

# Regional Ocean State Estimation and Prediction Experiments

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UC San Diego



# Using ECCO machinery for Regional Ocean State Estimation

## Science goals

Testing consistency with ocean dynamics and data at mesoscale/submesoscale and smaller scales

Regional ocean state estimates allow us to study ocean-atmosphere-wave processes at finer spatial/temporal scales

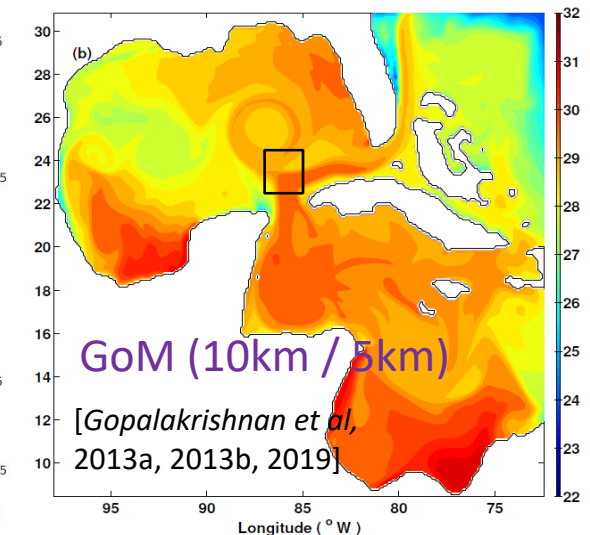
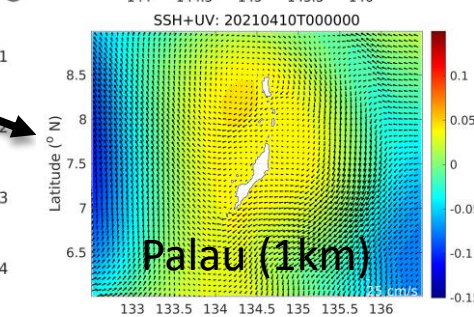
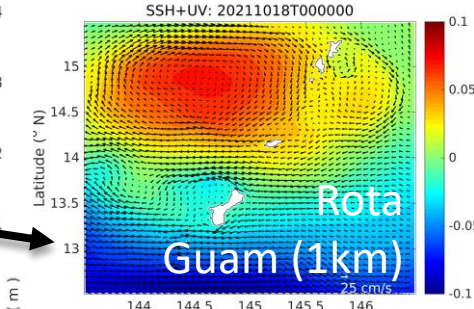
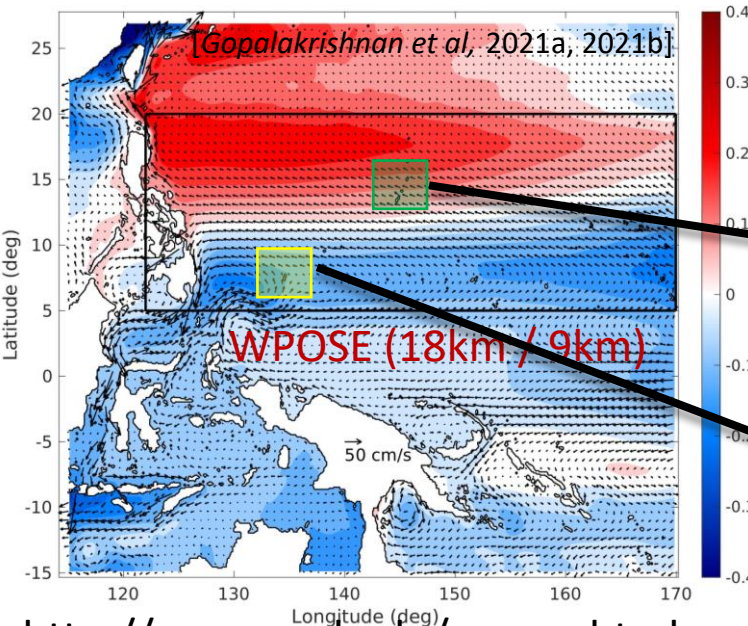
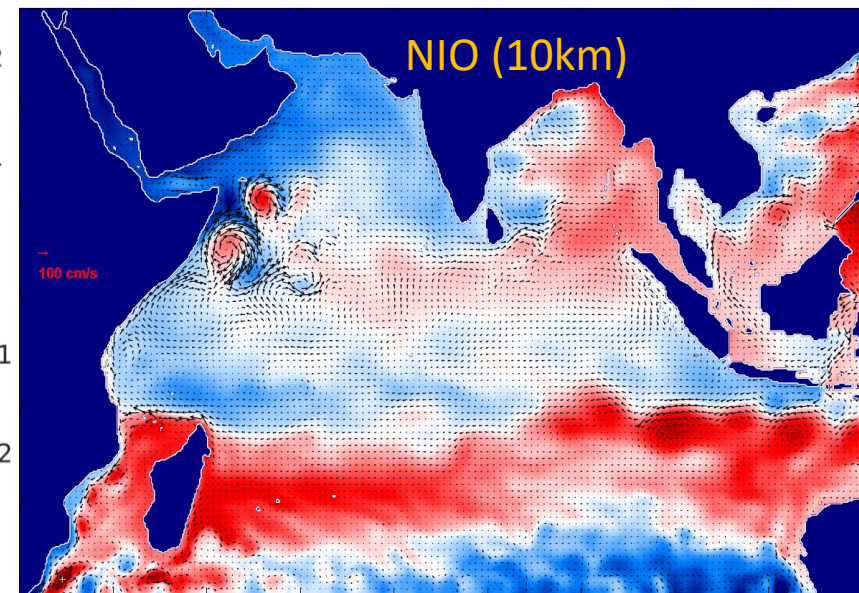
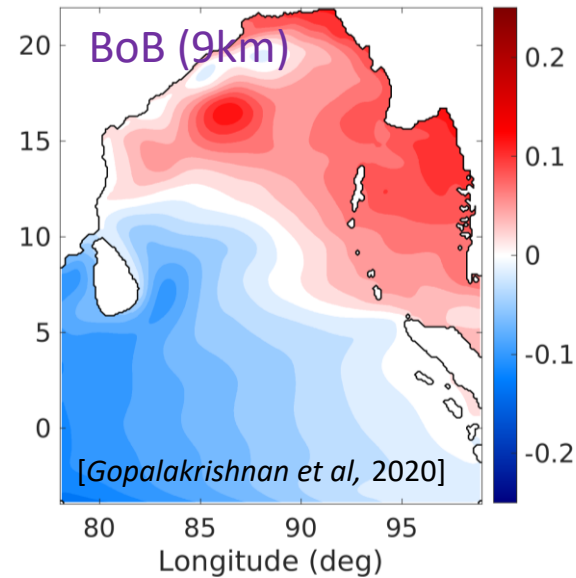
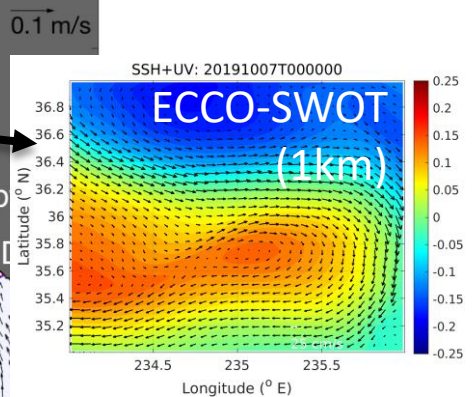
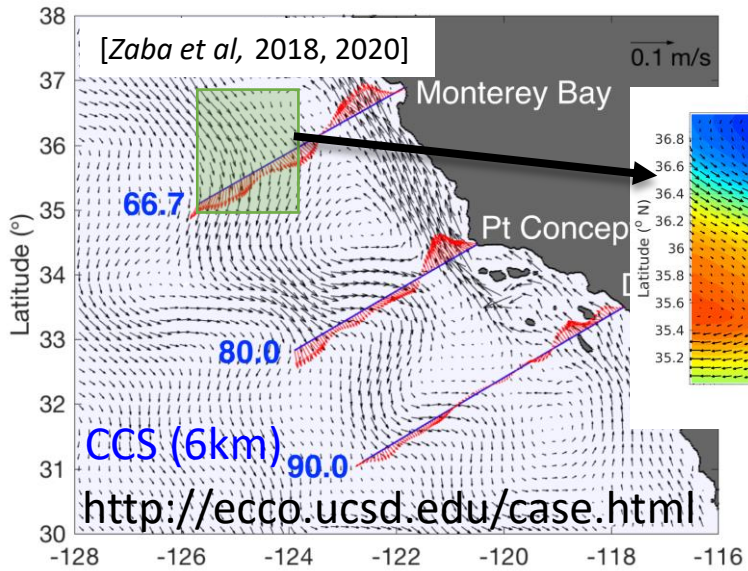
Understanding the feedback of regional ocean circulation on global circulation and climate system

Adjusting assimilation window to allow fitting mesoscale/submesoscale eddies

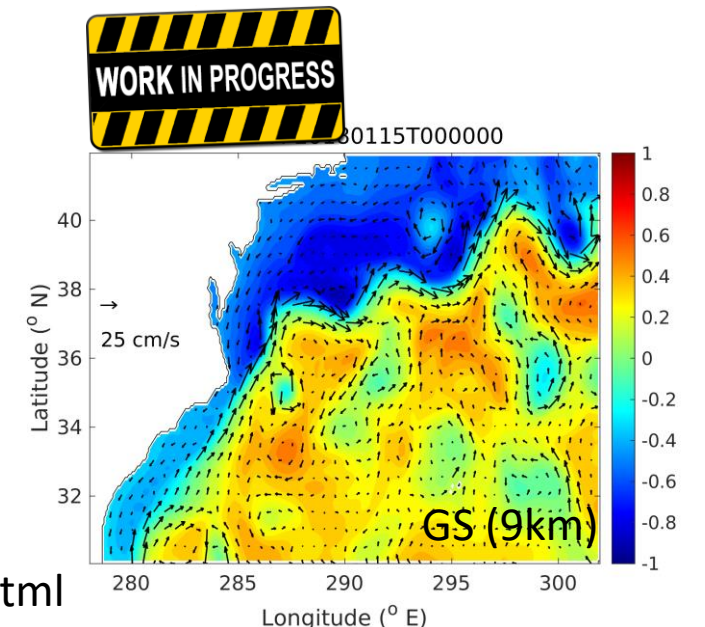
## Applications

- *Analyze 3D eddy structure, heat/salt transports (WPOSE)*
- *Estimate heat fluxes, energy budgets (CCS)*
- *Loop Current analysis/prediction, adaptive sampling (GoM)*
- *Acoustic data assimilation (WPOSE)*
- *Southern Ocean Carbon Cycle  
and many others...*

# Regional Ocean State Estimations



<http://ecco.ucsd.edu/gom.html>



# Modeling Gulf stream

## MITgcm Gulf Stream Domain

Lon: 278 – 302

Lat: 30 - 42

50 levels

1/12<sup>th</sup> degree resolution

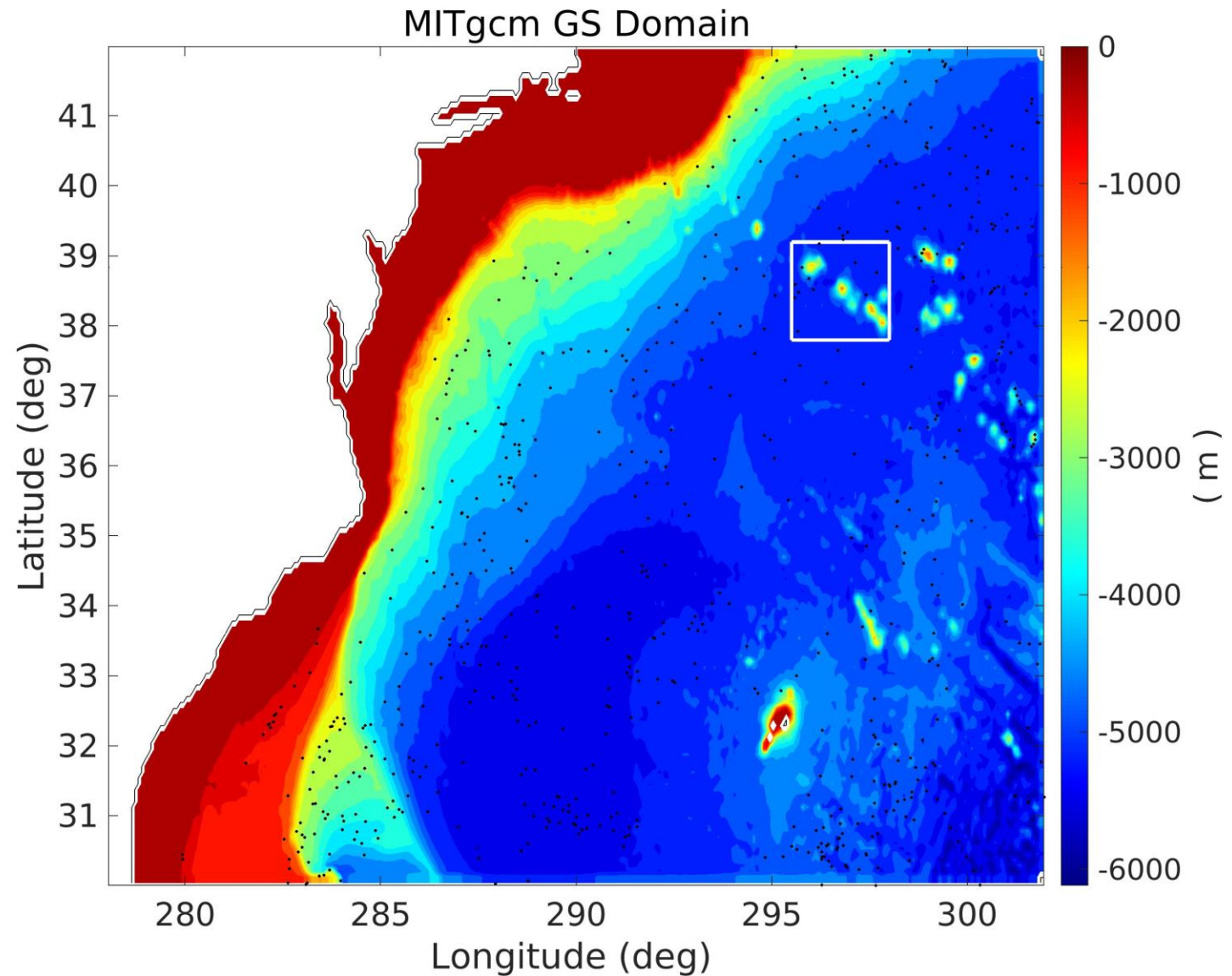
Black dots: Argo profiles for 2020

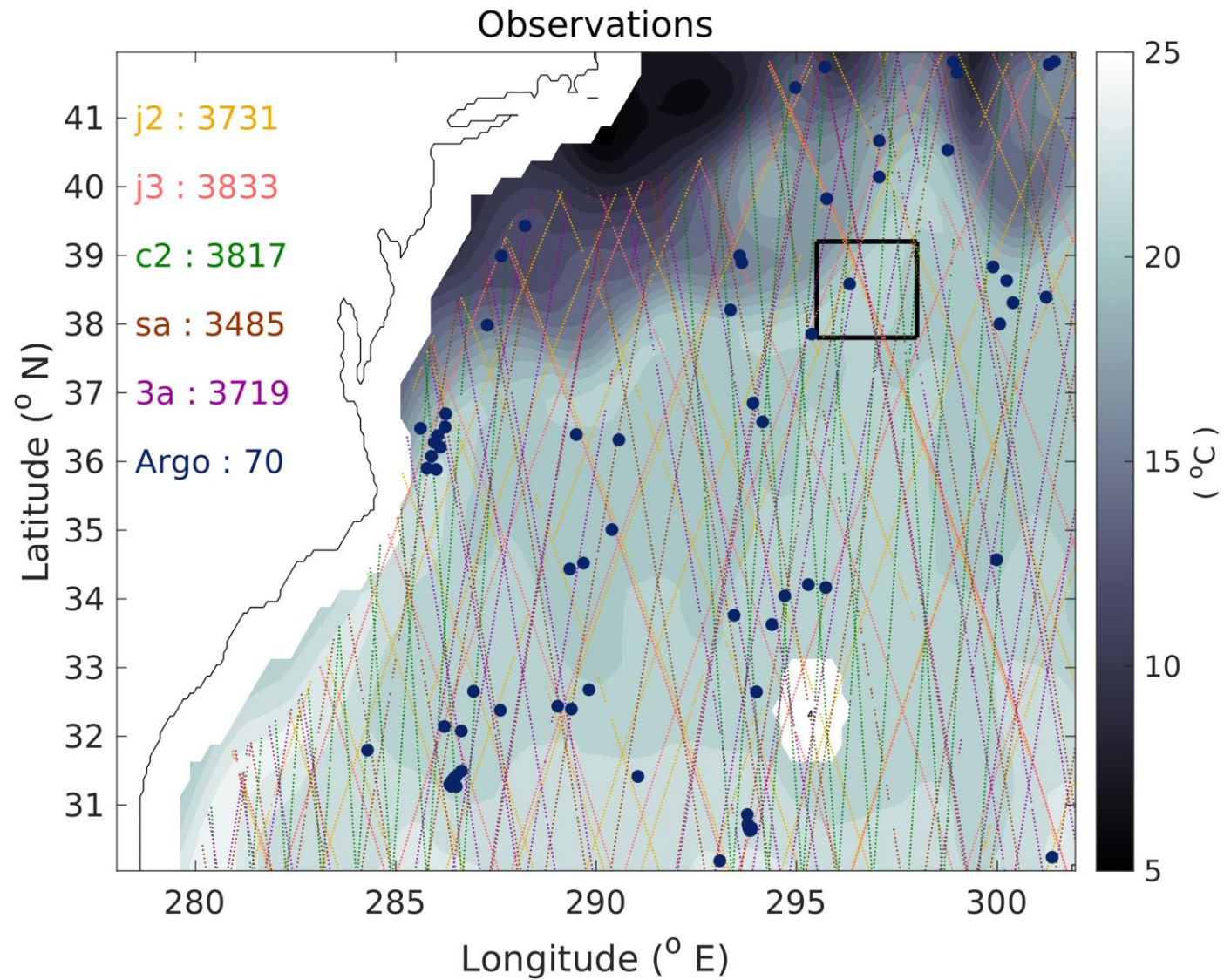
White box: NESMA experiment region

Forward model initialized from HYCOM/NCODA, forced using ERA5 reanalysis, and HYCOM/NCODA boundary conditions

Assimilation and Forecast experiments for 15, 30, ... days

Assimilate SSH, SST, and Argo T/S data

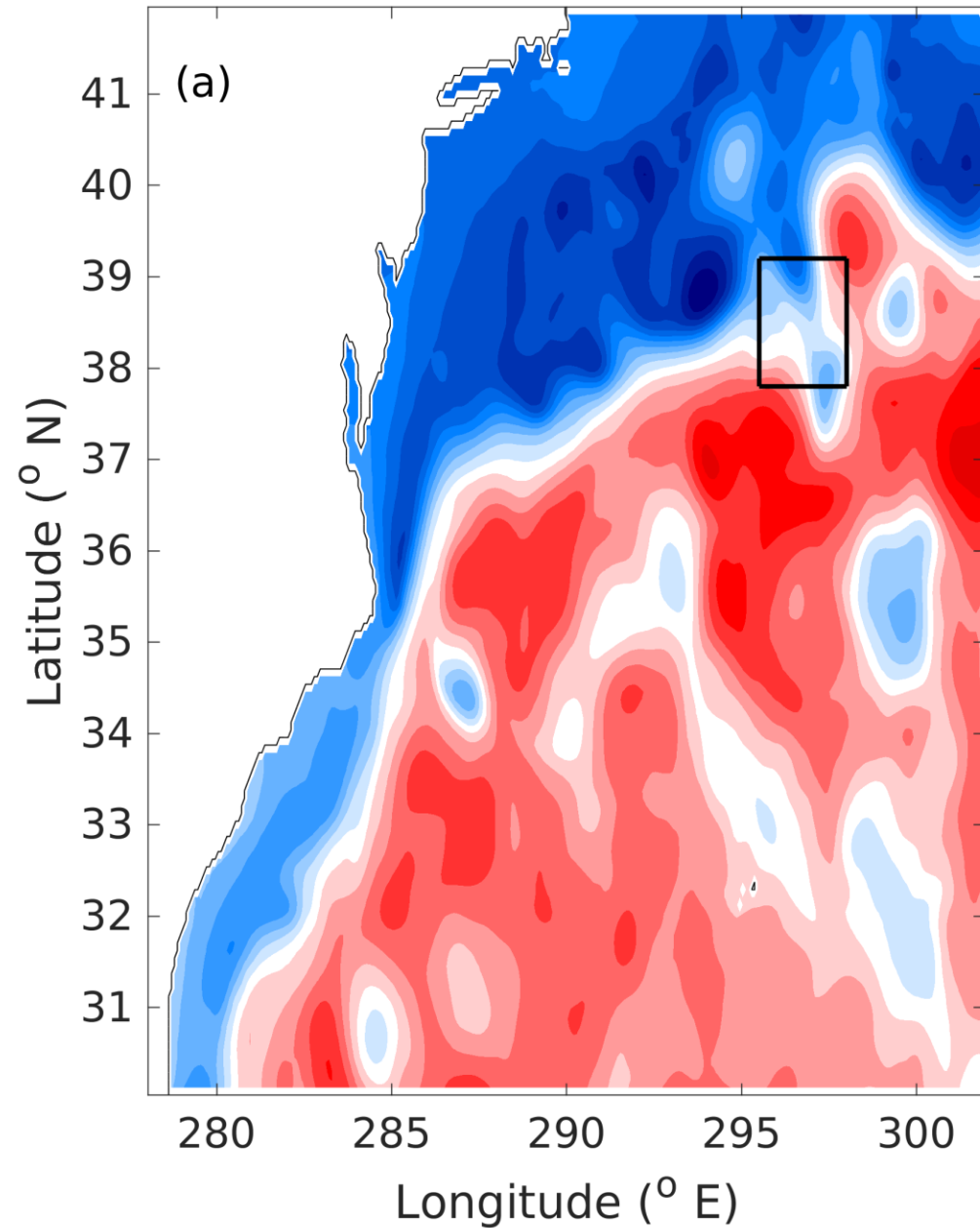




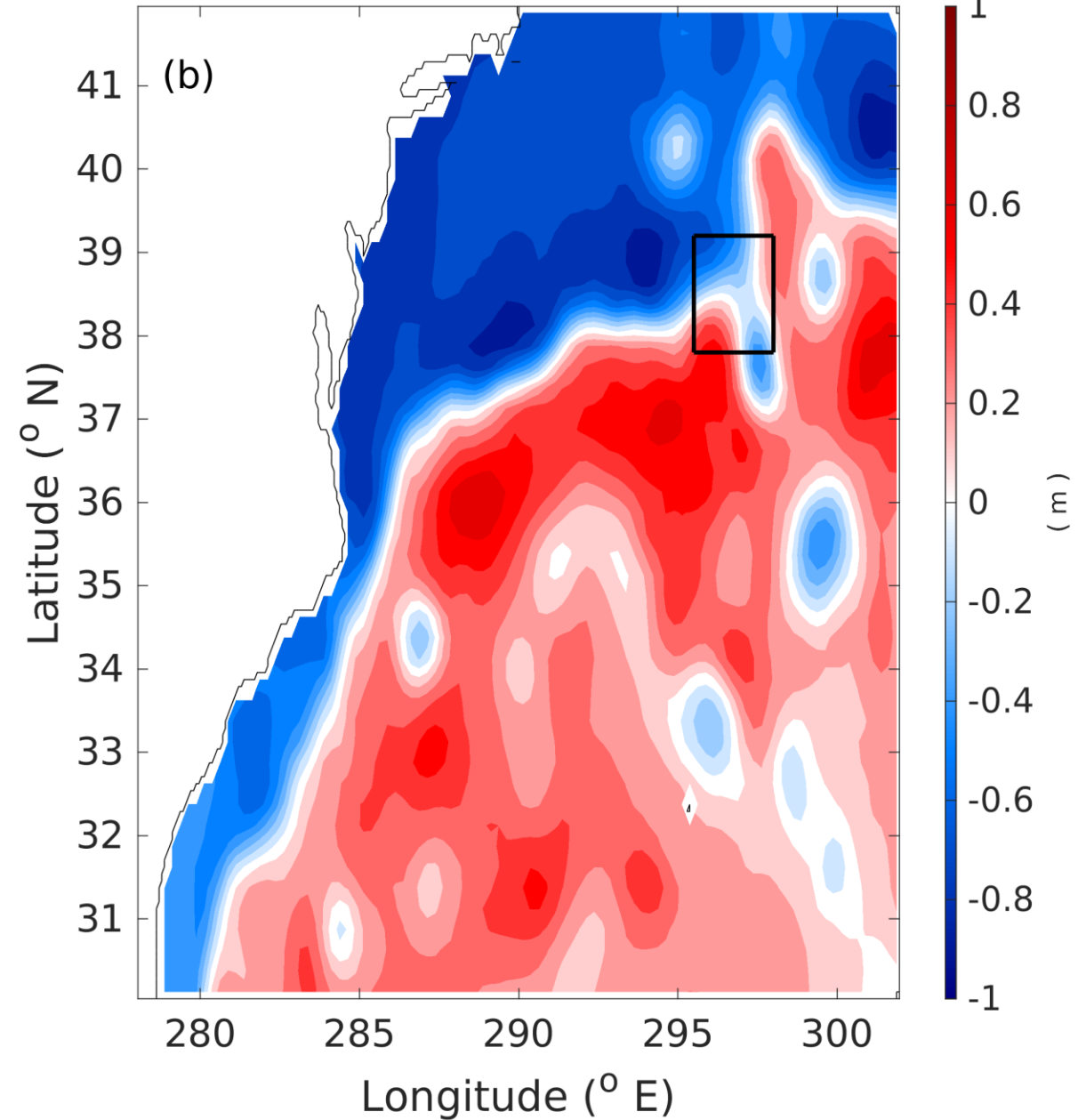
Observations: Shading shows mean SST over Jan 1-15, 2018.  
Satellite along track SSH data binned to model grid are shown for 15 days.  
Argo profile locations for 15 days are shown by blue filled circles.

# Hindcast SSH comparison for day 1

MIT : 2018-01-01 00:00:00

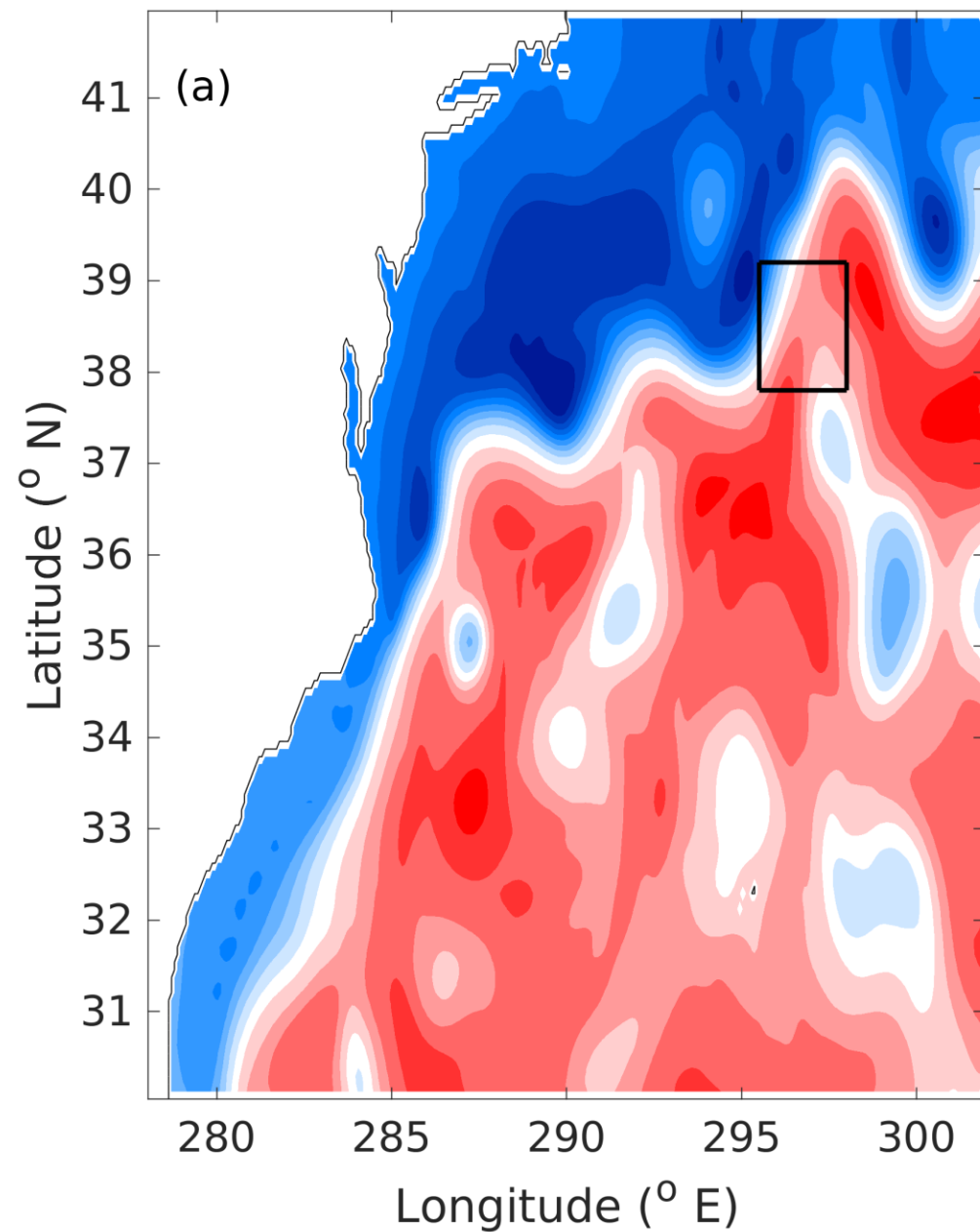


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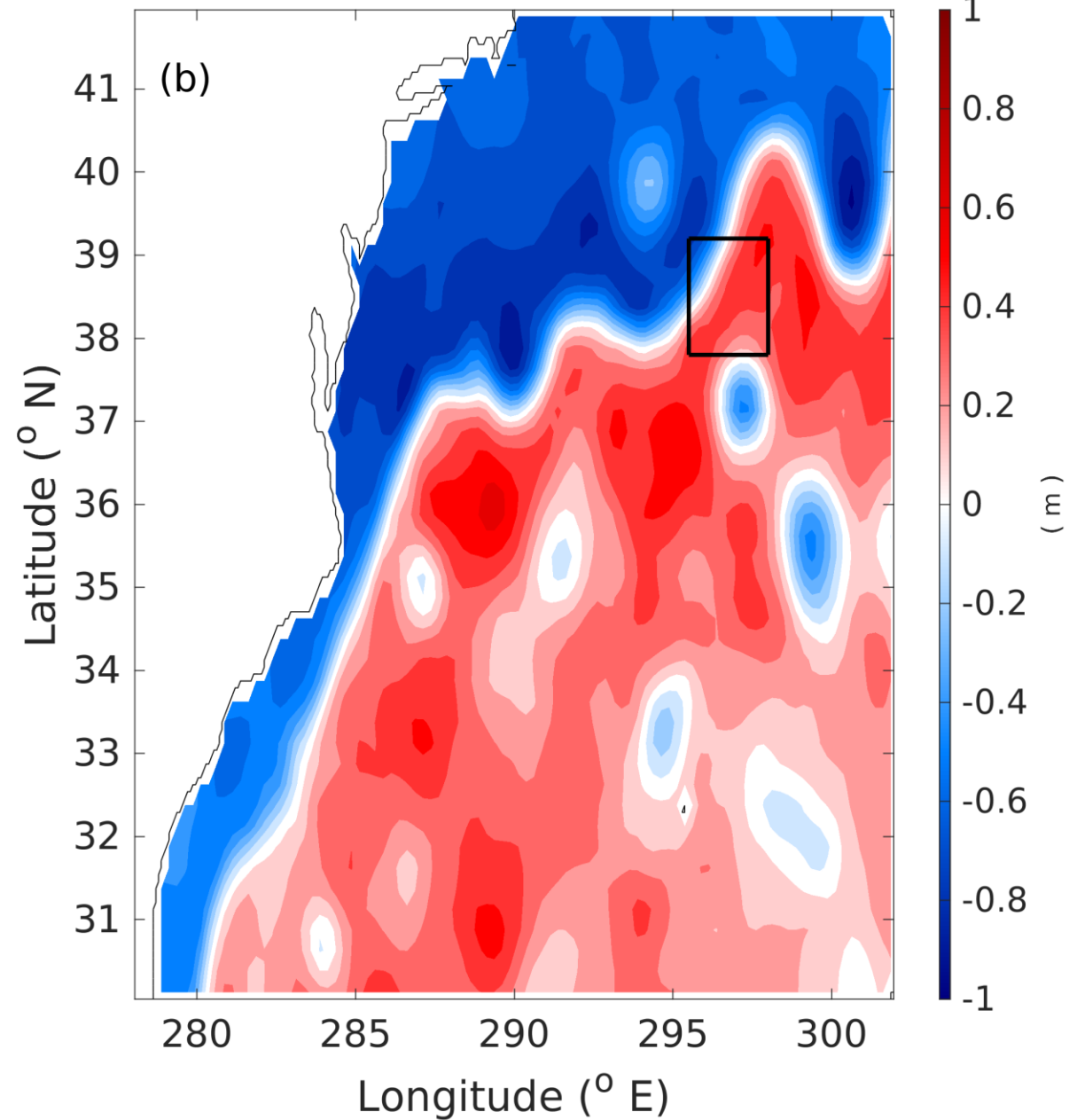


# Hindcast SSH comparison for day 15

MIT : 2018-01-15 00:00:00

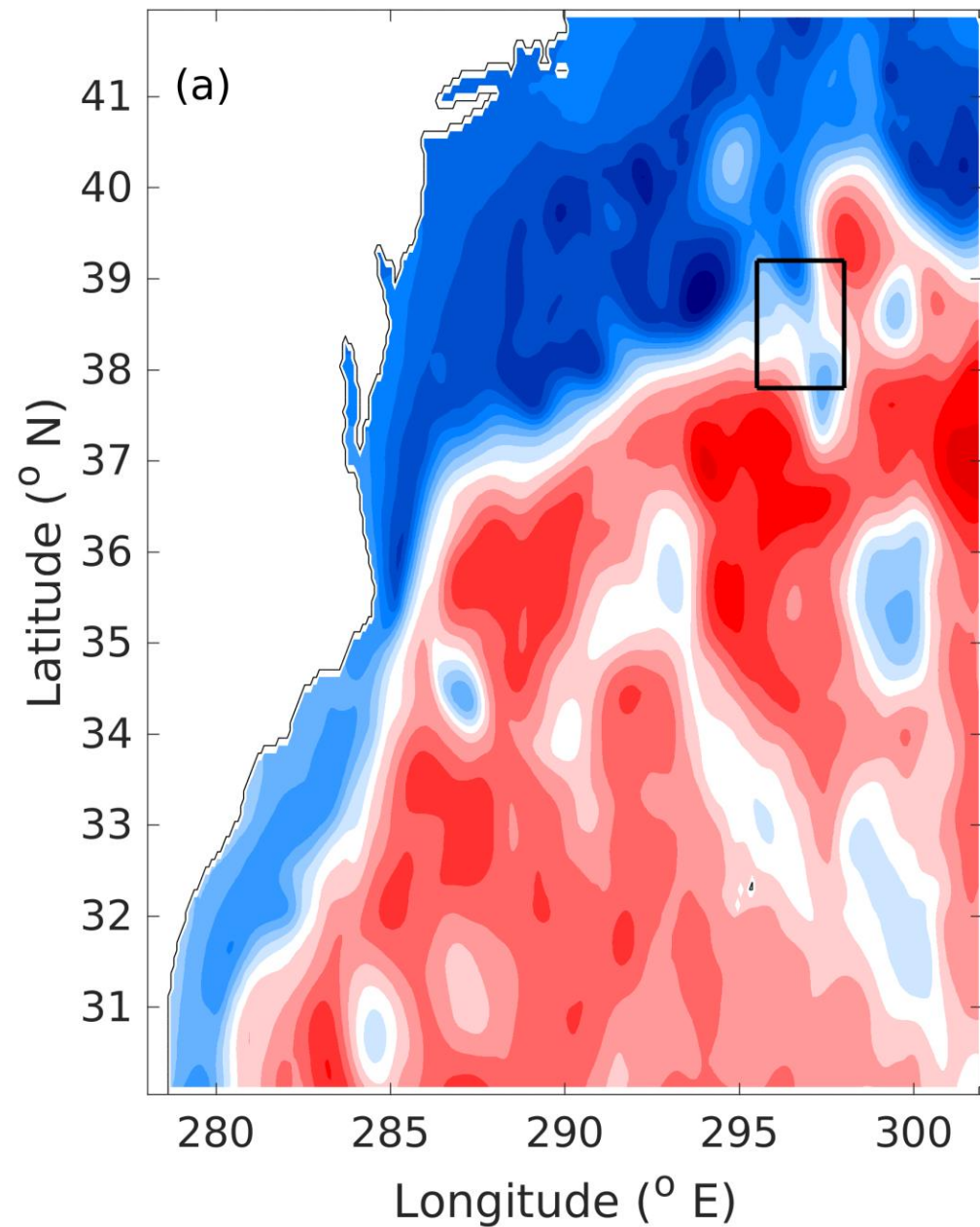


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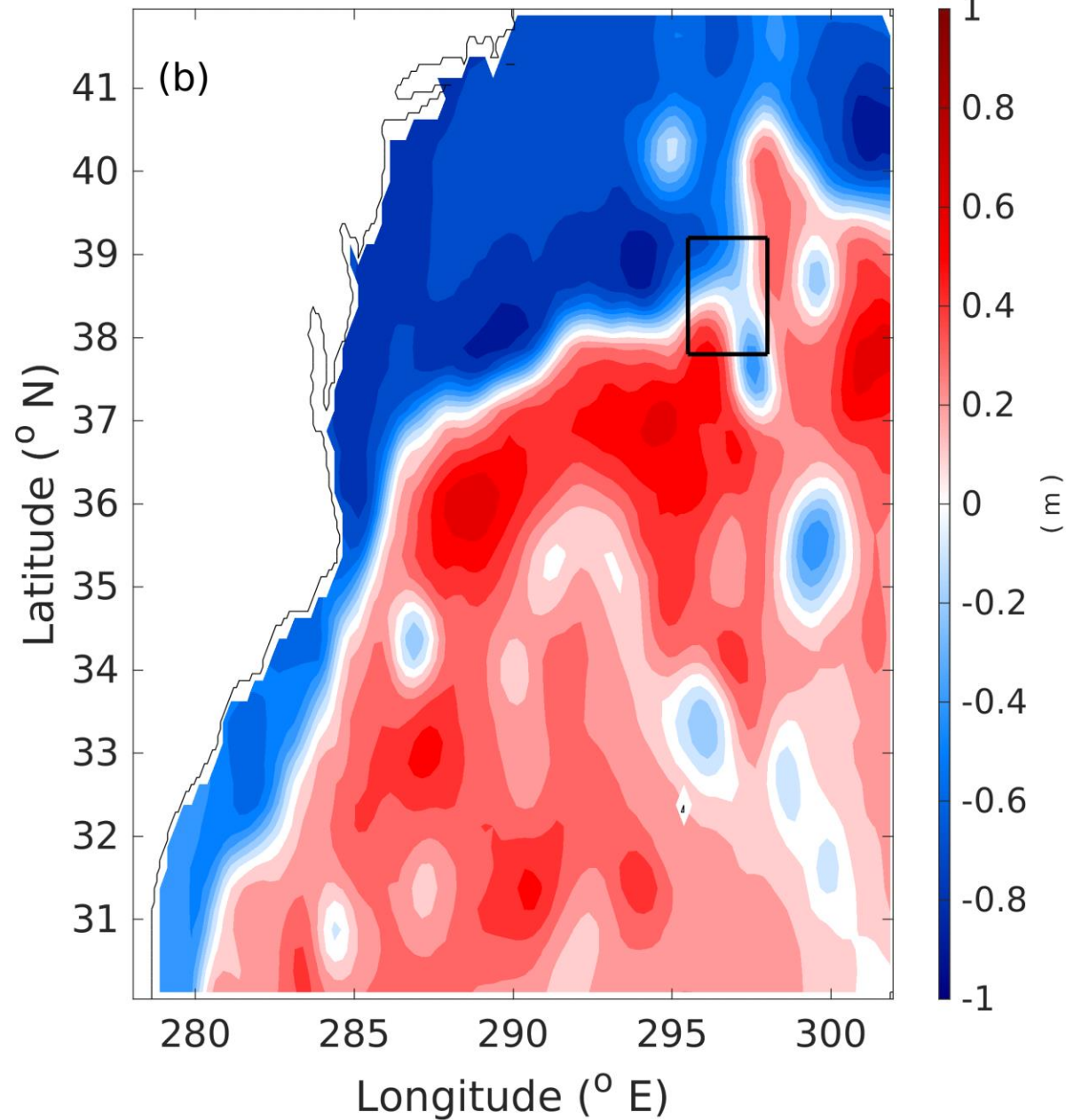


# Hindcast SSH movie

MIT : 2018-01-01 00:00:00

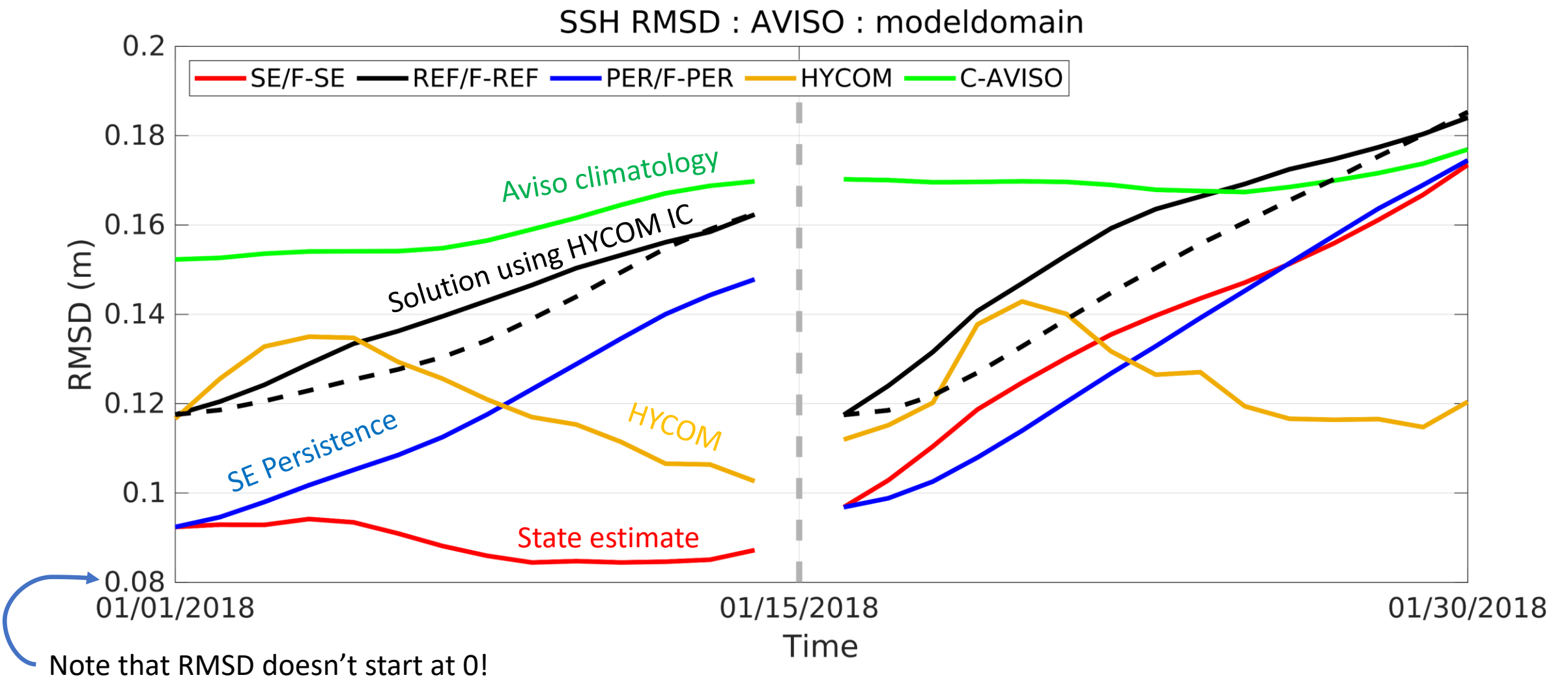


AVISO : 2018-01-01 00:00:00

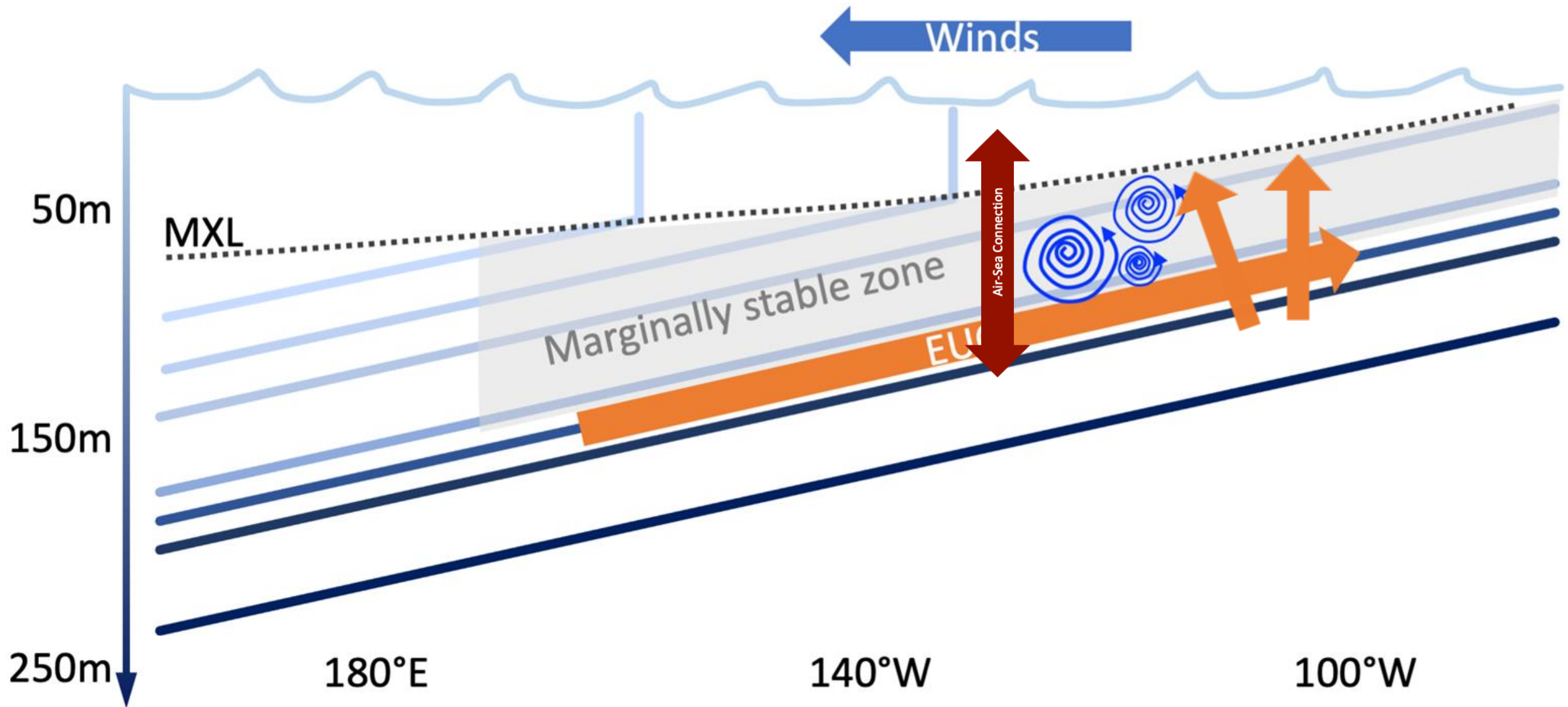




# SSH RMS Difference with AVISO for hindcast and forecast periods averaged over the model domain, masking depths < 500 m



Mixing above the Equatorial Undercurrent upwells cold water, downwells heat, and connects the atmosphere to the equatorial thermocline



# EquatorMix Remix: Assimilation of a Process Study Campaign for Estimating Pacific Upwelling and Mixing Physics (PUMP)

Matthew Mazloff, Bruce Cornuelle, Ariane Verdy (University of California - San Diego)



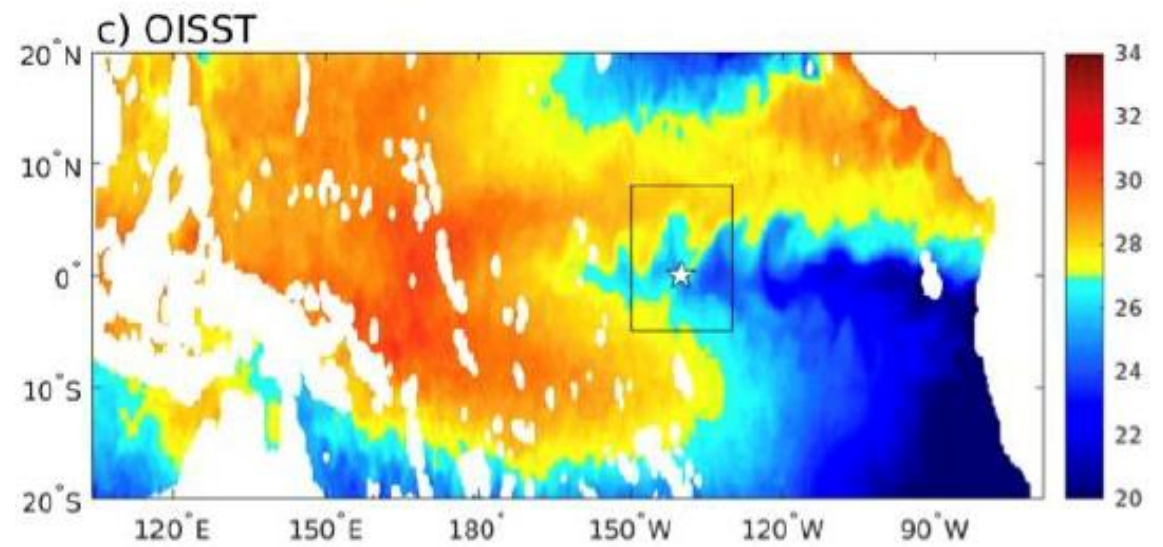
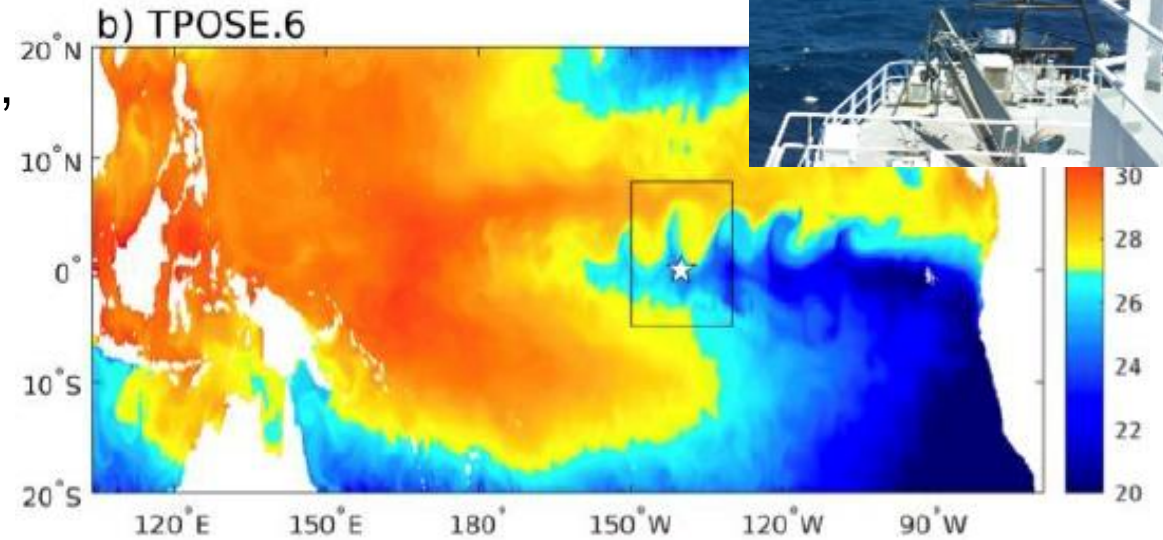
The **EquatorMix** process study occurred Oct 6 to Nov 3, 2012 while a tropical instability wave past through.

**Observations:** Fast-CTD, Doppler Sonar Systems, Extended meteorological sensors including UAVs

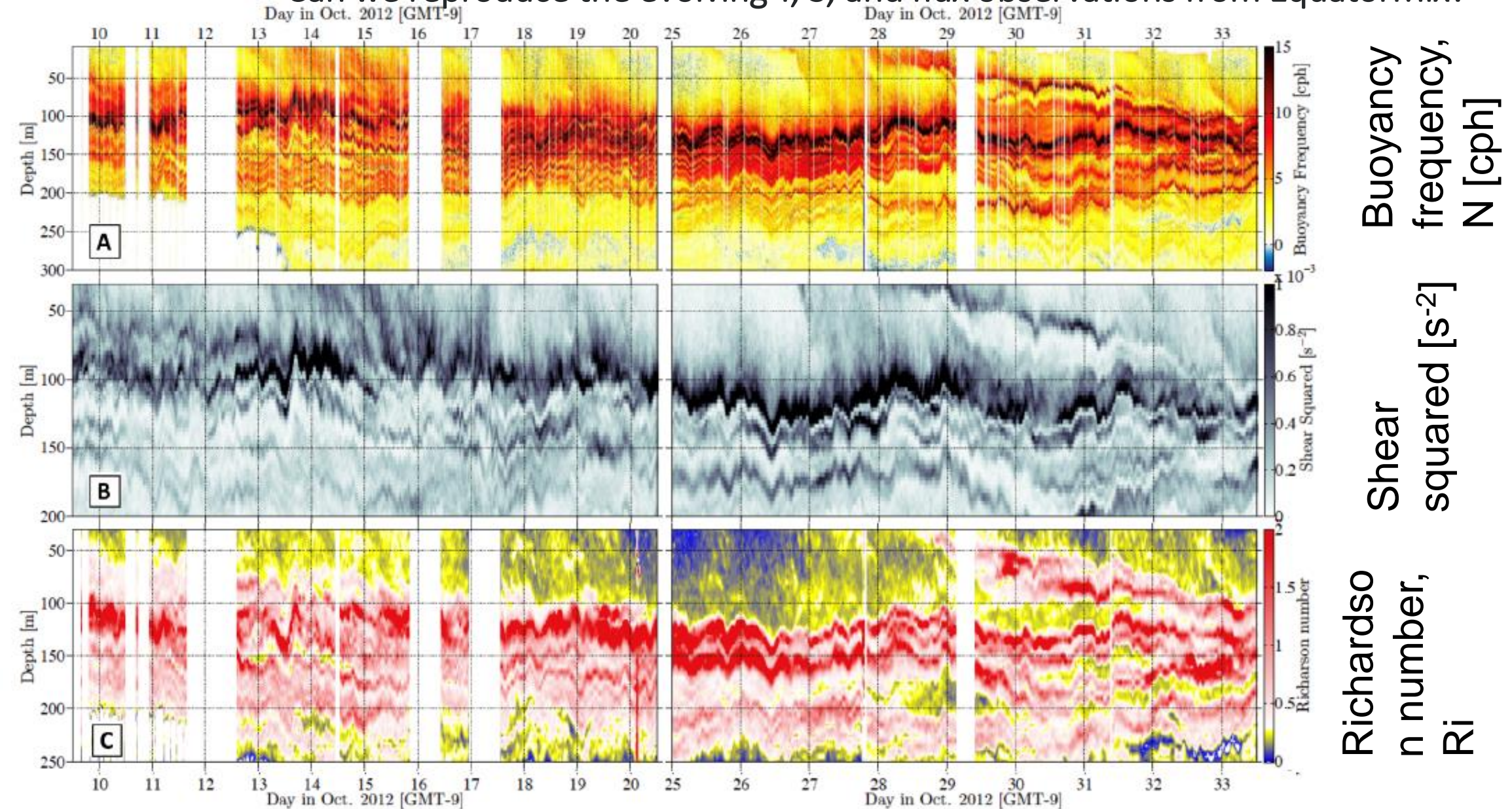
**Goal:** combine EquatorMix obs with our assimilating model infrastructure to gain understanding of:

- the processes important for PUMP
- how to model these processes
- how well these processes are constrained by the current broadscale observing system
- what analysis infrastructure can support PUMP
- how various obs platforms fit into PUMP campaign

State estimates produced are available for analysis

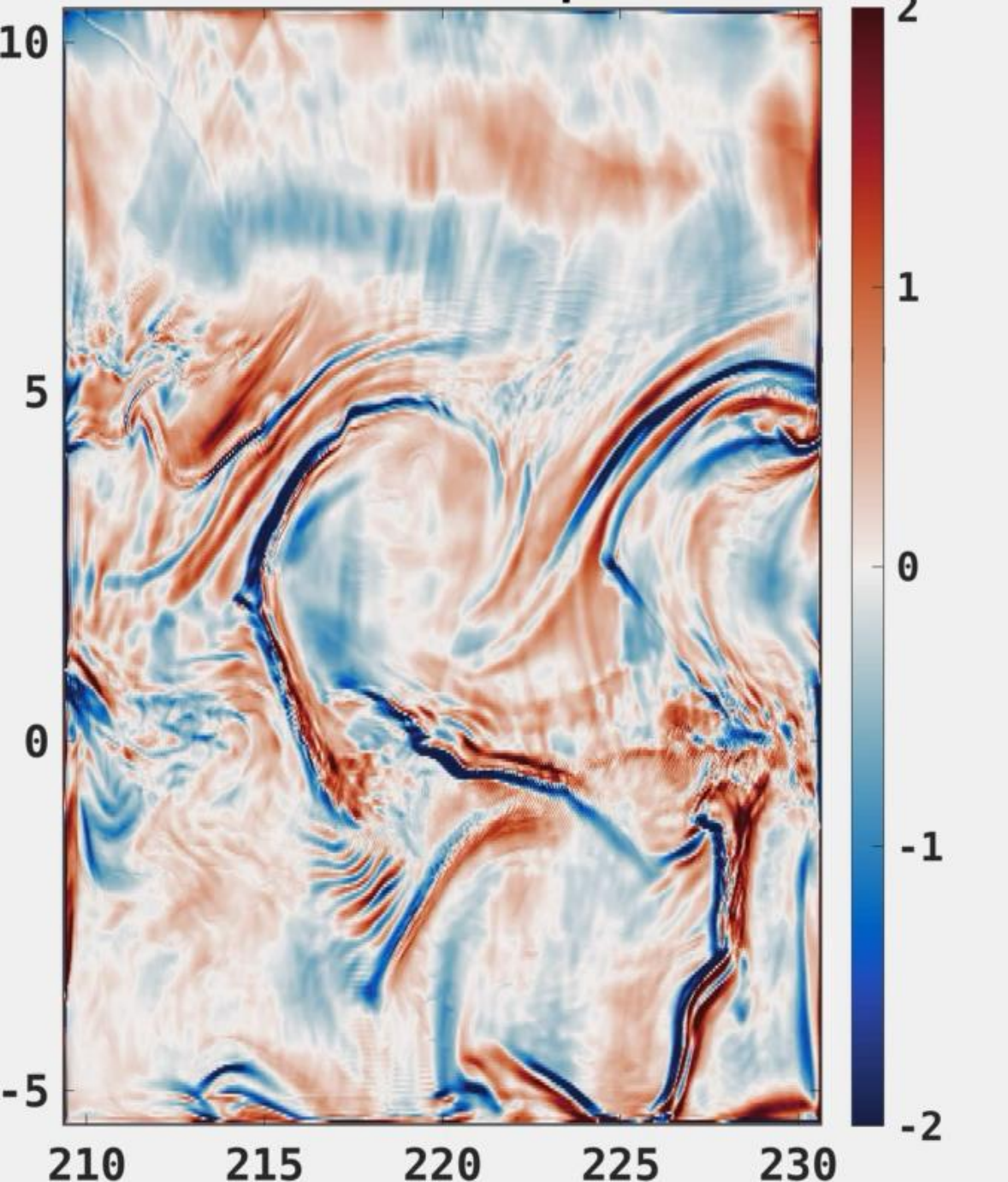


# Can we reproduce the evolving T, S, and flux observations from EquatorMix?

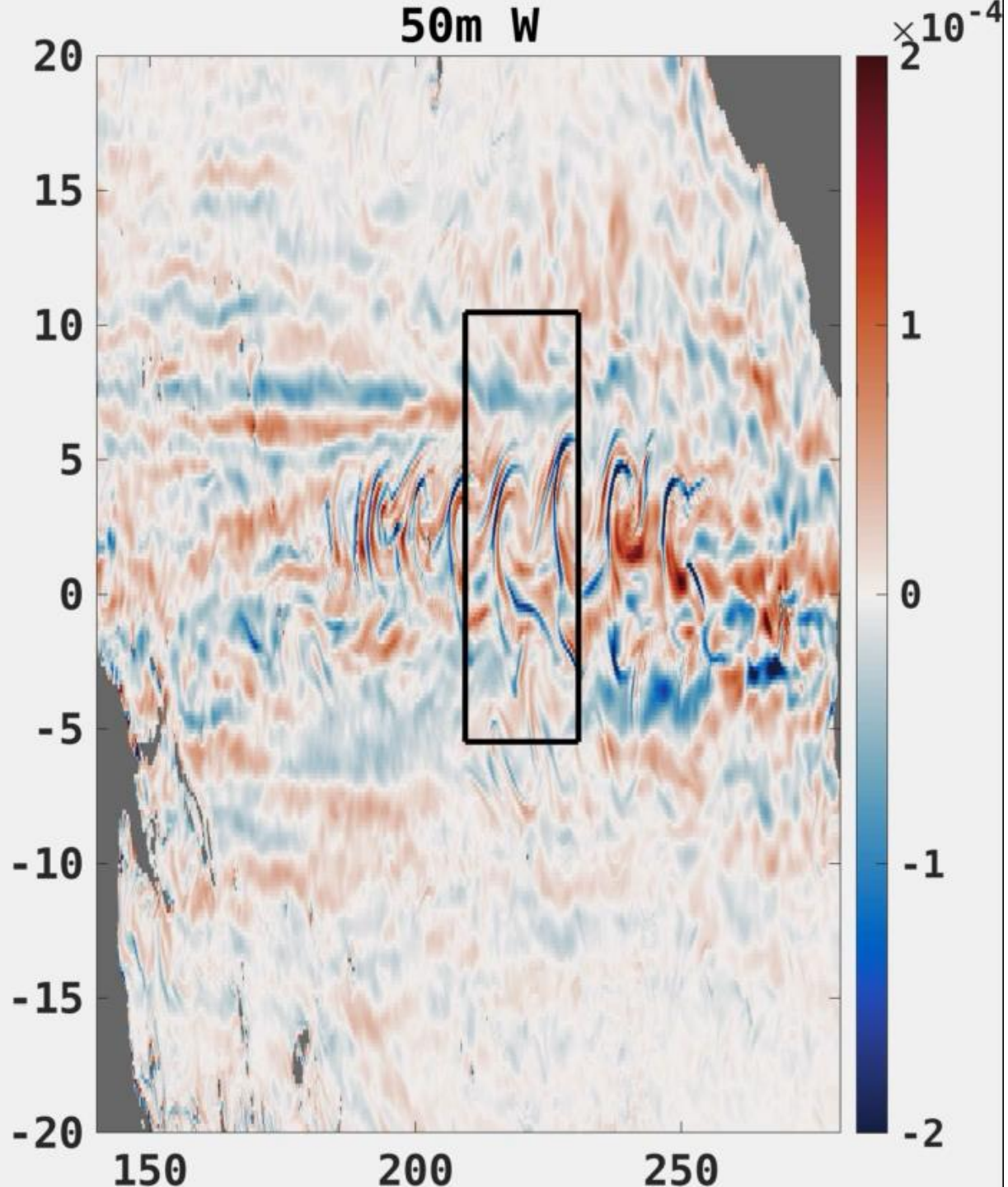


Workplan: assimilate these data in both a 1/6 large domain TPOSE, and in a nested 1/24 domain.

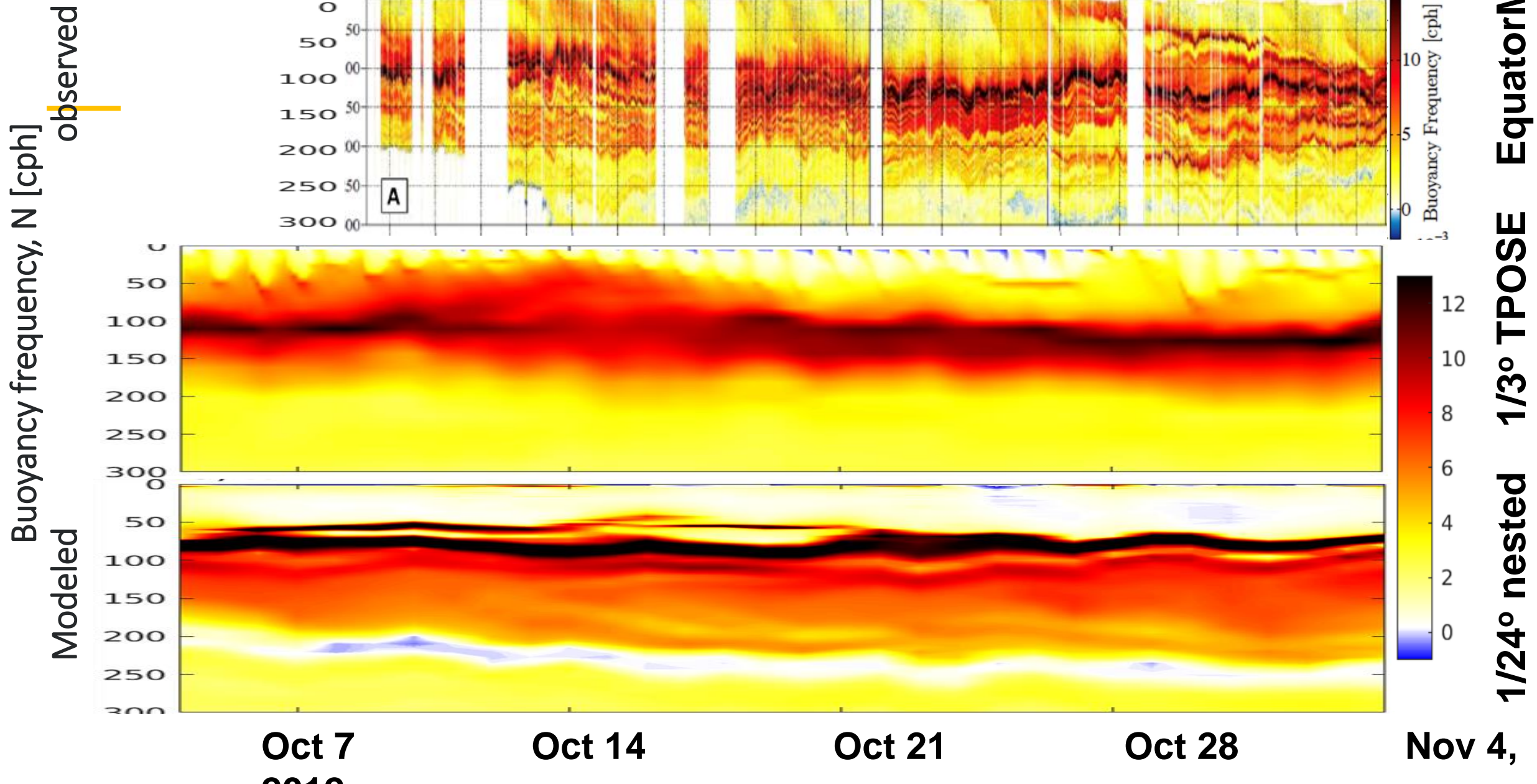
50m W on 15-Sep-2012



50m W

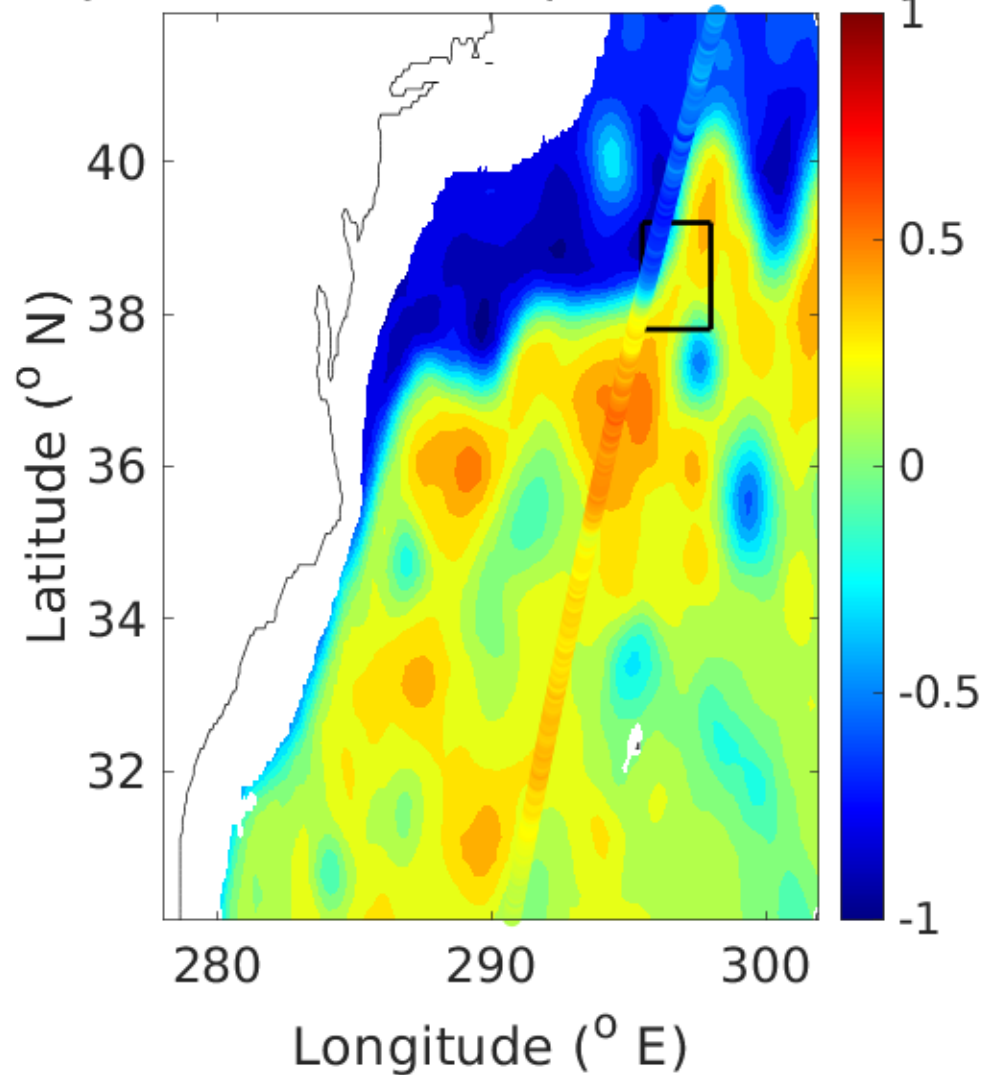


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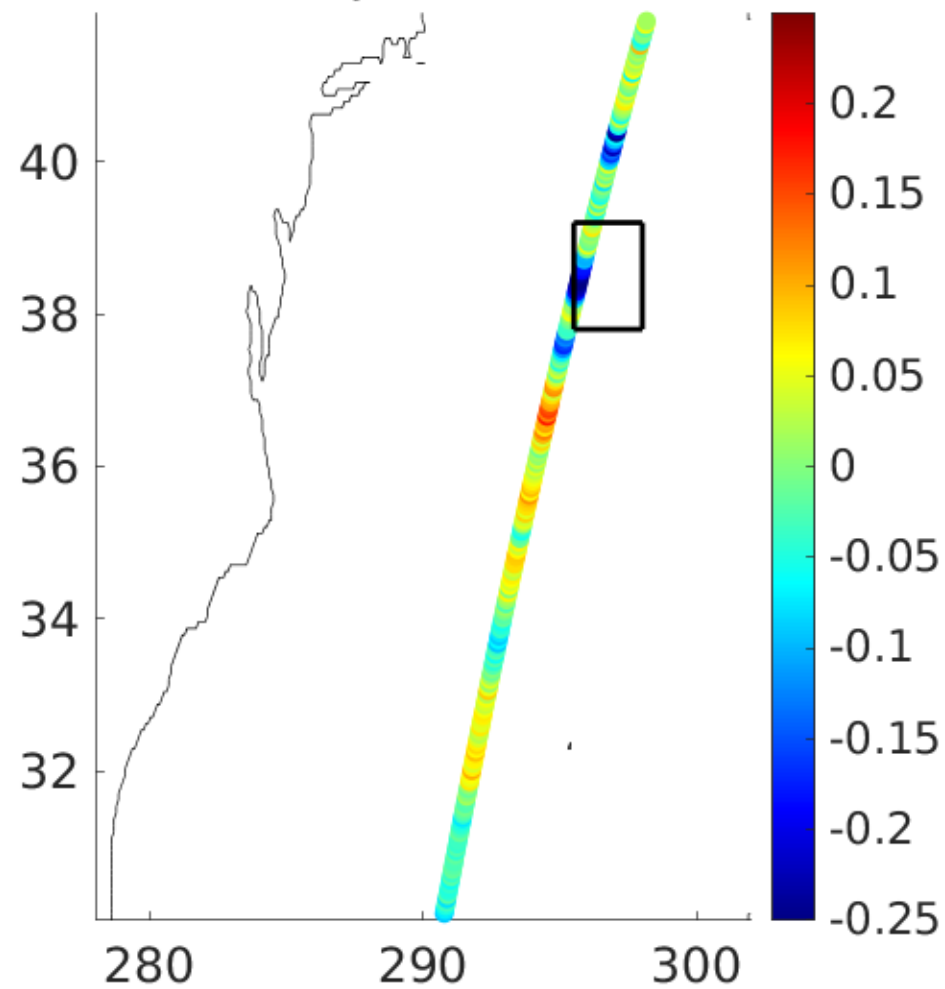




j3 - 01/10/2018 - p: 217 - c: 70

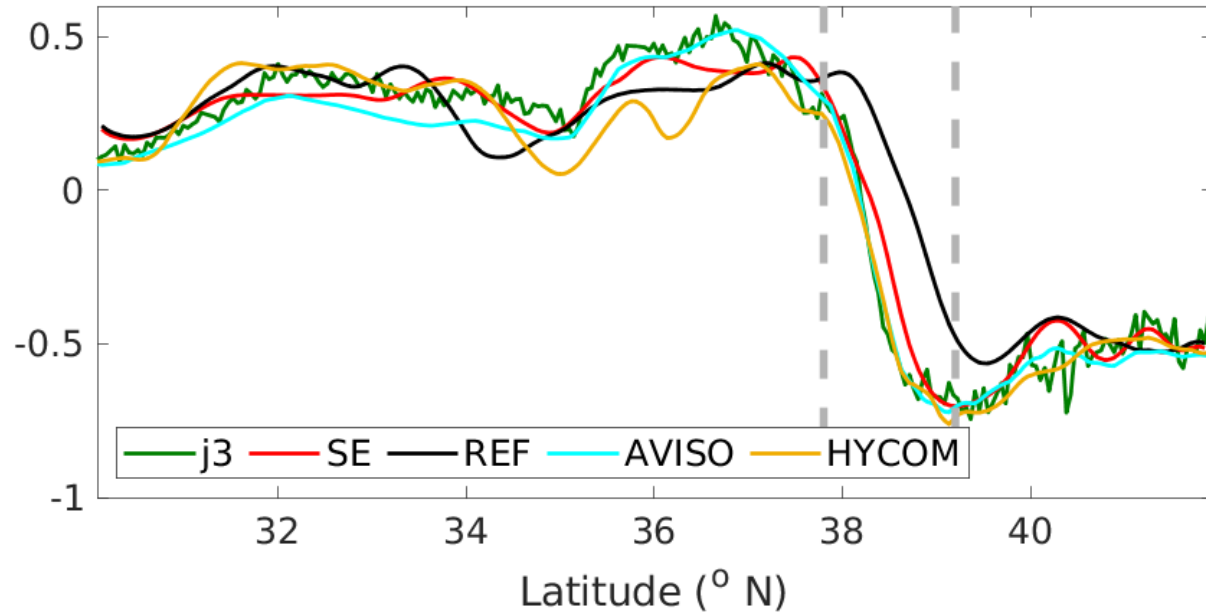


j3-SE





j3 - 01/10/2018 - p: 217 - c: 70



j3 - 01/10/2018 - p: 217 - c: 70

