

Impact of High Resolution Atmospheric forcing on Circulation Variability within a Regional Model for the Mississippi Sound and Bight

*Chudong Pan¹, Michael Dinniman², Patrick Fitzpatrick³, Yee H. Lau³,
Eileen Hofmann², Jerry Wiggert¹*

1. Division of Marine Science, The University of Southern Mississippi

2. Center for Coastal Physical Oceanography, Old Dominion University

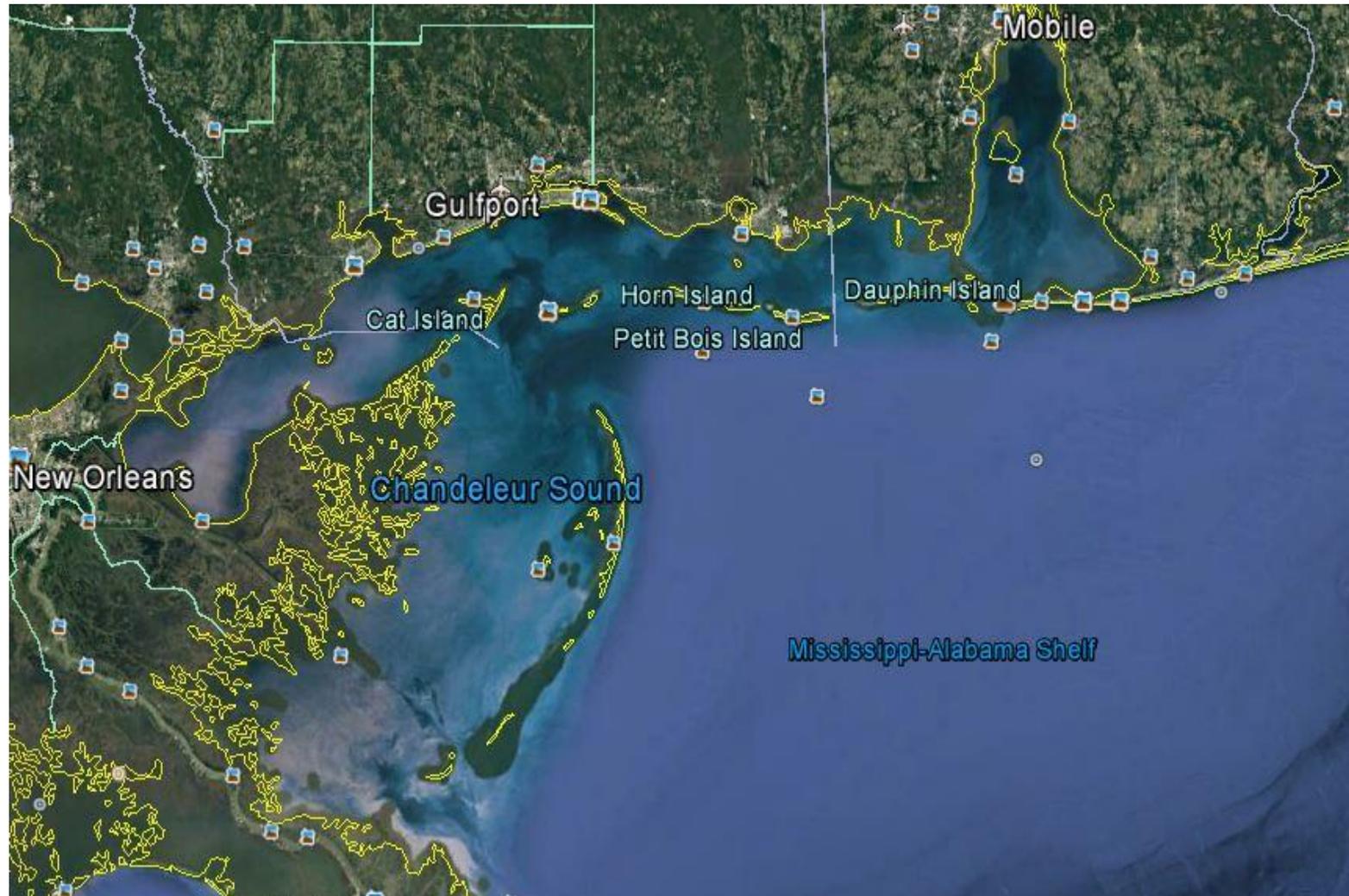
3. Geosystems Research Institute (GRI), Mississippi State University.



Motivation

Mississippi Sound, Mobile Bay and Mississippi Bight

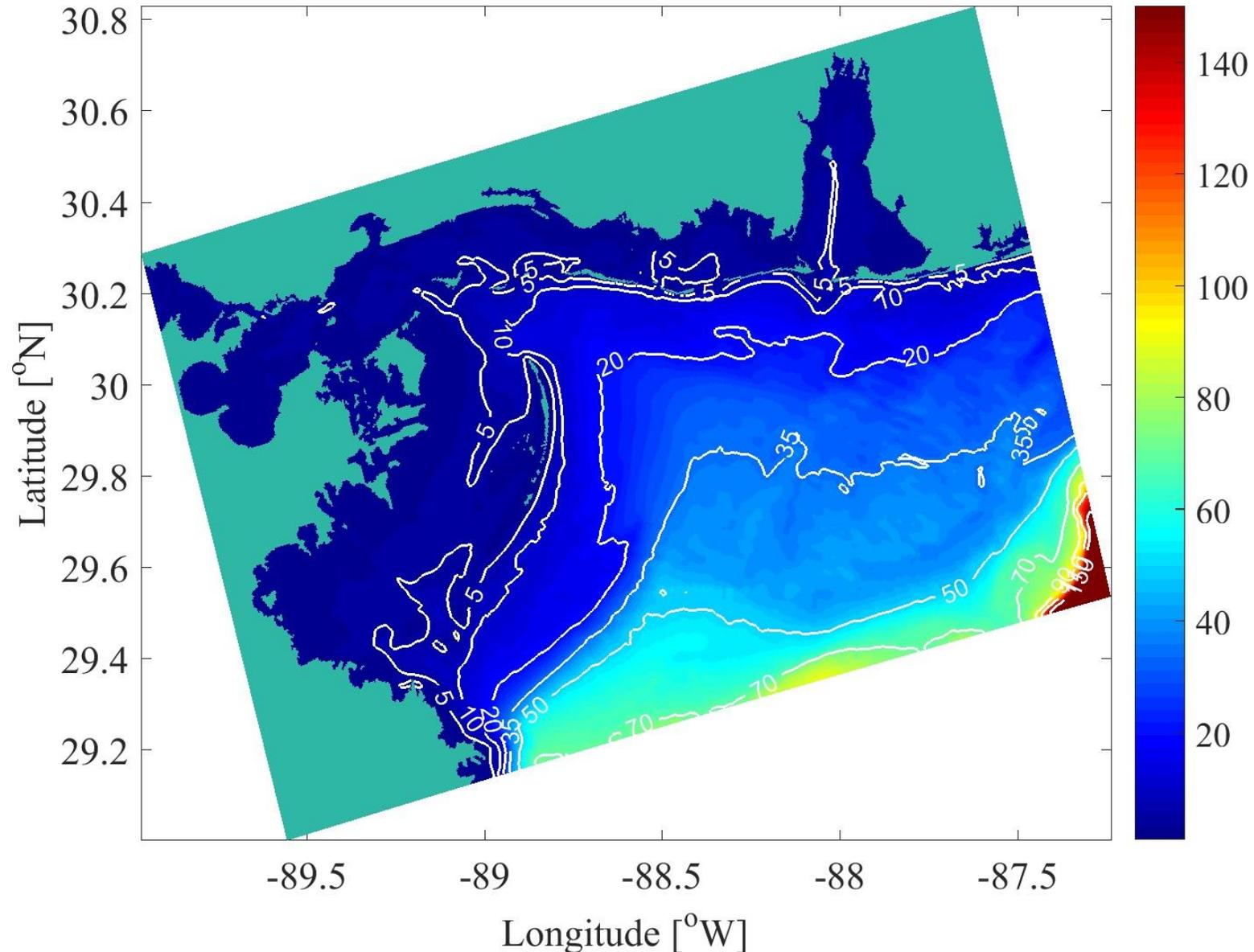
- A determinant factor for the material exchange between the Mississippi Sound and Bight is the local circulation.
- The ocean circulation and water properties of the Mississippi Sound and Bight are sensitive to meteorological forcing, such as wind, precipitation, evaporation, and heat fluxes.
- An accurate meteorological data set with high spatial and temporal resolution is essential to drive the CONCORDE synthesis model.
- Question: How different would it be if the model is driven by a high resolution forcing or a low resolution forcing? What is the impact of high resolution forcing on local circulation and material exchange between the Mississippi Sound and Bight?



Regional Ocean Modeling System (ROMS)

- Initial conditions: derived from 1km Gulf of Mexico Navy Coastal Ocean Model (GOM NCOM);
- Boundary conditions: nested with GOM NCOM;
- Grid horizontal resolution: ~ **400m**; Vertical grid: 24 level of terrain-following coordinate;
- Model run: 01/01/2014- Now.
- Surface forcing: low resolution (~**30km**) North America Regional Reanalysis (NARR) vs high resolution (~**1km**) CONCORDE Meteorological Analysis (CMA)

CONCORDE Model Domain and Topography



NARR vs CMA

North America Regional
Reanalysis (NARR):

- Long term regional meteorological reanalysis from NCEP, assimilating observations from different platforms;
- Spatial resolution – 30 km;
- Temporal resolution – 3-hourly.

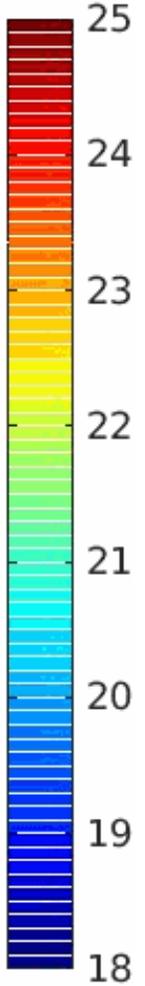
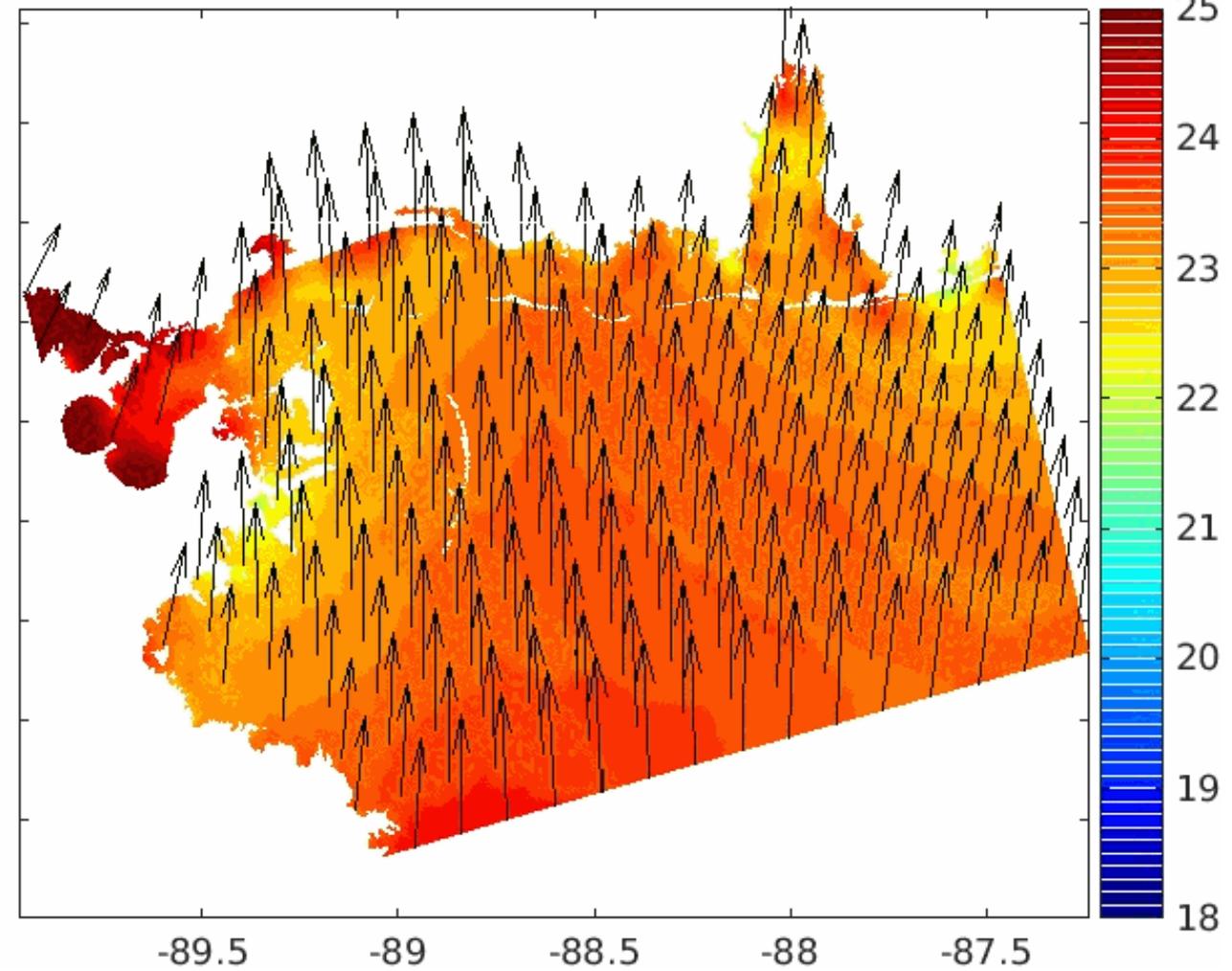
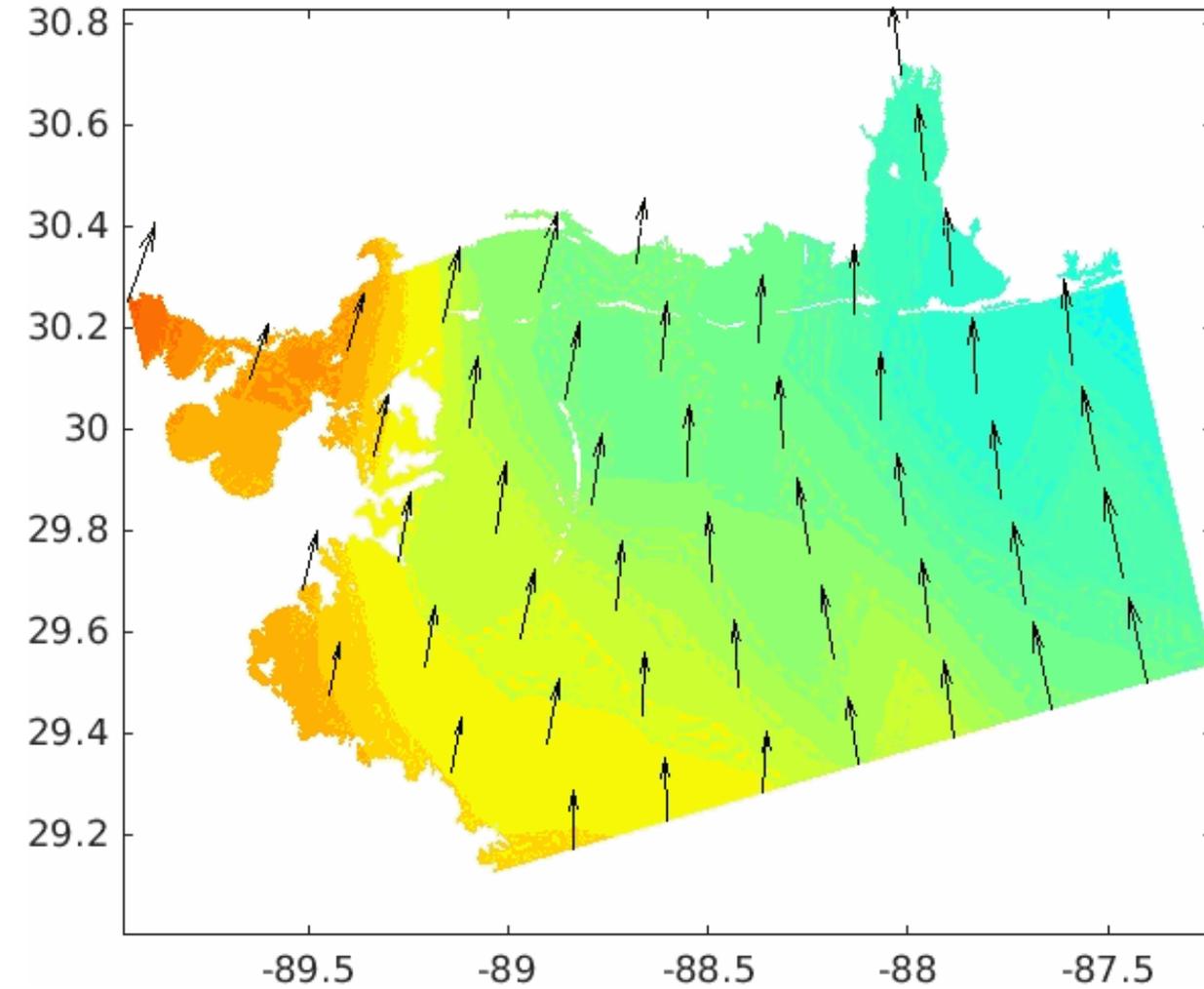
CONCORDE Meteorological
Analysis (CMA):

- A blend of products from Real-Time Mesoscale Analysis (RTMA), North America Mesoscale Forecast System (NAM), The Next Generation Weather Radar (NEXRAD), Advanced Very High Resolution Radiometer (AVHRR)
- Spatial resolution – 1 km;
- Temporal resolution – 1-hourly.

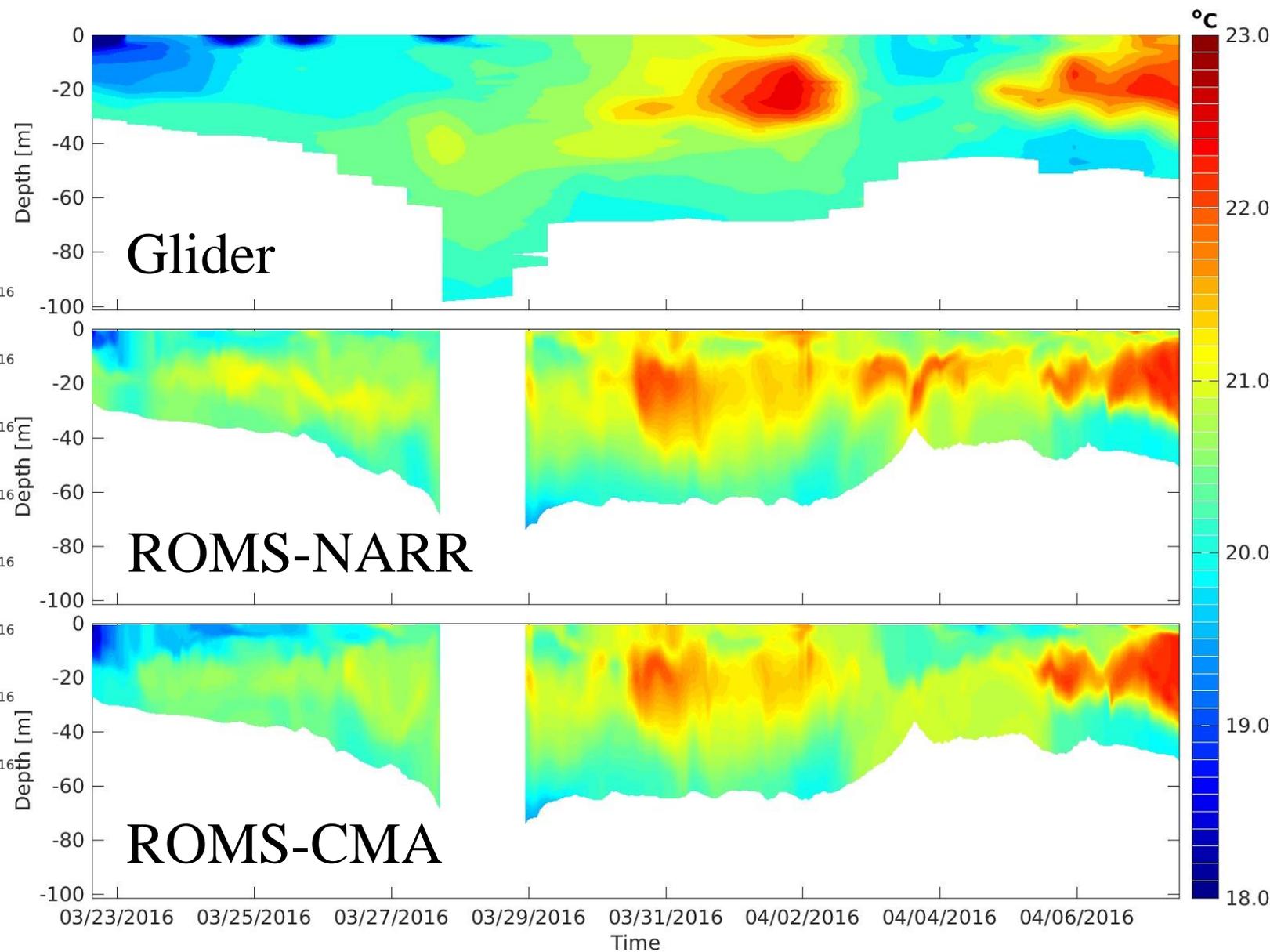
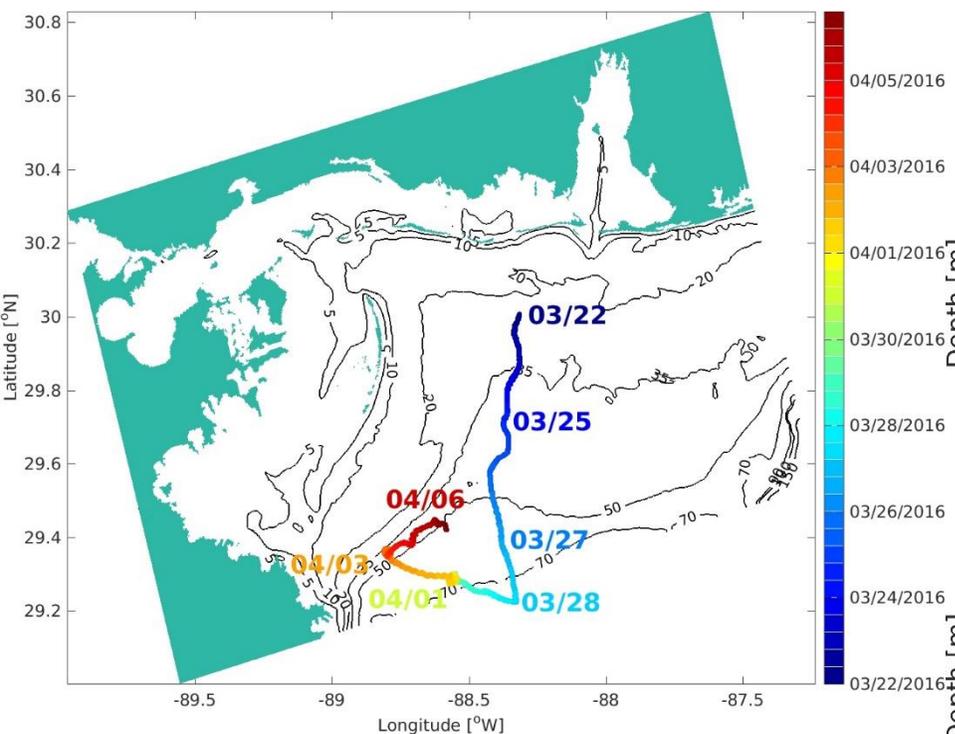
NARR vs CMA

NARR:Wind & Air Temperature 04/04/2015 00:00

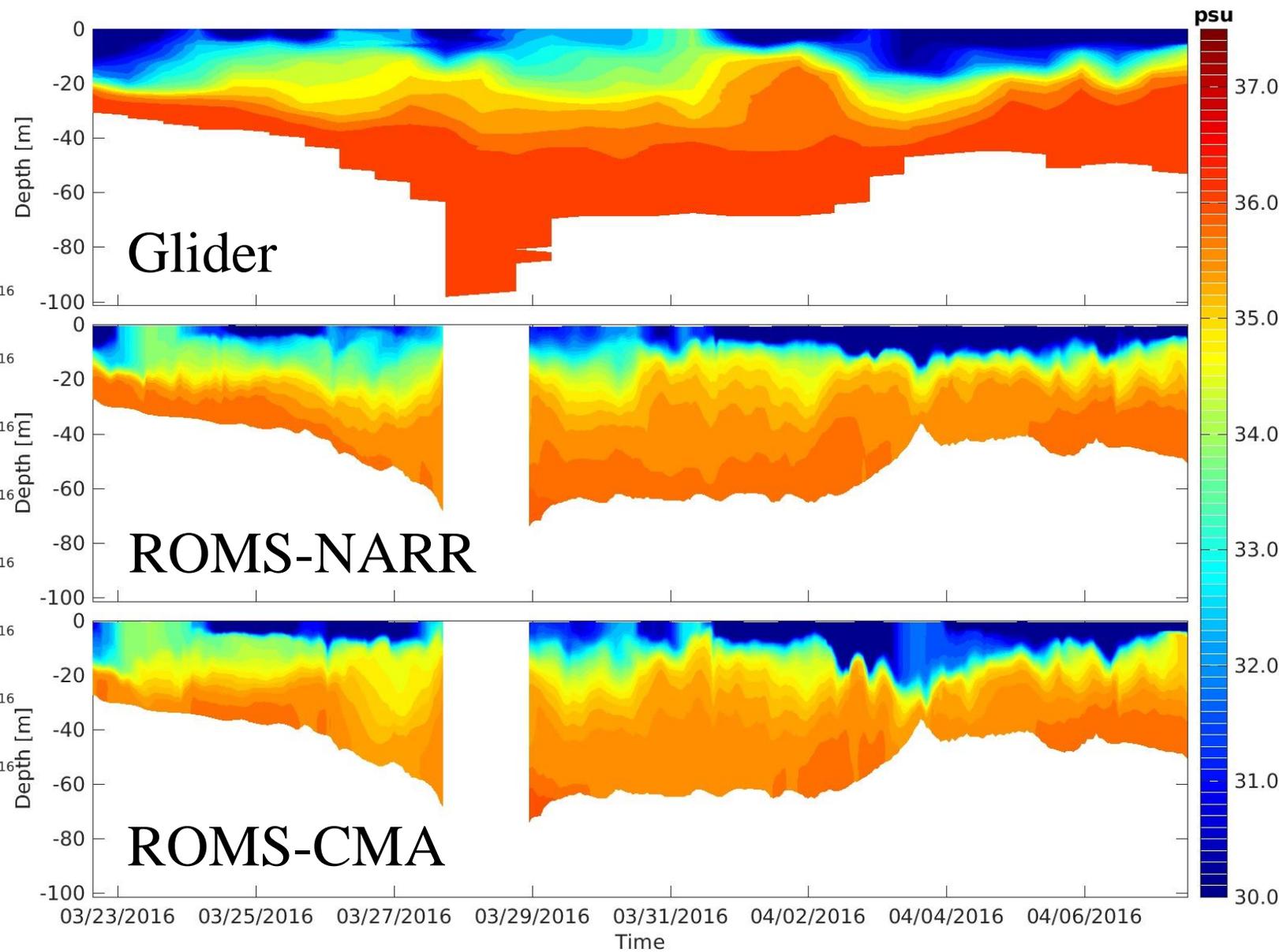
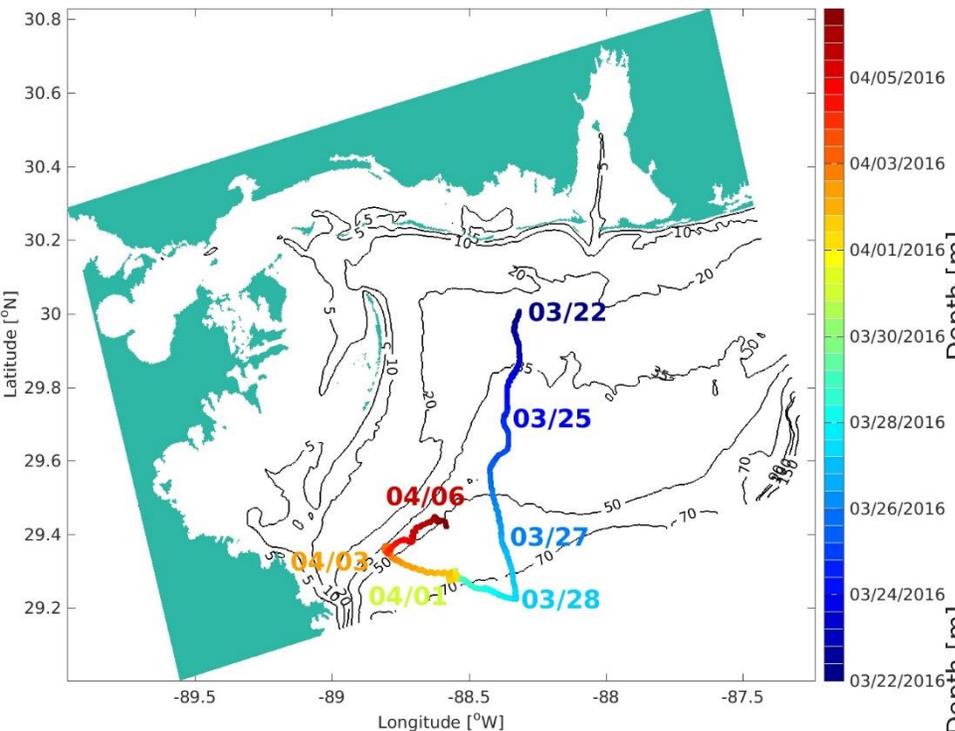
CMA:Wind & Air Temperature 04/04/2015 00:00



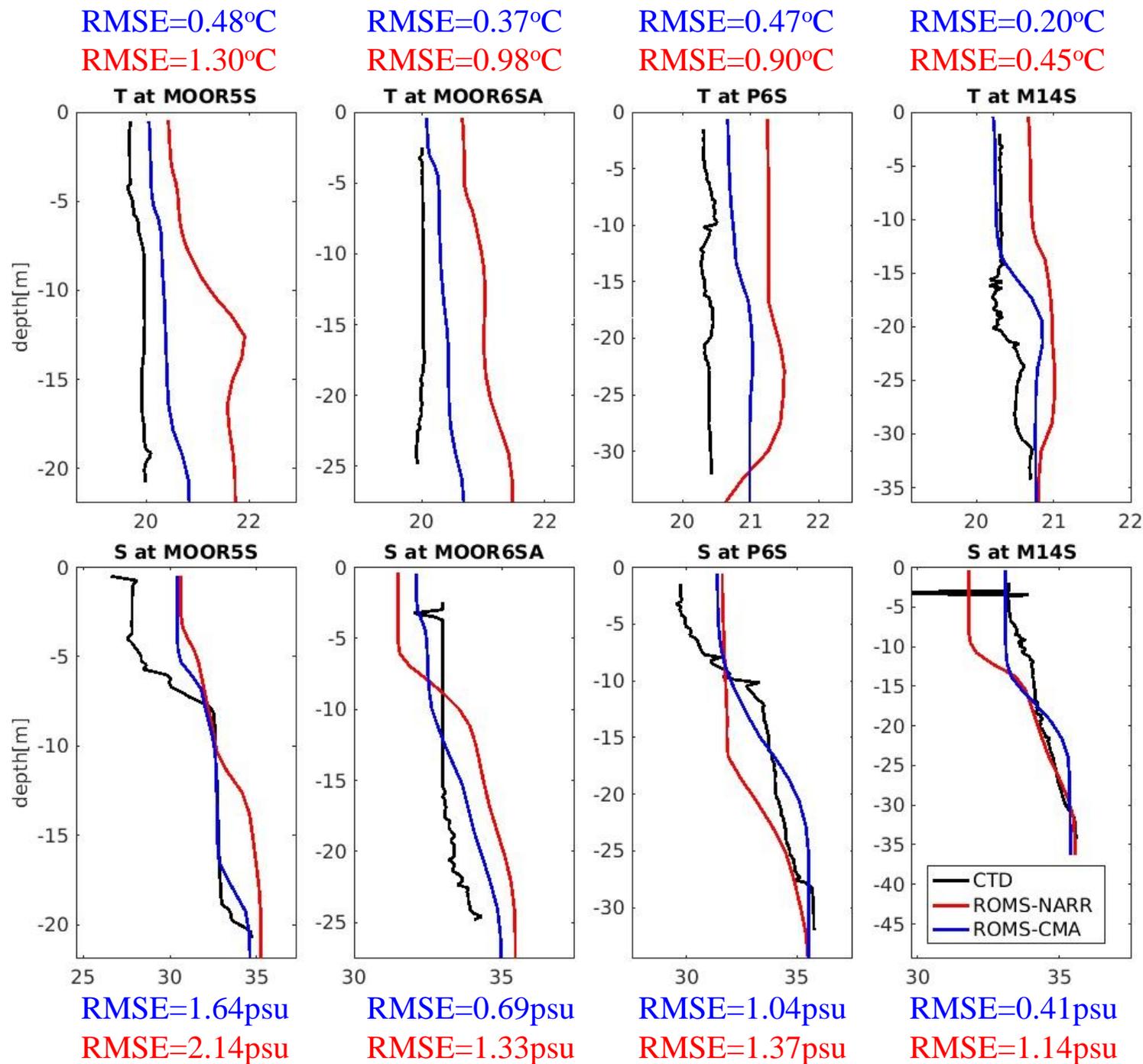
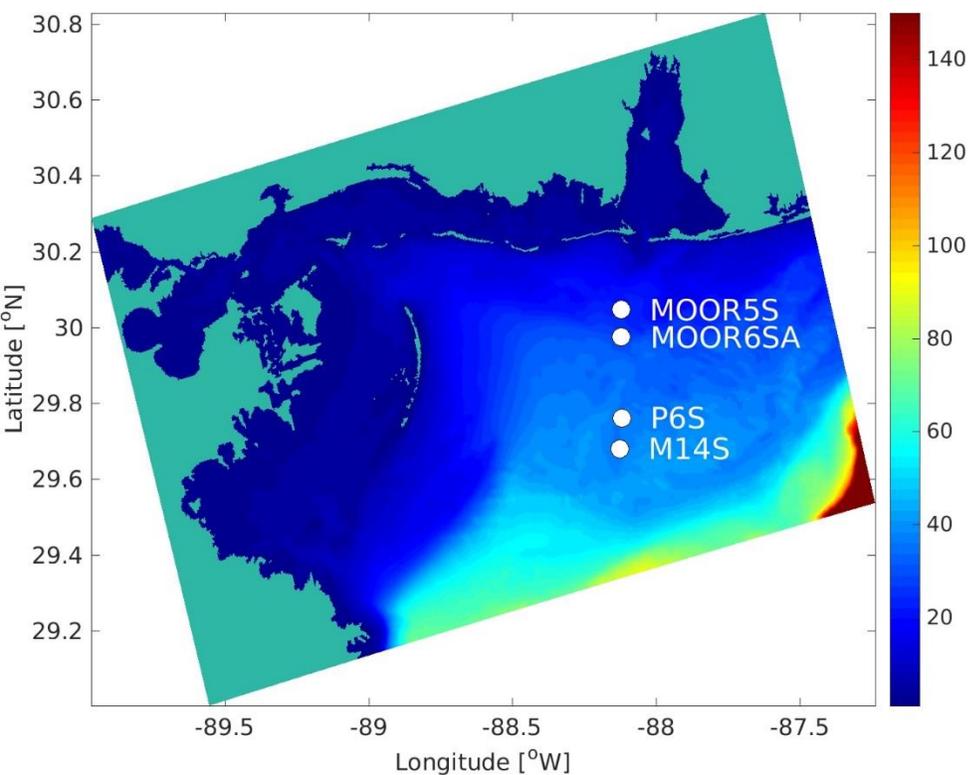
Model results vs glider observations from CONCORDE spring cruise in 2016



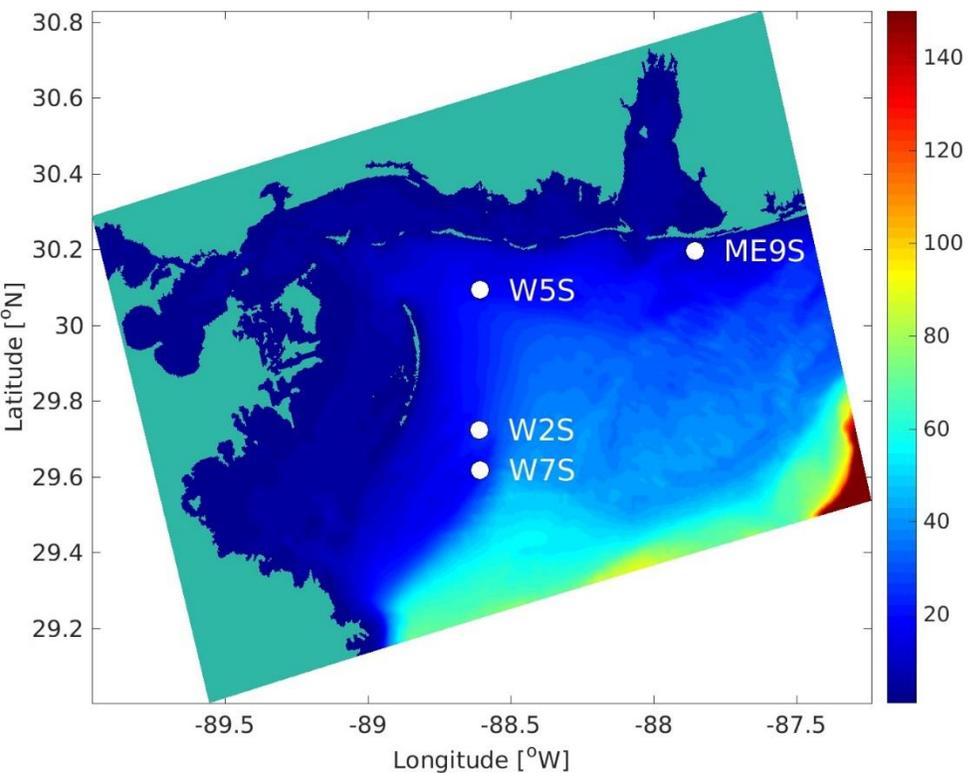
Model results vs glider observations from CONCORDE spring cruise in 2016



Model results vs CTD profiles from CONCORDE spring cruise in 2016



Model results vs CTD profiles from CONCORDE spring cruise in 2016

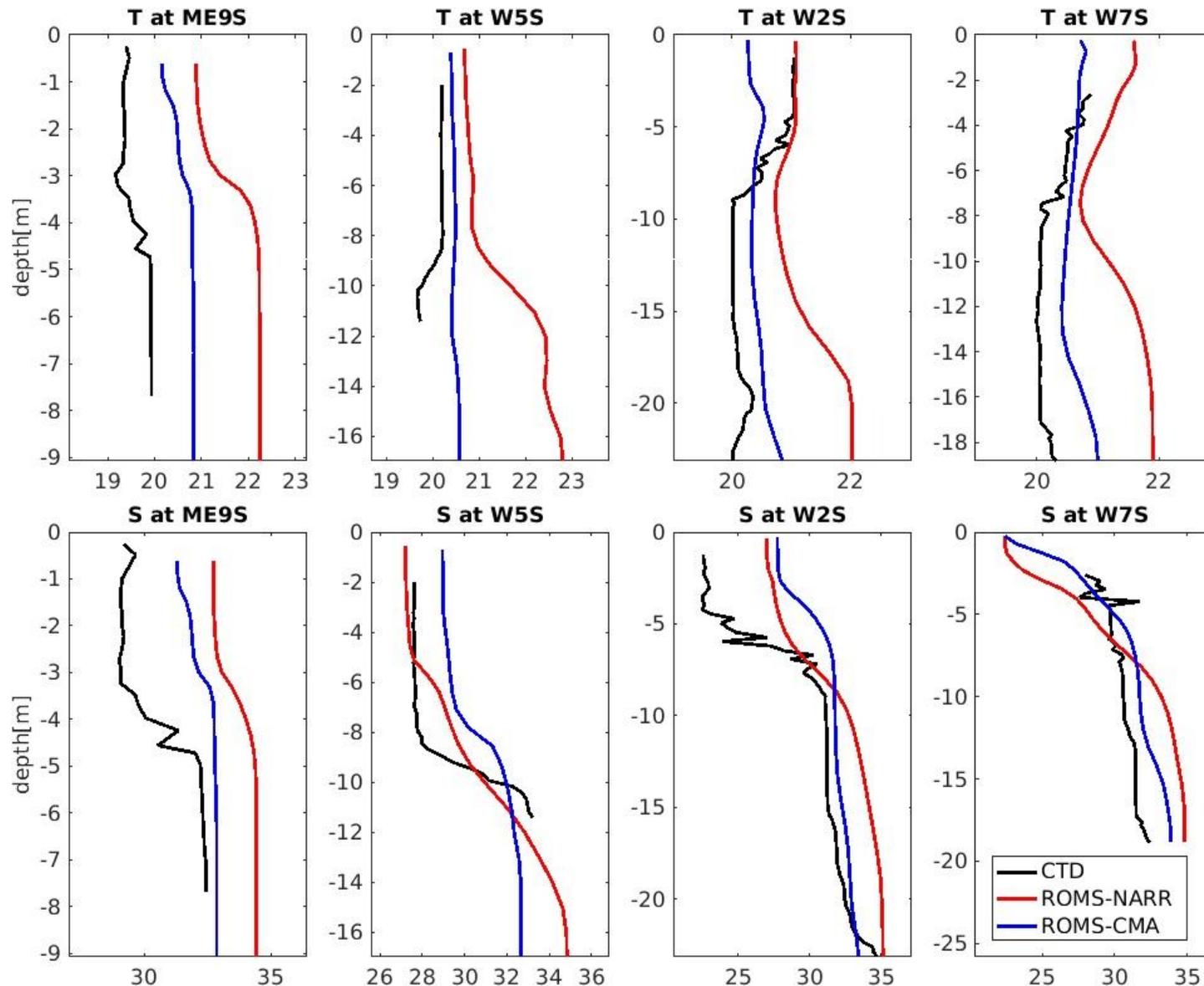


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RMSE=2.15°C

RMSE=0.52°C
RMSE=1.67°C

RMSE=0.51°C
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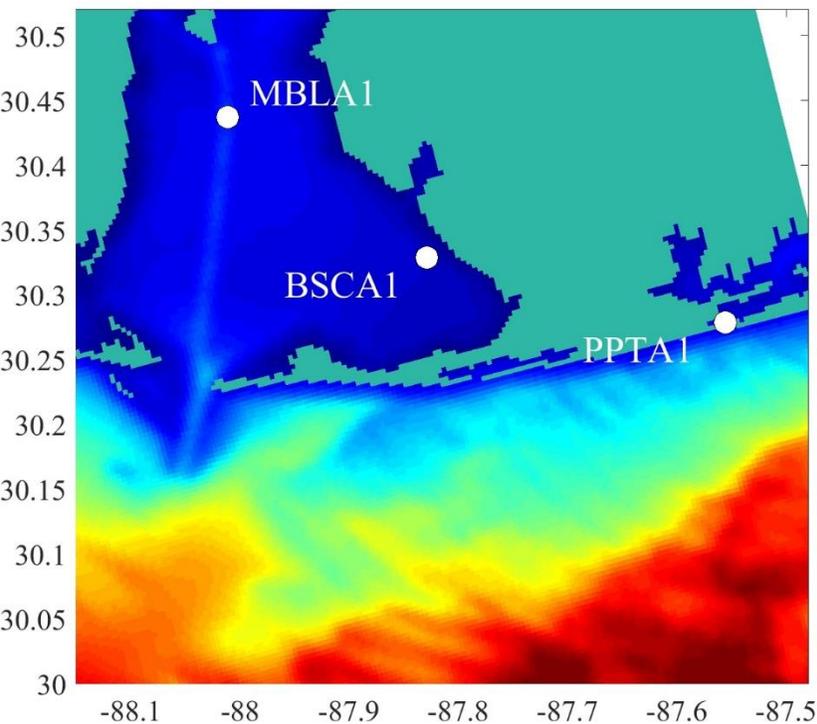
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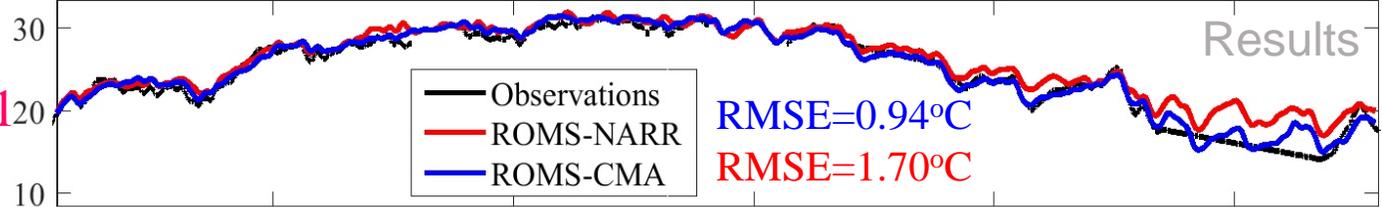
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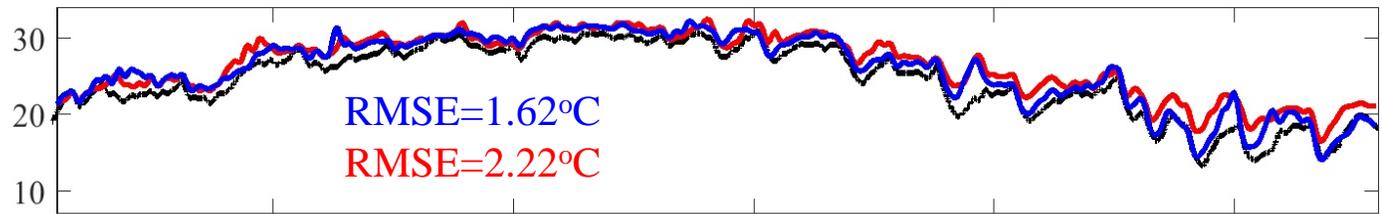
Model results vs NDBC buoys in 2015



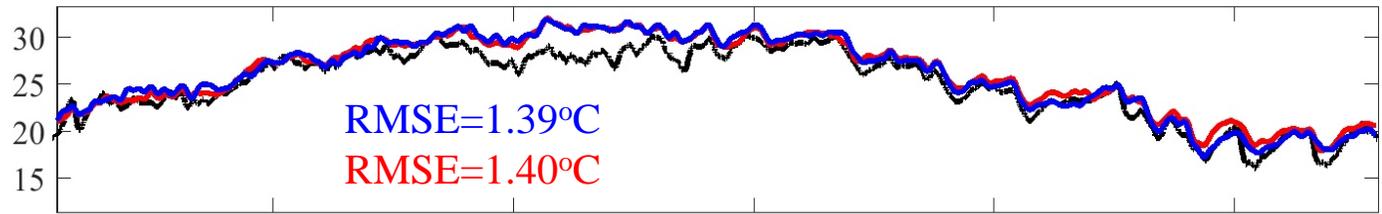
T at MBLA1



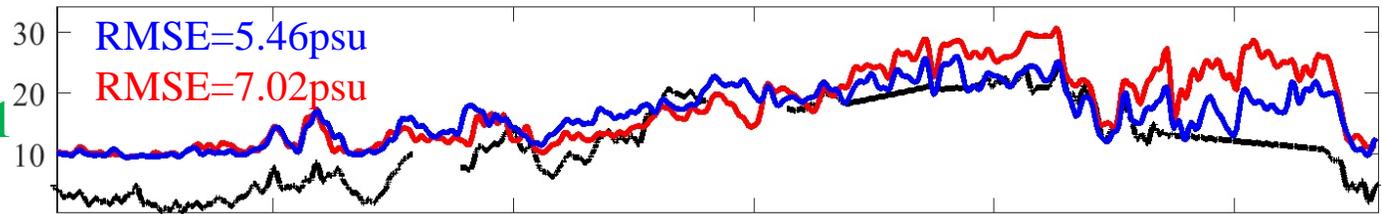
T at BSCA1



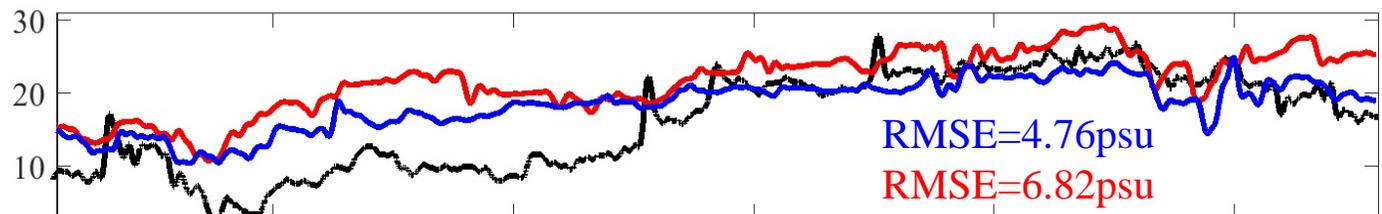
T at PPTA1



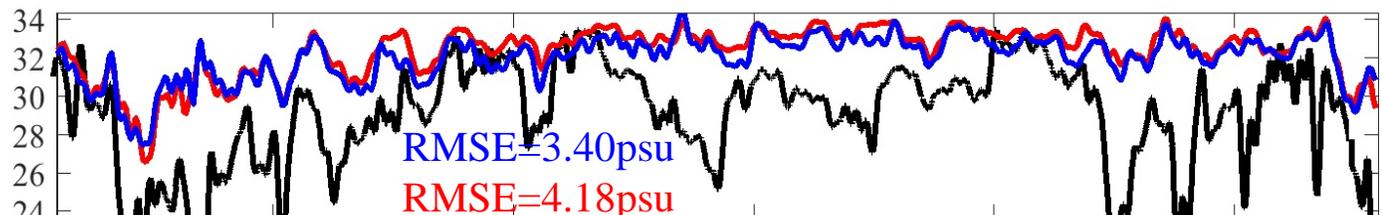
S at MBLA1



S at BSCA1



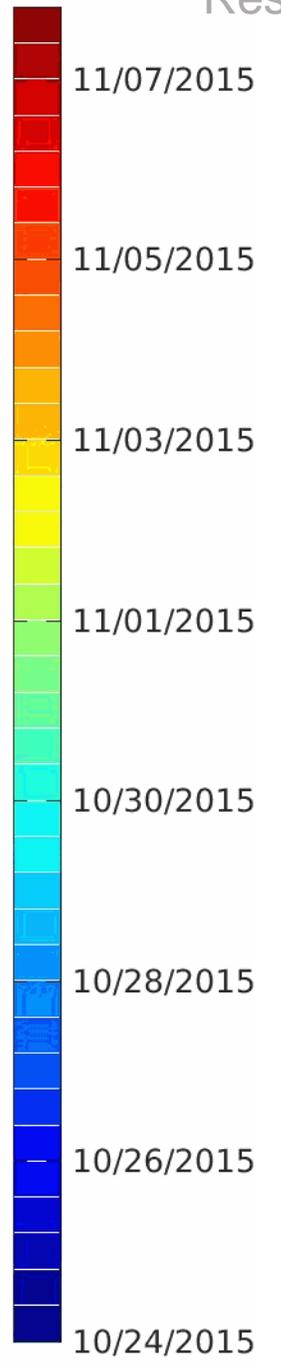
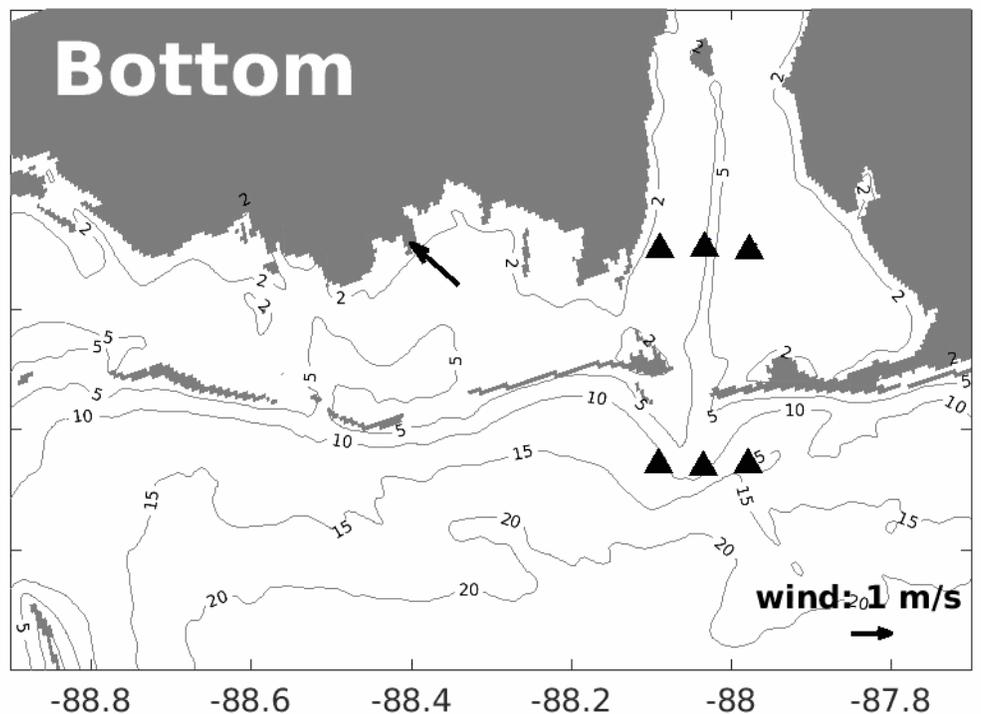
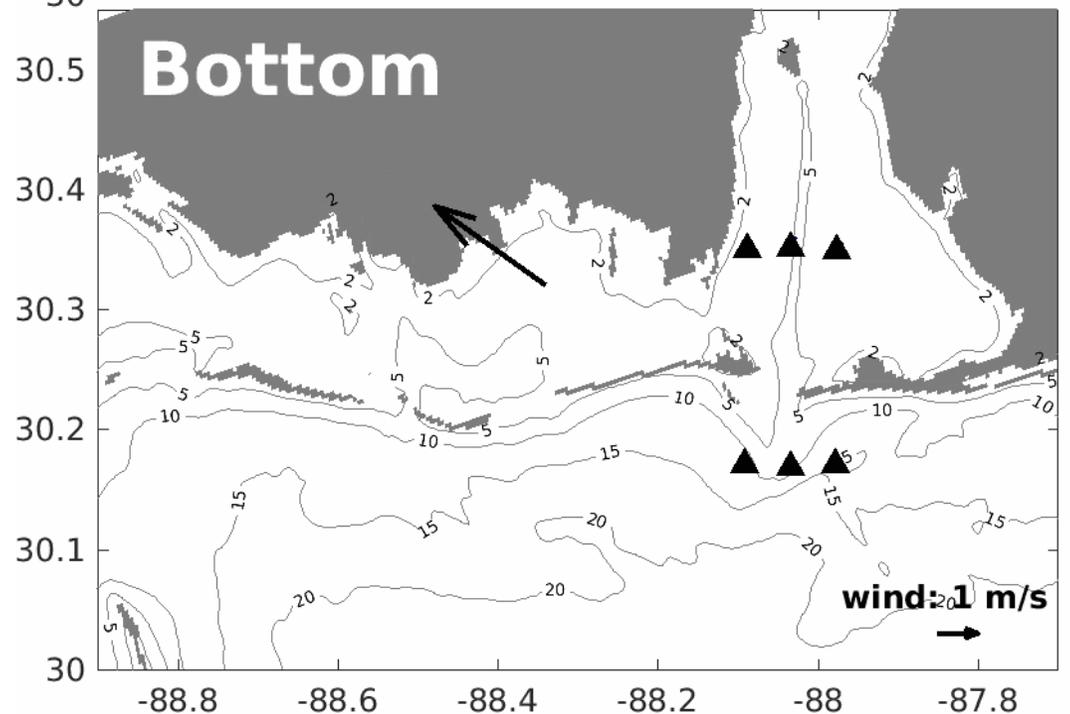
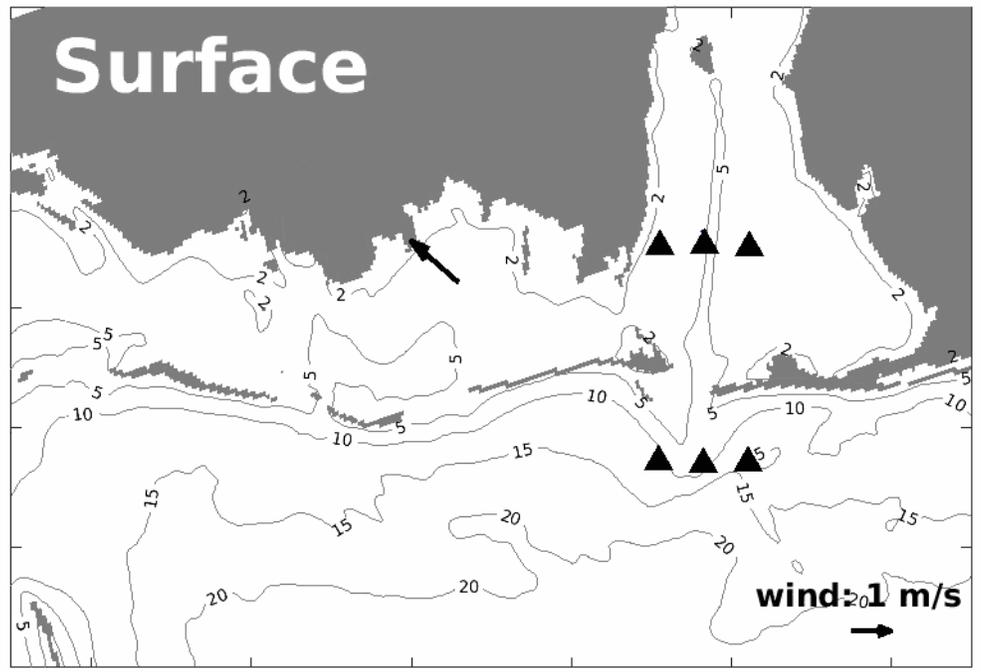
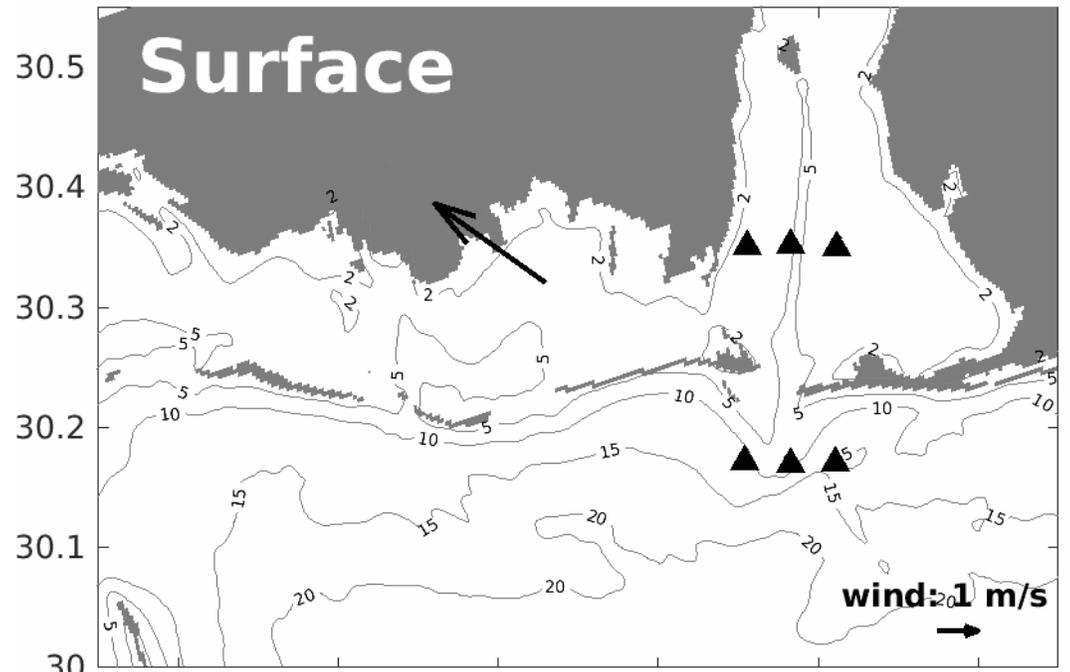
S at PPTA1



Results

NARR driven drifters on 10/24/2015**CMA driven drifters on 10/24/2015**

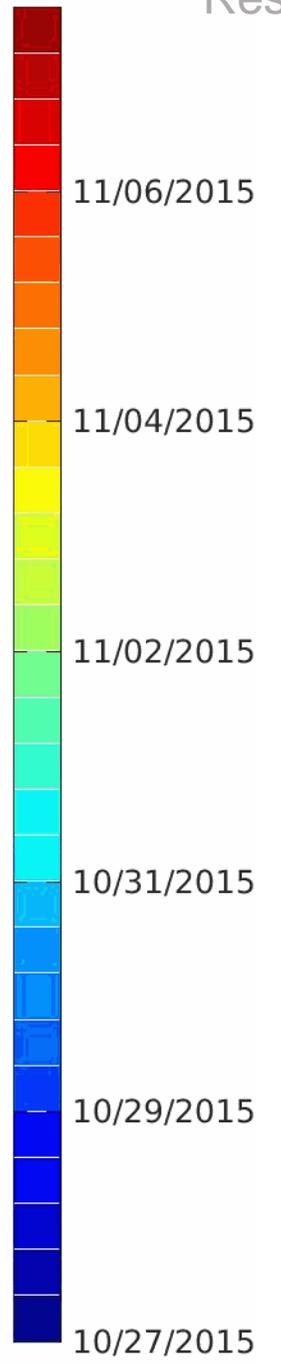
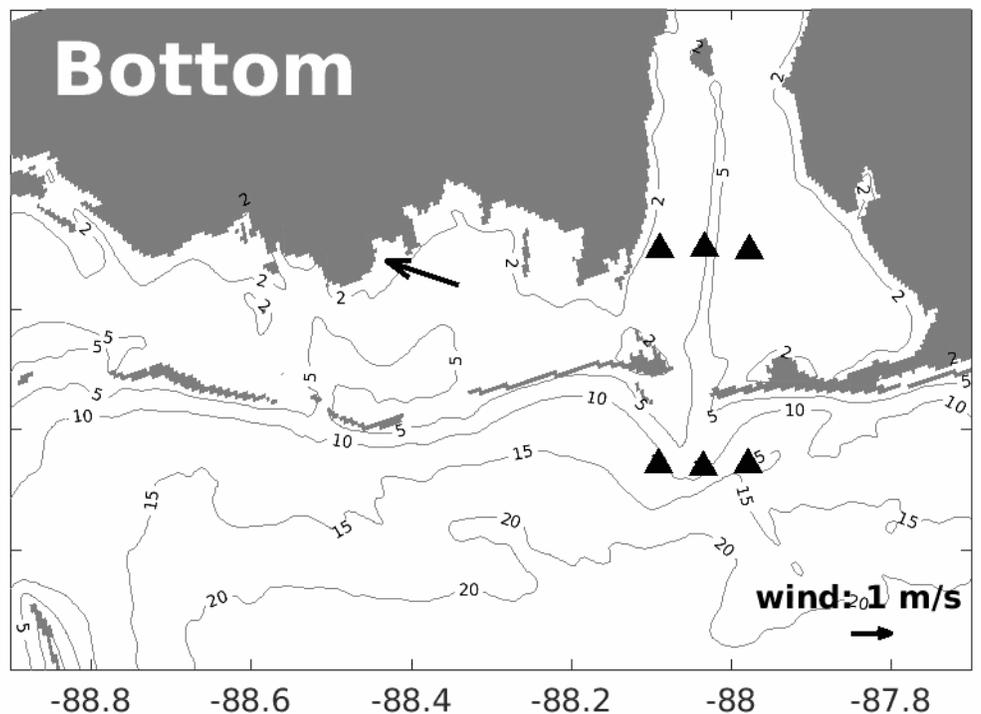
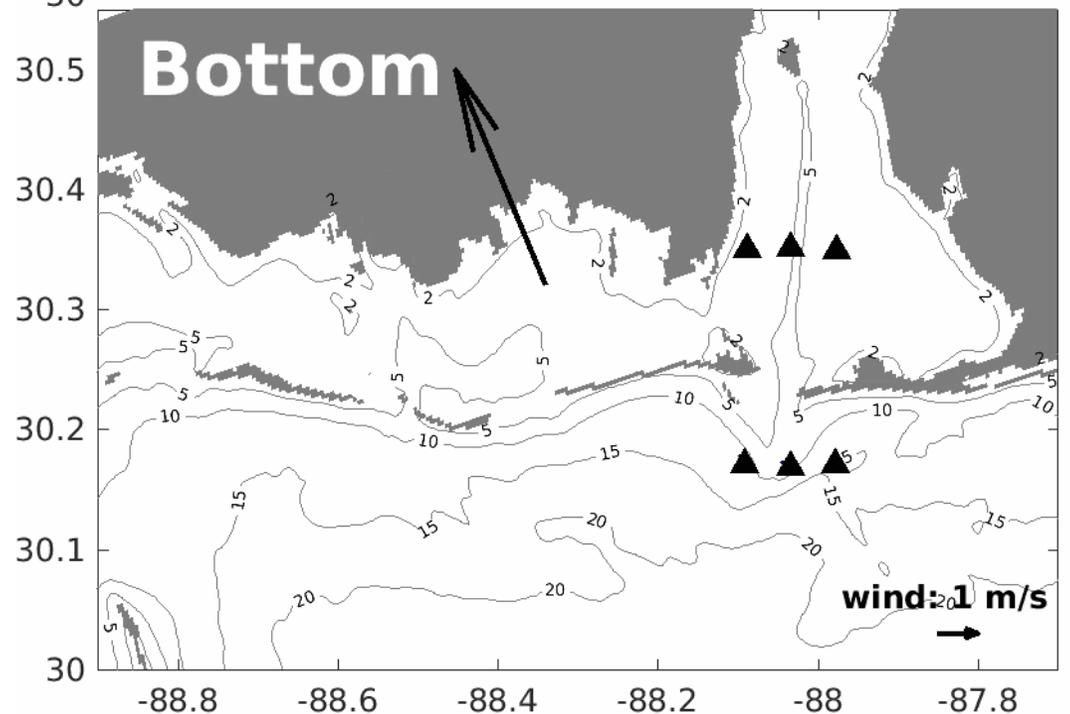
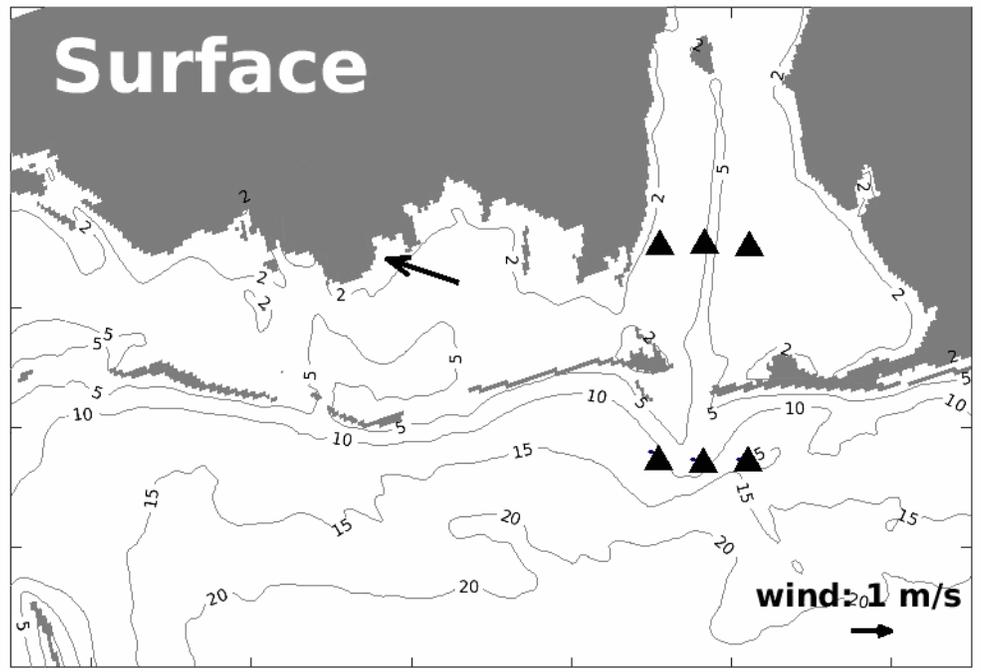
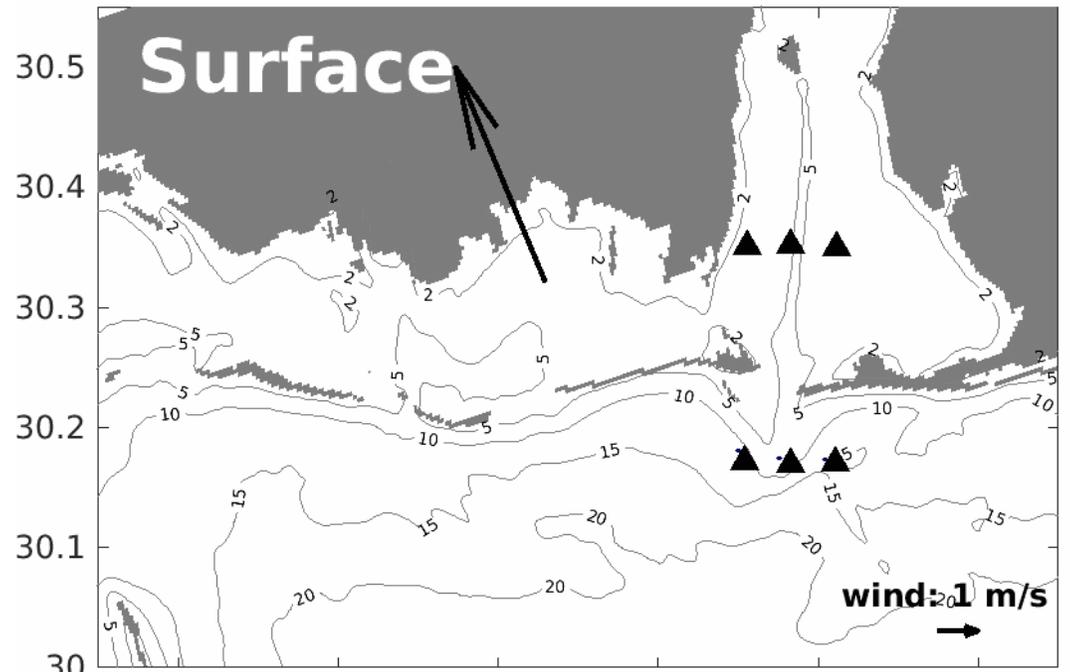
Results



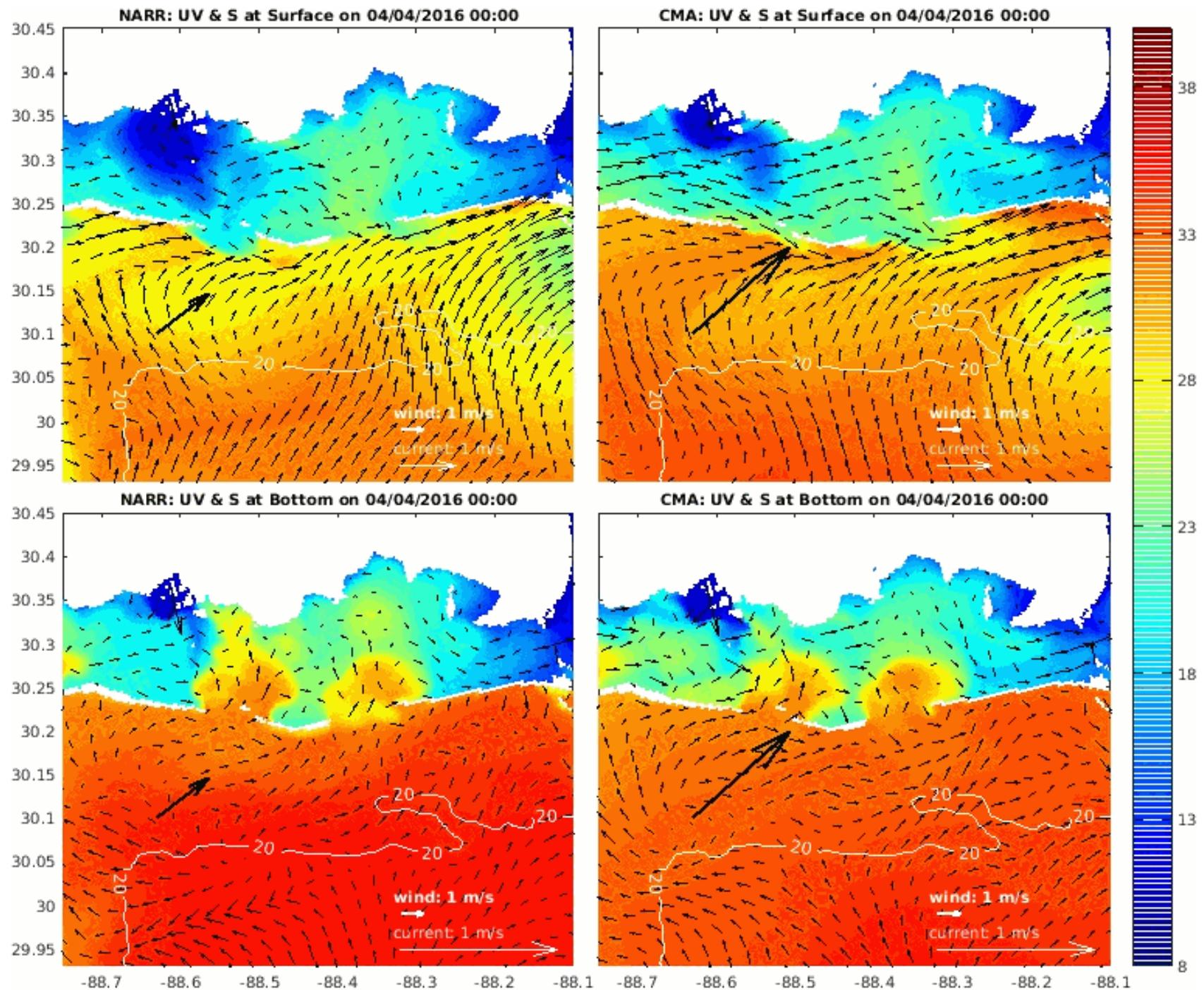
NARR driven drifters on 10/27/2015

CMA driven drifters on 10/27/2015

Results



- In the beginning of April 2016, the wind direction rotated in a clockwise direction. Model driven by CMA shows higher mixing rate.



Summary

- 1) Model-observation comparisons suggest that the model performance is improved by high resolution CMA forcing.
- 2) Drifters experiments show that the trajectory of the drifters is very sensitive to the wind direction and magnitude. Because of the higher frequency of wind variation in CMA forcing, the drifters show very different paths compared with the drifters driven by NARR forcing, suggesting a strong impact of high resolution forcing on material transport in and out of the Mississippi Sound and Bight.
- 3) The freshwater plume coming out of the Mobile Bay post Hurricane Patricia is stronger when the model is driven by CMA forcing. The model driven by CMA forcing displays a higher mixing rate compared with the model results derived from NARR forcing.

Acknowledgements

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- We thank Naval Research Laboratory (NRL) for providing NCOM data at: <https://data.gulfresearchinitiative.org/data/R4.x260.206:0001>.
- The RTMA forcing was downloaded from: <https://nomads.ncdc.noaa.gov/data/ndgd/>.
- The NAM data was downloaded from: <http://nomads.ncdc.noaa.gov/data/meso-eta-hi/>.
- The NEXRAD data was downloaded from: <https://www.ncdc.noaa.gov/nexradinv/chooseday.jsp?id=klix> and <https://www.ncdc.noaa.gov/nexradinv/chooseday.jsp?id=kmob>.
- The AVHRR data was downloaded from: <http://cwcgom.aoml.noaa.gov/thredds/ncss/grid/AVHRRSST/SST.nc/dataset.html>
- The NARR data was downloaded from: <https://nomads.ncdc.noaa.gov/thredds/catalog/narr-a/> .
- The river discharge data was downloaded from USGS: <http://waterdata.usgs.gov/nwis>.
- Special thank goes to Dr. Mustafa Cambazoglu at USM for fruitful discussions and help.
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Thank you!

Questions?