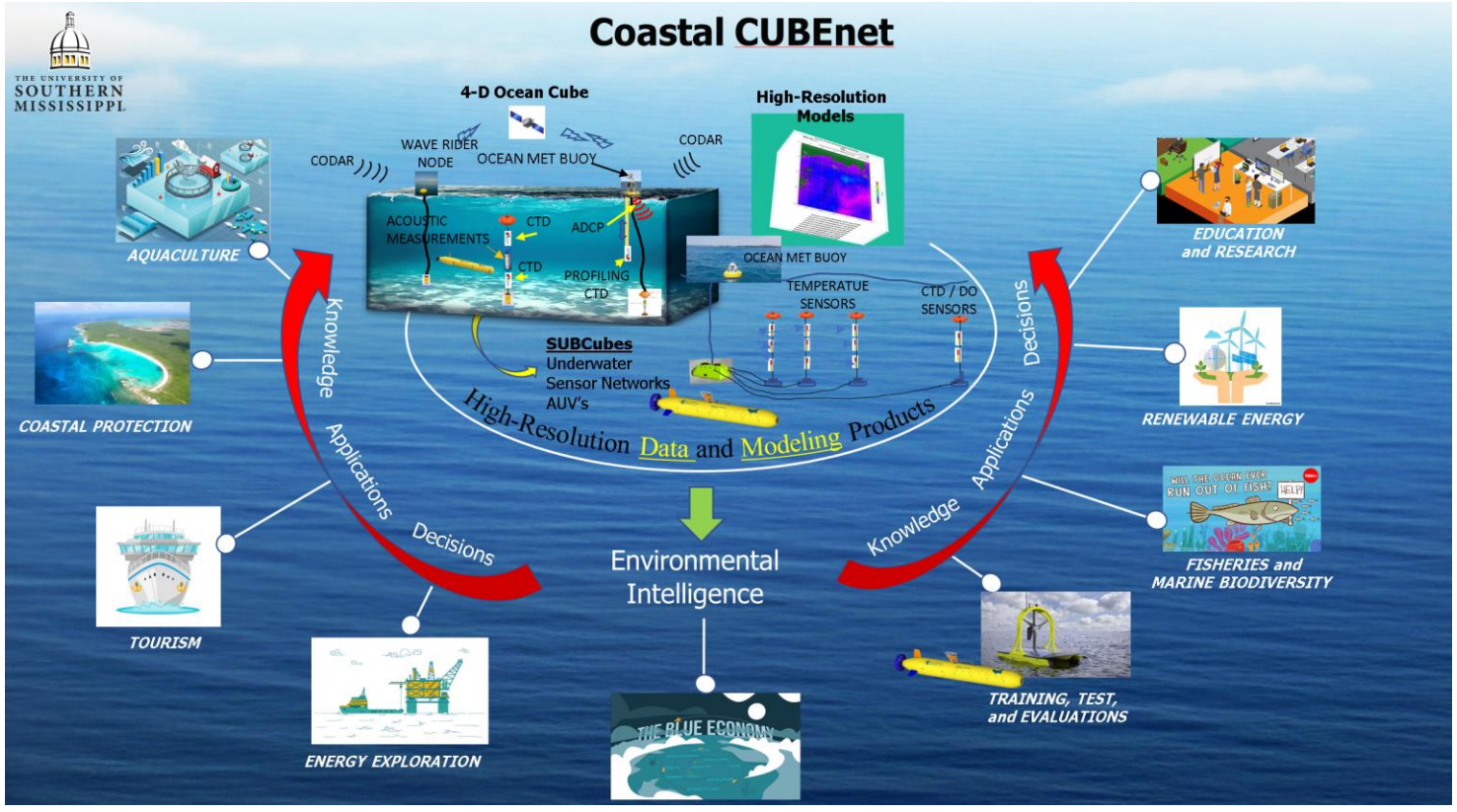


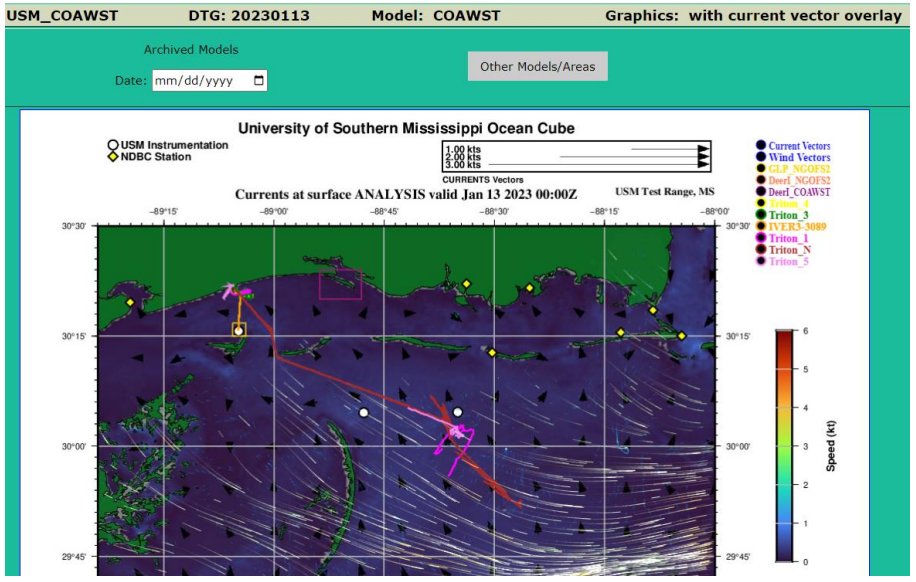
Tidal variations, i.e. amplitude and phase match well with measurements at local NOAA tidal gauges.

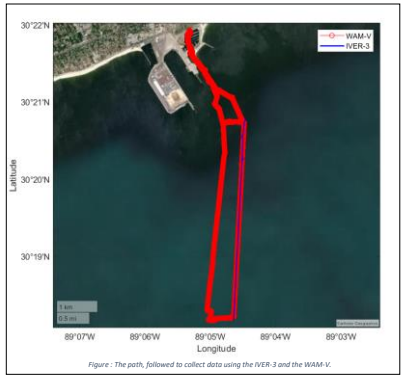


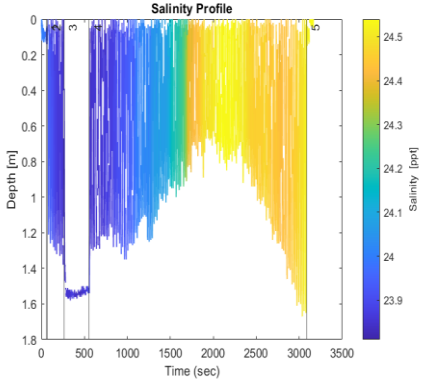
The channels connecting the estuarine bodies are being upgraded to improve predictions in Lake Pontchartrain.

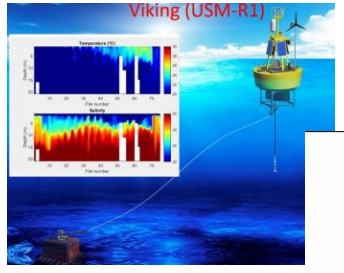
Data Fusion with field measurements within CUBEnet

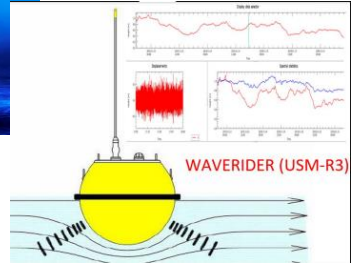


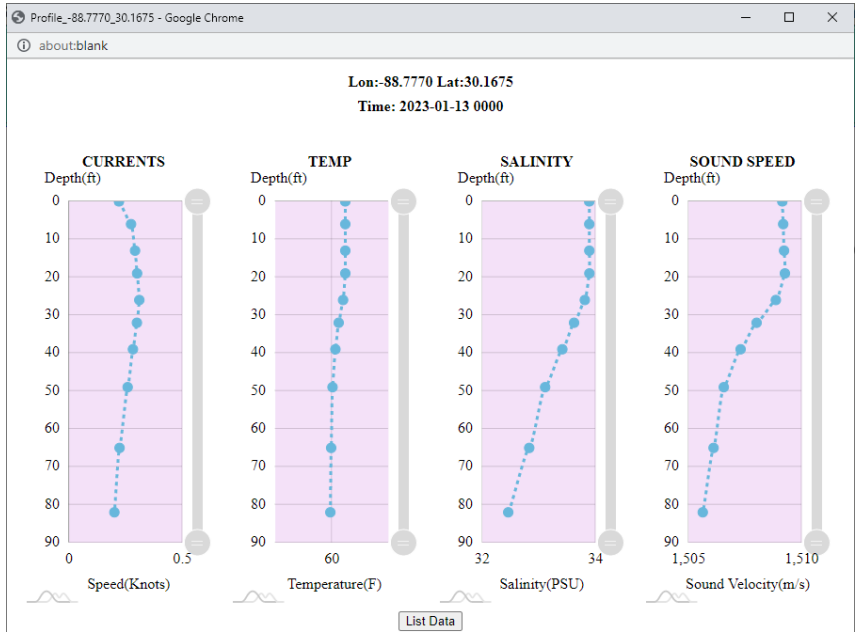




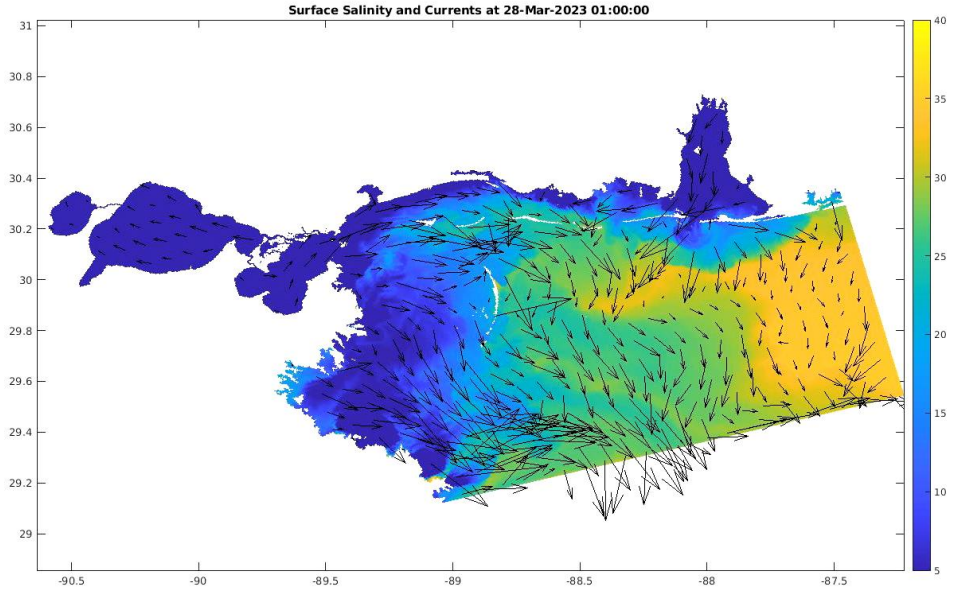


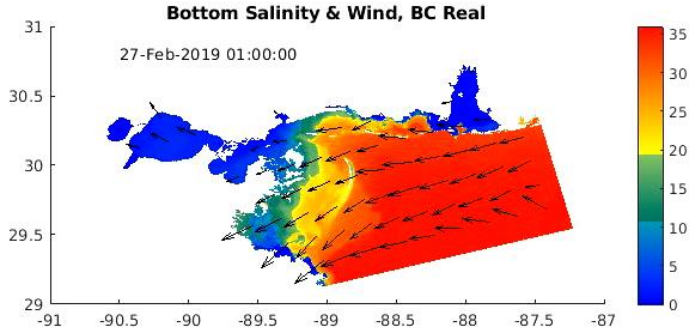


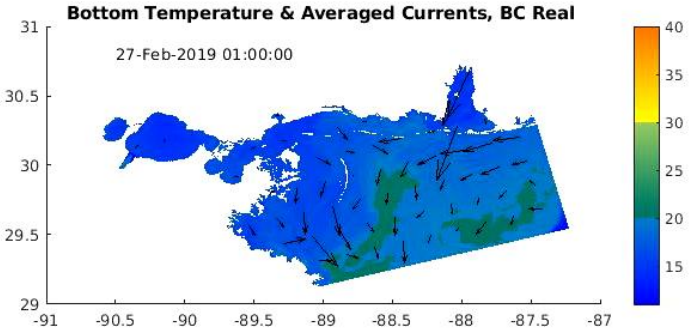


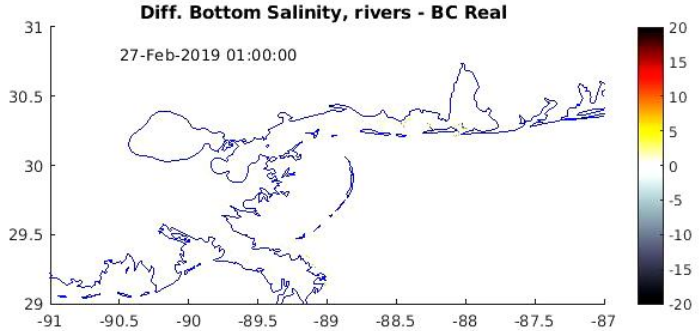


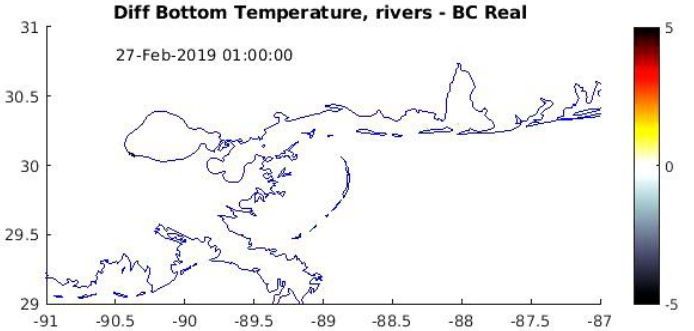
Daily model predictions: Salinity and Currents











We create model products based on the needs of funding agencies, decision makers, resource managers and stakeholders.

THE UNIVERSITY OF SOUTHERN MISSISSIPPI

Data Availability: USM THREDDS server

Yacumama TDS Installation

Welcome to THREDDS Data Server top-level TDS Catalog.

Hosted by The University of Southern Mississippi.

Catalog

Dataset	Size	Last Modified
msbCOAWST_Daily		--
Forecast Model Run Collection (2D time coordinates)		--
Best Time Series		--
Forecast Model Run		--
Constant Forecast Date		--
Constant Forecast Offset		--
files		--

Yacumama TDS Installation

return to catalog

Dataset: Best Time Series
Catalog: Unidata THREDDS Data Server/msbCOAWST_Daily

featureType	GRID
id	msbCOAWST/Daily/msbCOAWST_Daily_best.ncd

Access | **Preview**

Access:

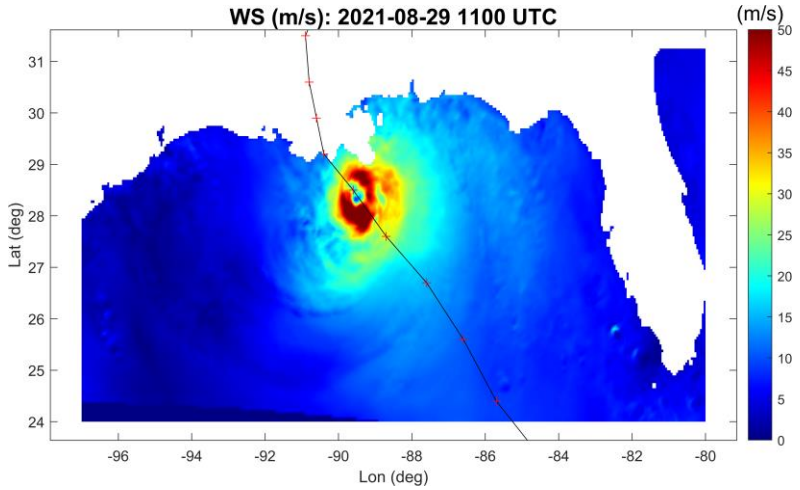
Service	Type	Description
OPENDAP	Data Access	Access dataset through OPeNDAP using the DAP2 protcol.
CdmRemote	Data Access	Provides index subsetting on remote CDM datasets, using ncstream.
CdmrFeature	Data Access	Provides coordinate subsetting on remote CDM Feature Datasets, using ncstream.
JupyterNotebook	Data Access	Generate a Jupyter Notebook that uses Siphon to access this dataset.
NetcdfSubset	Data Access	A web service for subsetting CDM scientific datasets.
WMS	Data Access	Supports access to georegistered map images from geoscience datasets.
WCS	Data Access	Supports access to geospatial data as 'coverages'.
ISO	Metadata	Provide ISO 19115 metdata representation of a dataset's structure and metadata.
NCML	Metadata	Provide NCML representation of a dataset.
UDDC	Metadata	An evaluation of how well the metadata contained in the dataset conforms to the NetCDF Attribute Convention for Data Discovery (NACDD)

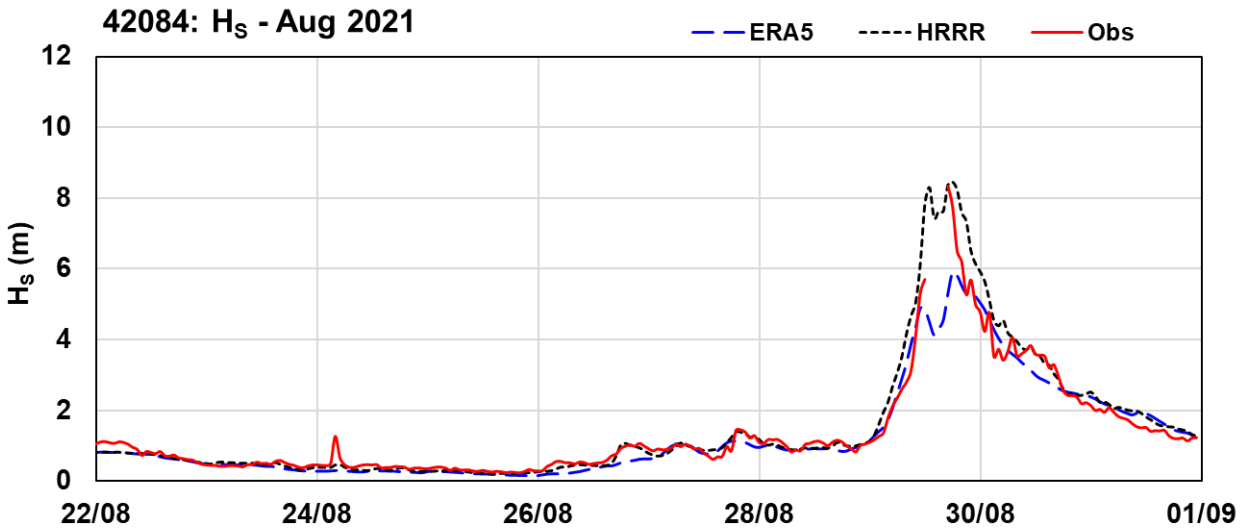
Ongoing and Future Work

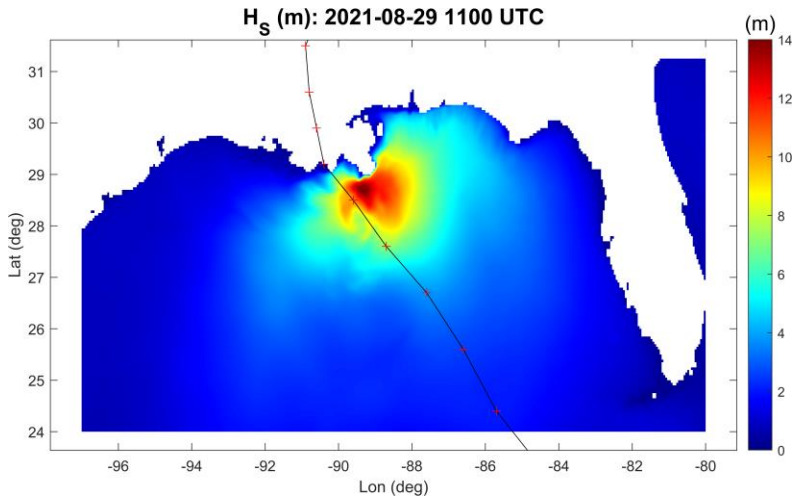
- Expand the modeling system to include wave modeling and coupled simulations
  - Ongoing work on studying waves in Gulf of Mexico and particularly in Mississippi Sound and Bight

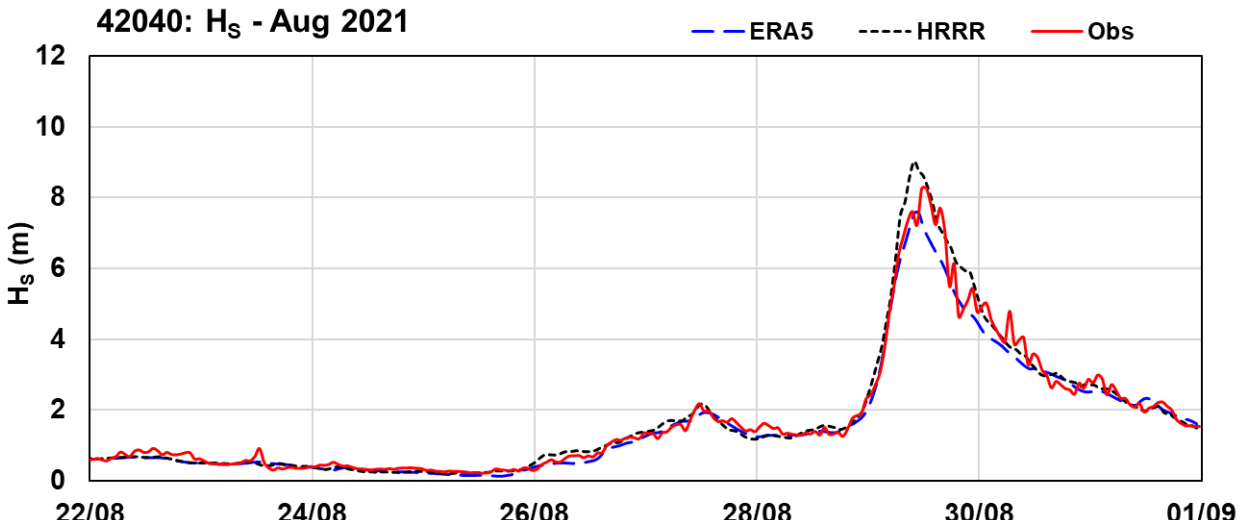
WaveWatch III simulations for wave predictions in the study area using various atmospheric forcing products, HRRR (shown on the right), ERA5 as well as ECMWF.

SWAN simulations coupled with ROMS are underway to understand the wavecurrent interactions in this area









Summary and Conclusions

- It is crucial to develop an accurate and reliable modeling system for coastal waters of Mississippi Sound and Bight

- We developed a daily operational system and initiated the validation of the system.

- The results showed that the model has capability to reproduce the water levels, temperature, salinity and advection of freshwater into the estuarine systems.

- The developed system and future simulations during freshwater diversion events will be critical to timely inform decision makers, stake holders and coastal communities.

- Future work will include expanding the operational system to include wave and sediment transport components.

Project partners and funding agencies

THANK YOU!

kemal.cambazoglu@usm.edu
brandy.armstrong@usm.edu
jerry.wiggert@usm.edu