Regional state estimation activities at Scripps Institution of Oceanography

Ariane Verdy, Matt Mazloff, Ganesh Gopalakrishnan, Bruce Cornuelle

Regional state estimates are…

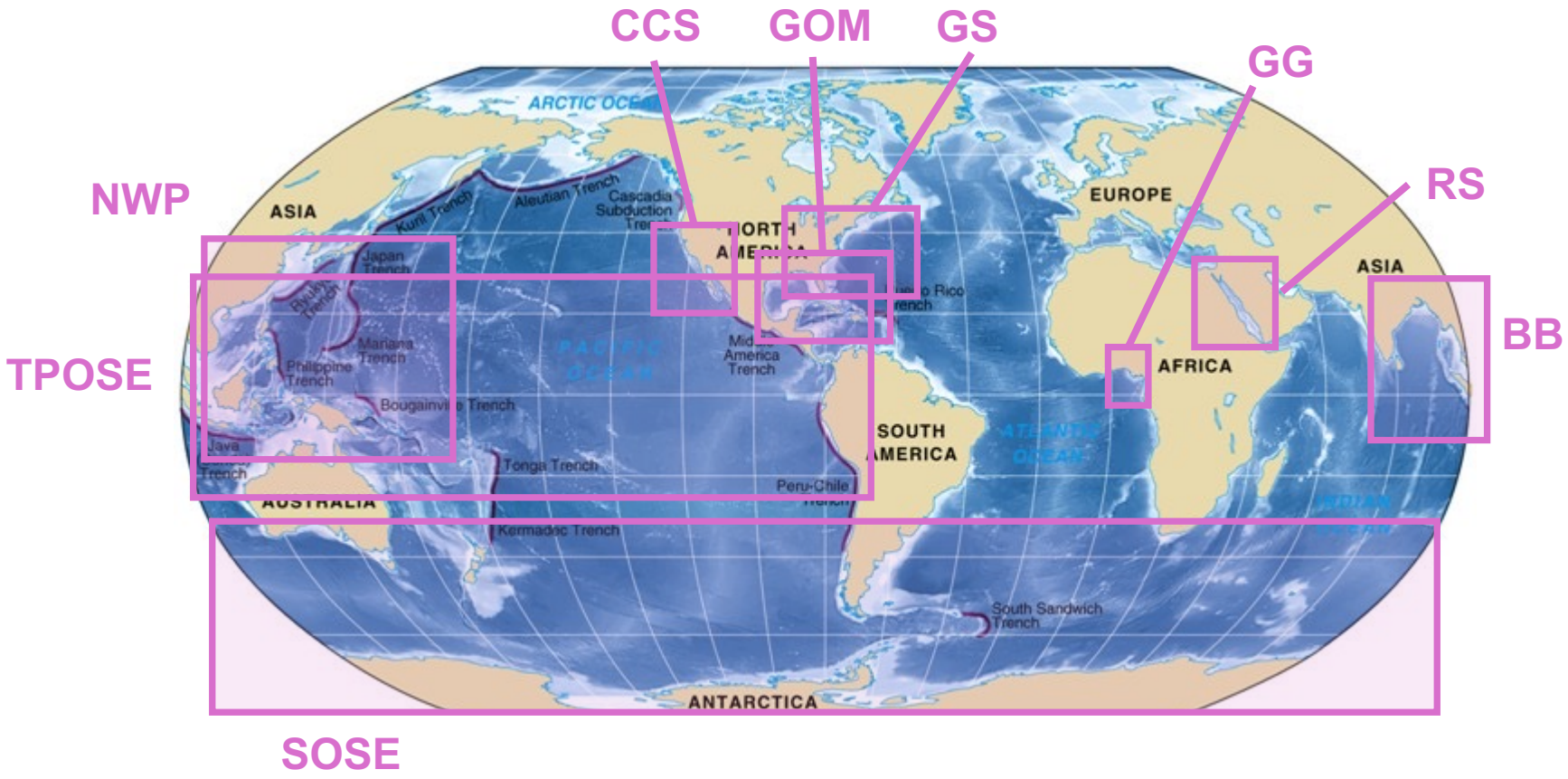
- High spatial resolution
- Open boundary conditions
- Short-to-long assimilation window
- Local constraints (targeted assimilation)
- Efficient development configurations
- Some with biogeochemistry
- (mostly) not on the ECCO website

SIO also provides:

- Profiles data processing for ECCO
- MITgcm development
  (BLING bgc package,
  ObsFit, etc)

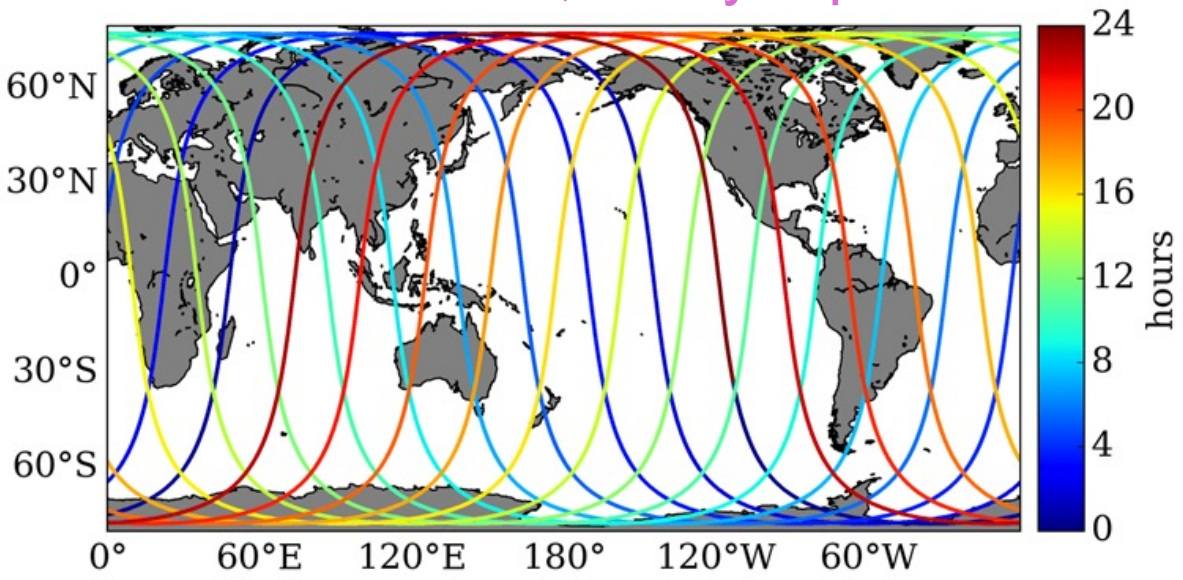
2024 ECCO meeting

Regional state estimation activities at Scripps Institution of Oceanography



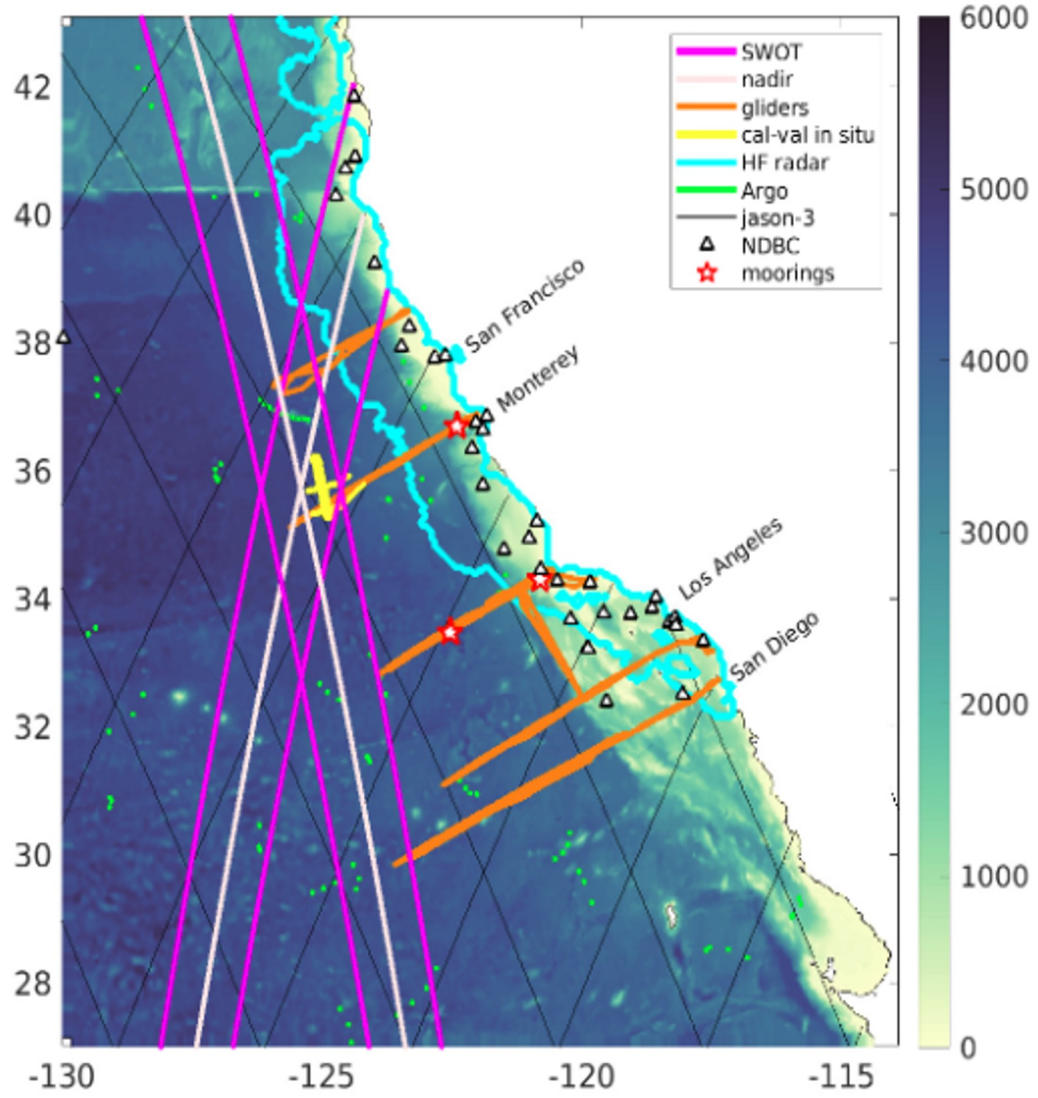
California Current System (CCS)

SWOT altimeter, 1-day repeat



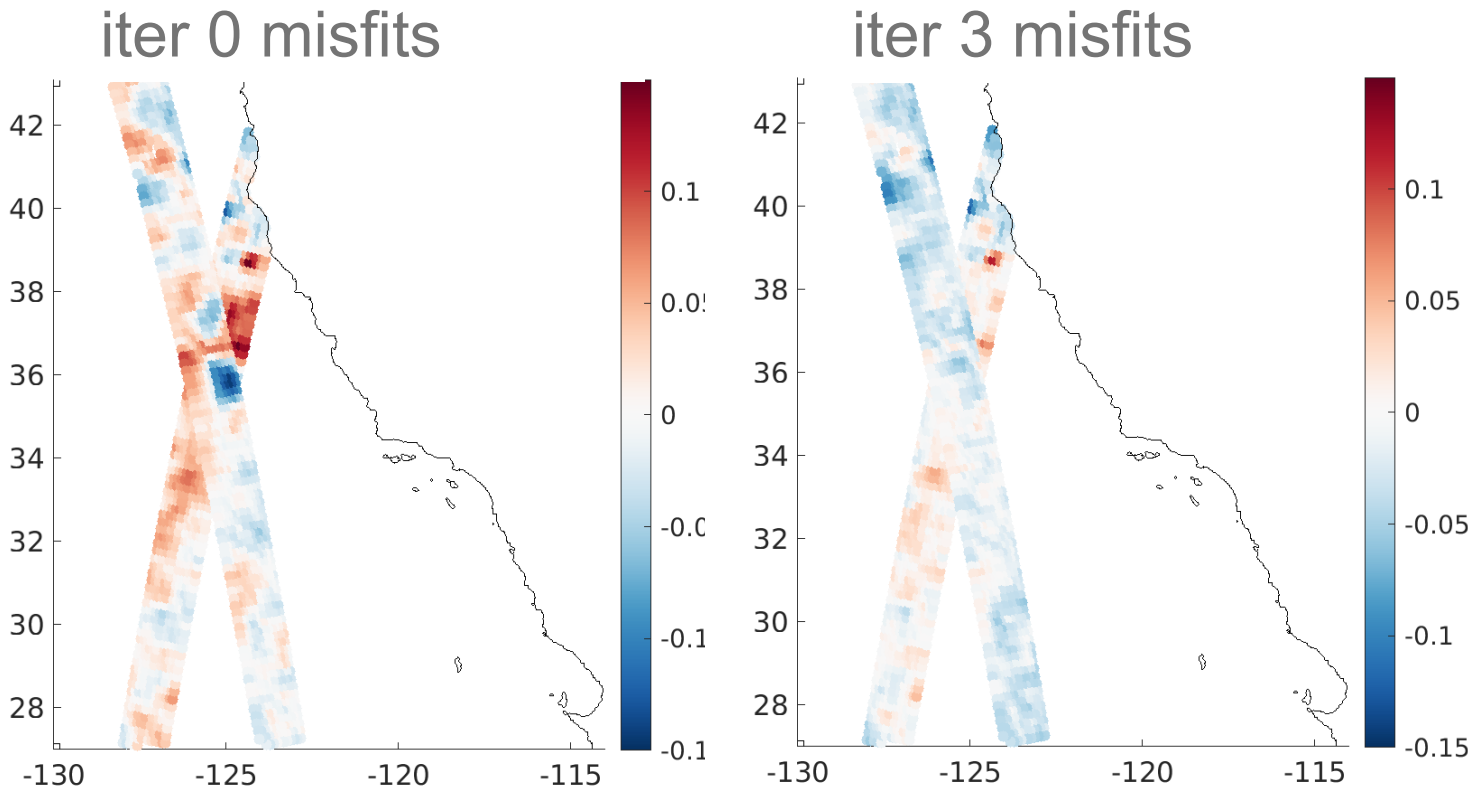
4D-Var assimilation for SWOT: from geostrophic balance to 1-10 km-scale dynamics

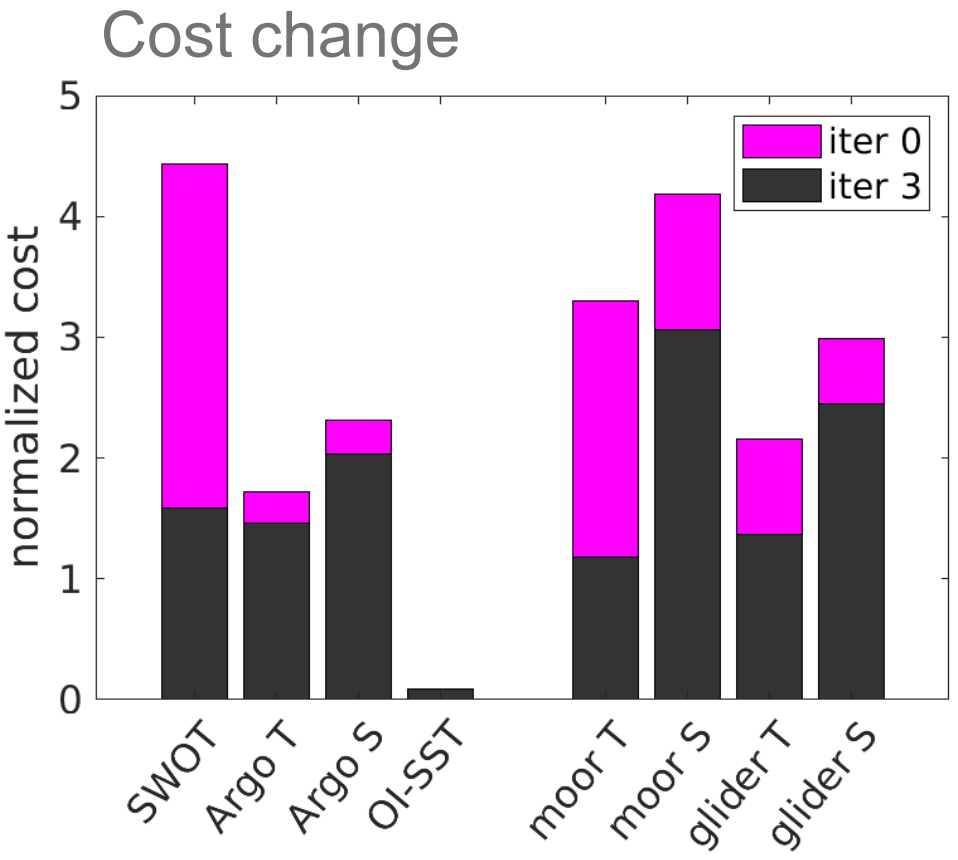
Observing system



California Current System (CCS)

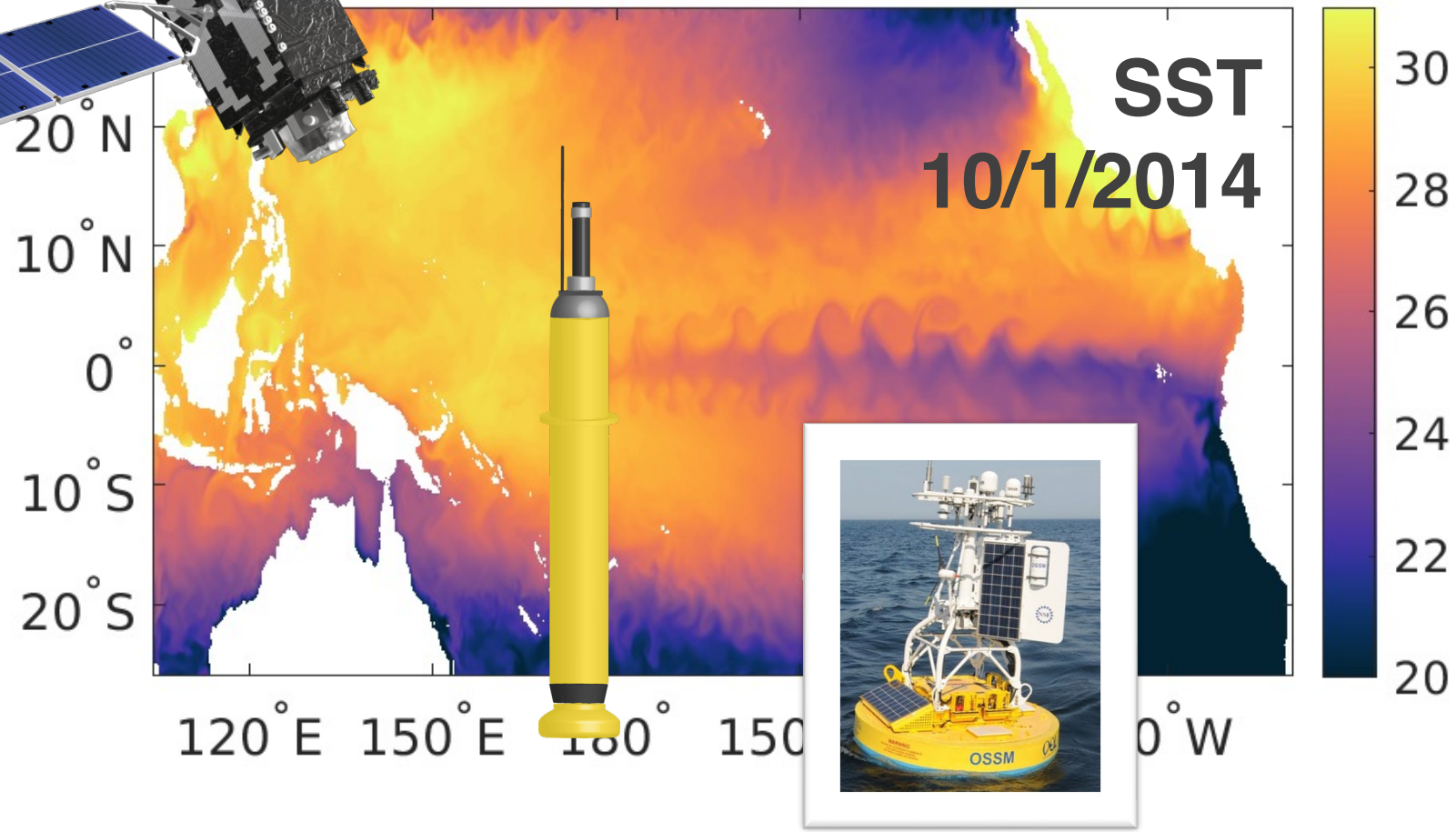
Proof of concept: 5-day assimilation (May 10-14, 2023)





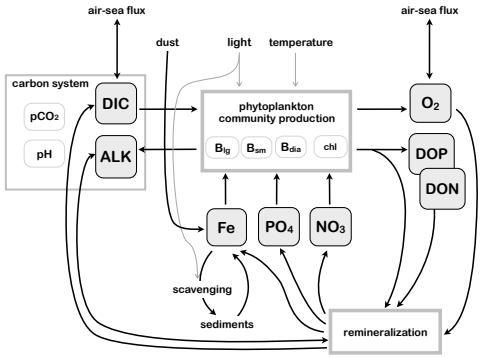
independent cal-val observations

Tropical Pacific Ocean State Estimate (TPOSE)



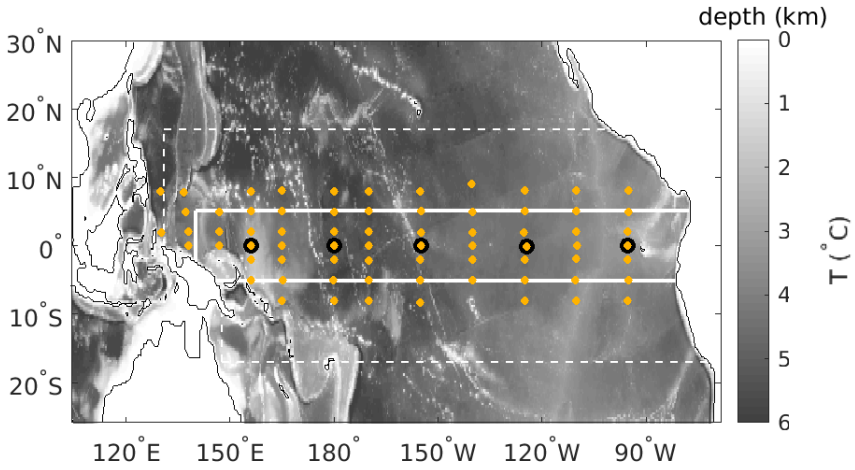
2010-2019

+ bgc

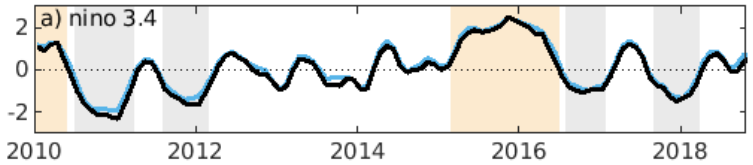


Exploring connections between surface forcing and interior dynamics through mixing

Tropical Pacific Ocean State Estimate (TPOSE)



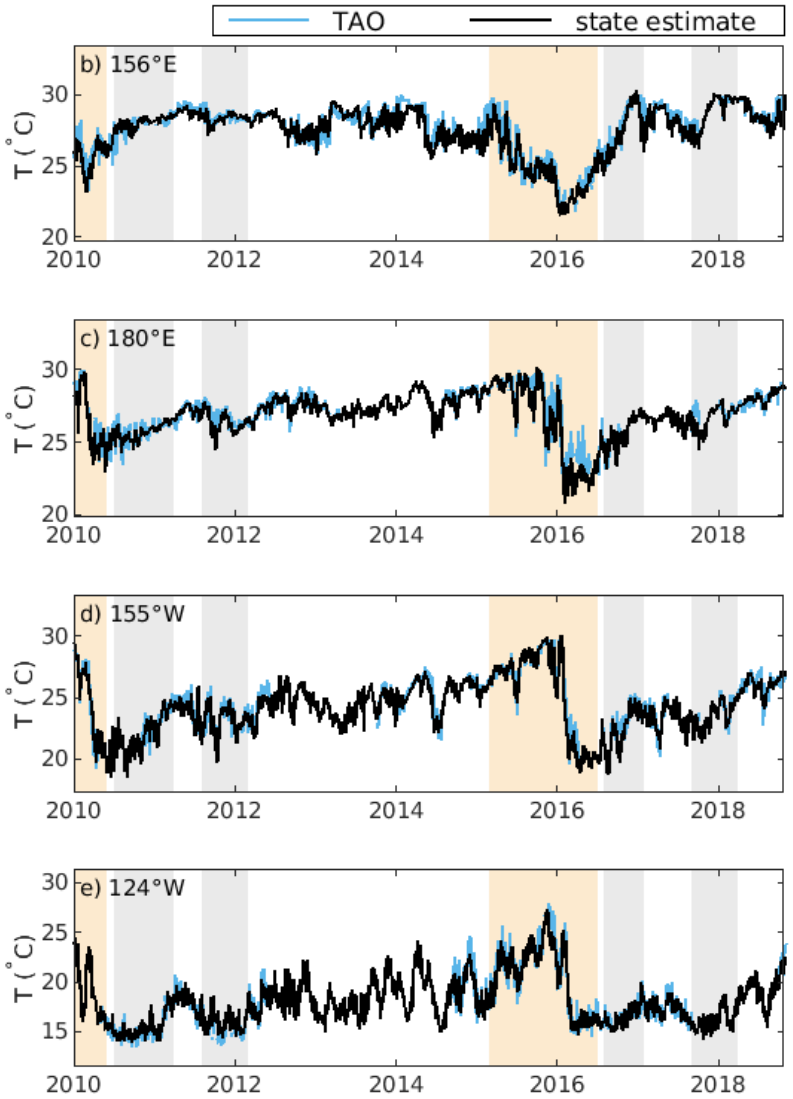
Nino3.4



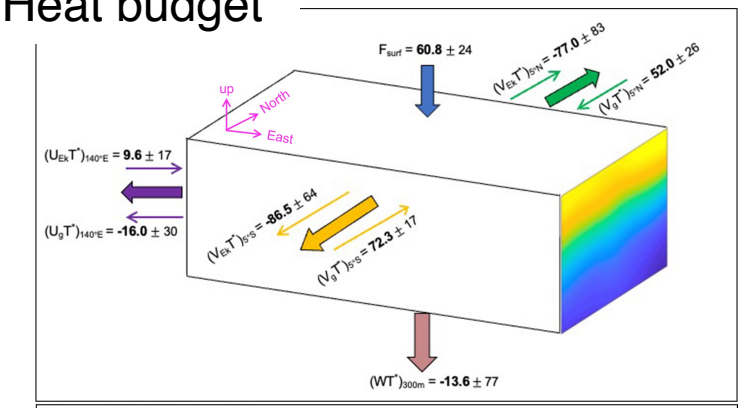
Good fit to observations

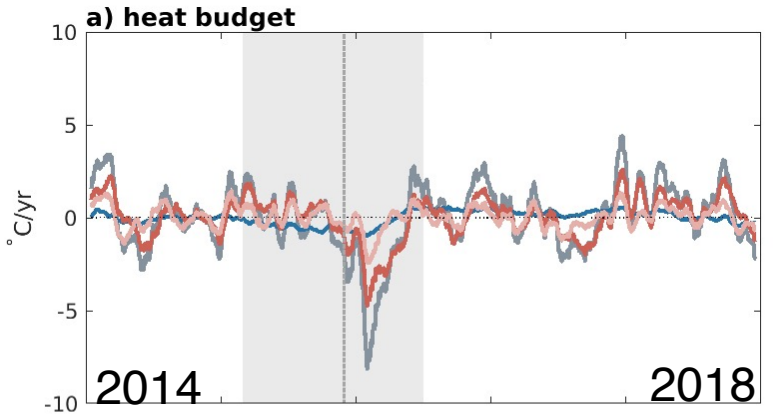
Tool for understanding T, S budgets variability during 2015/16 El Nino

100-m T from TAO moorings (independent data)



Heat budget

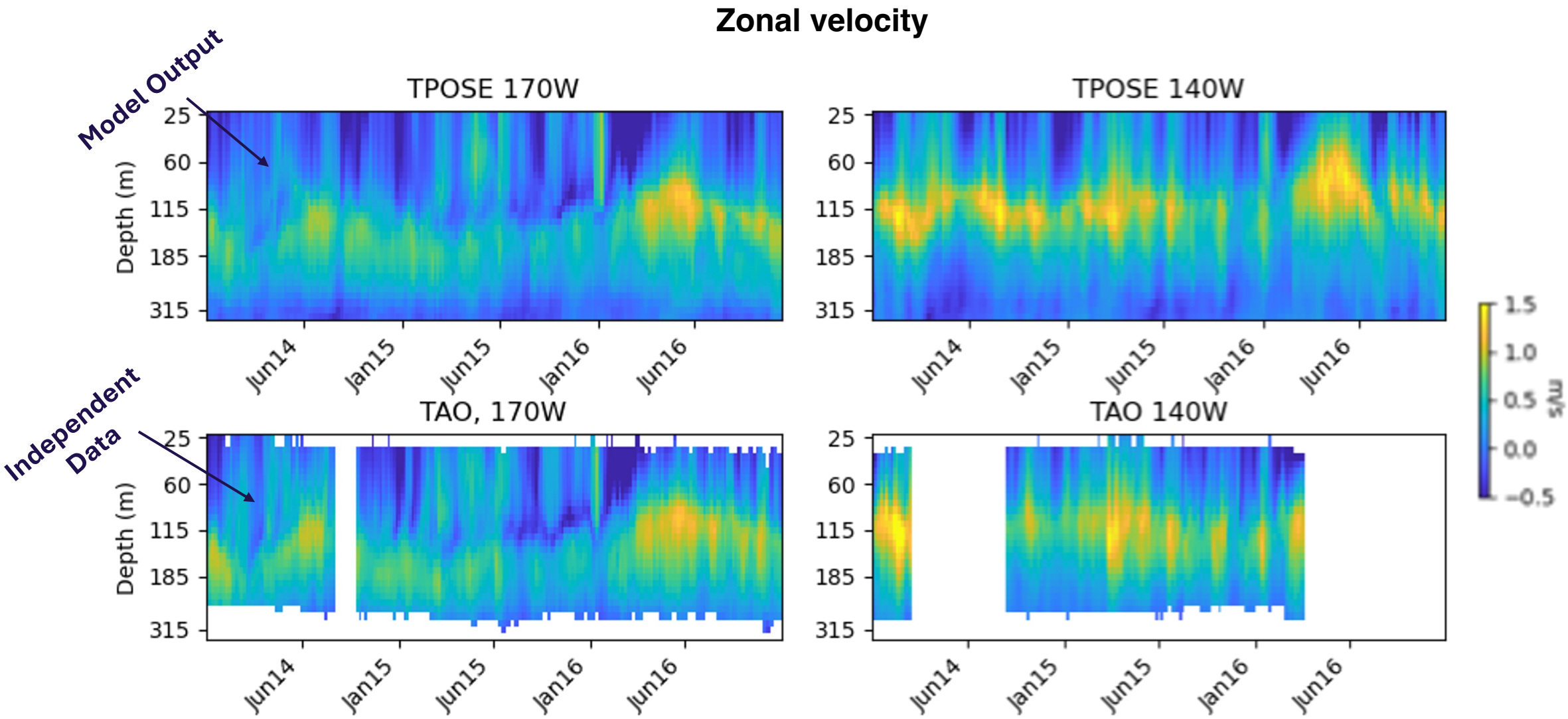




Verdy et al. (2023). **Balancing Volume, Temperature, and Salinity Budgets During 2014-2018 in the Tropical Pacific Ocean State Estimate**. JGR-Oceans

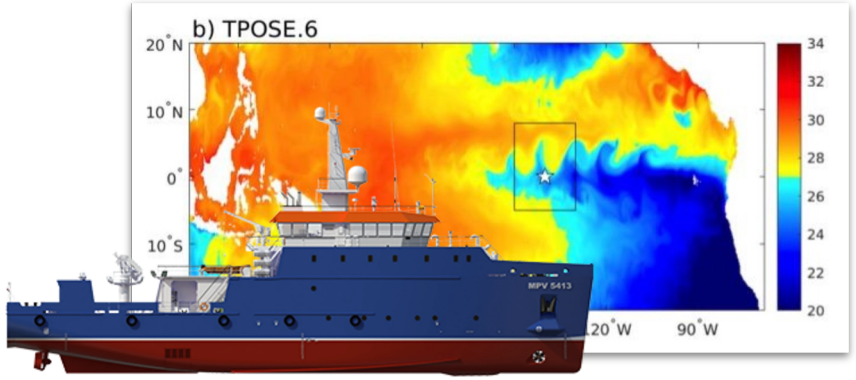
Tropical Pacific Ocean State Estimate (TPOSE)

Ellen Davenport, UCSD

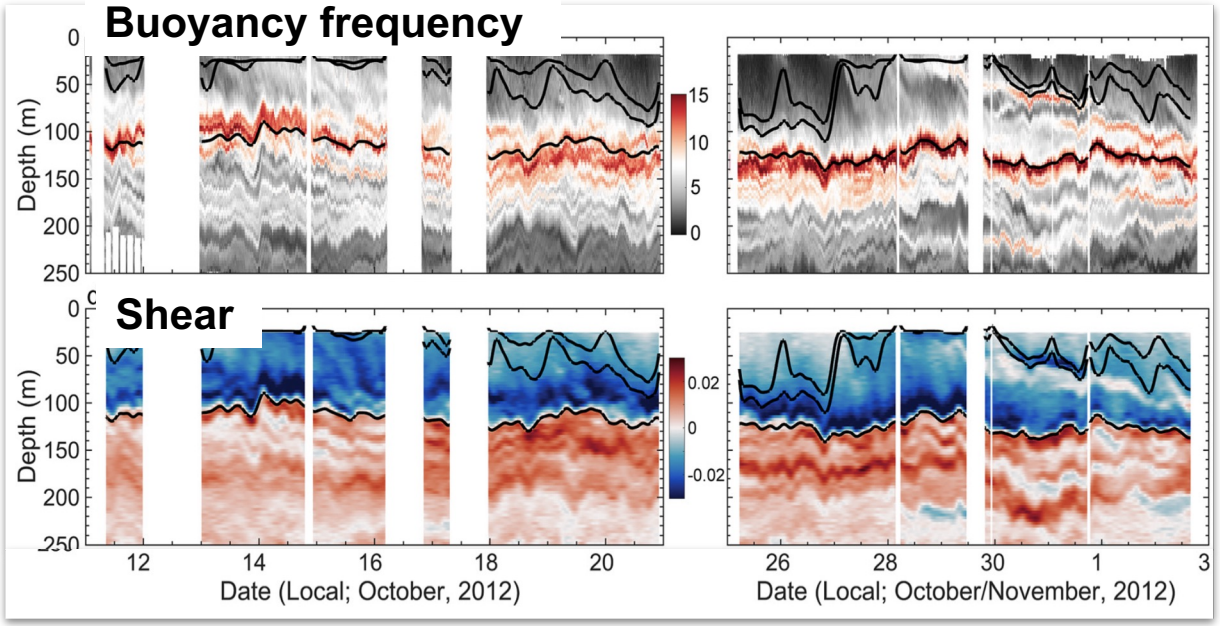


Tropical Pacific Ocean State Estimate (TPOSE)

Ellen Davenport, UCSD

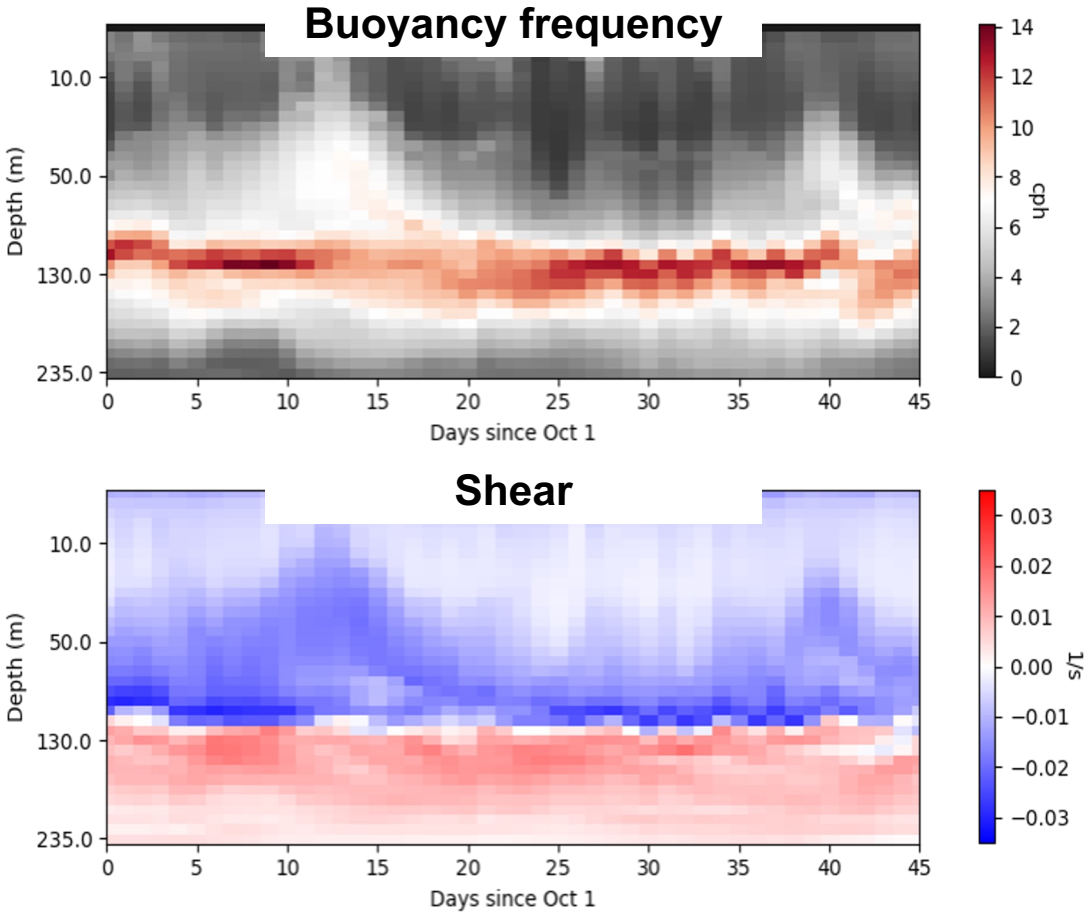


EquatorMix: 0°N,140°W, October 2012

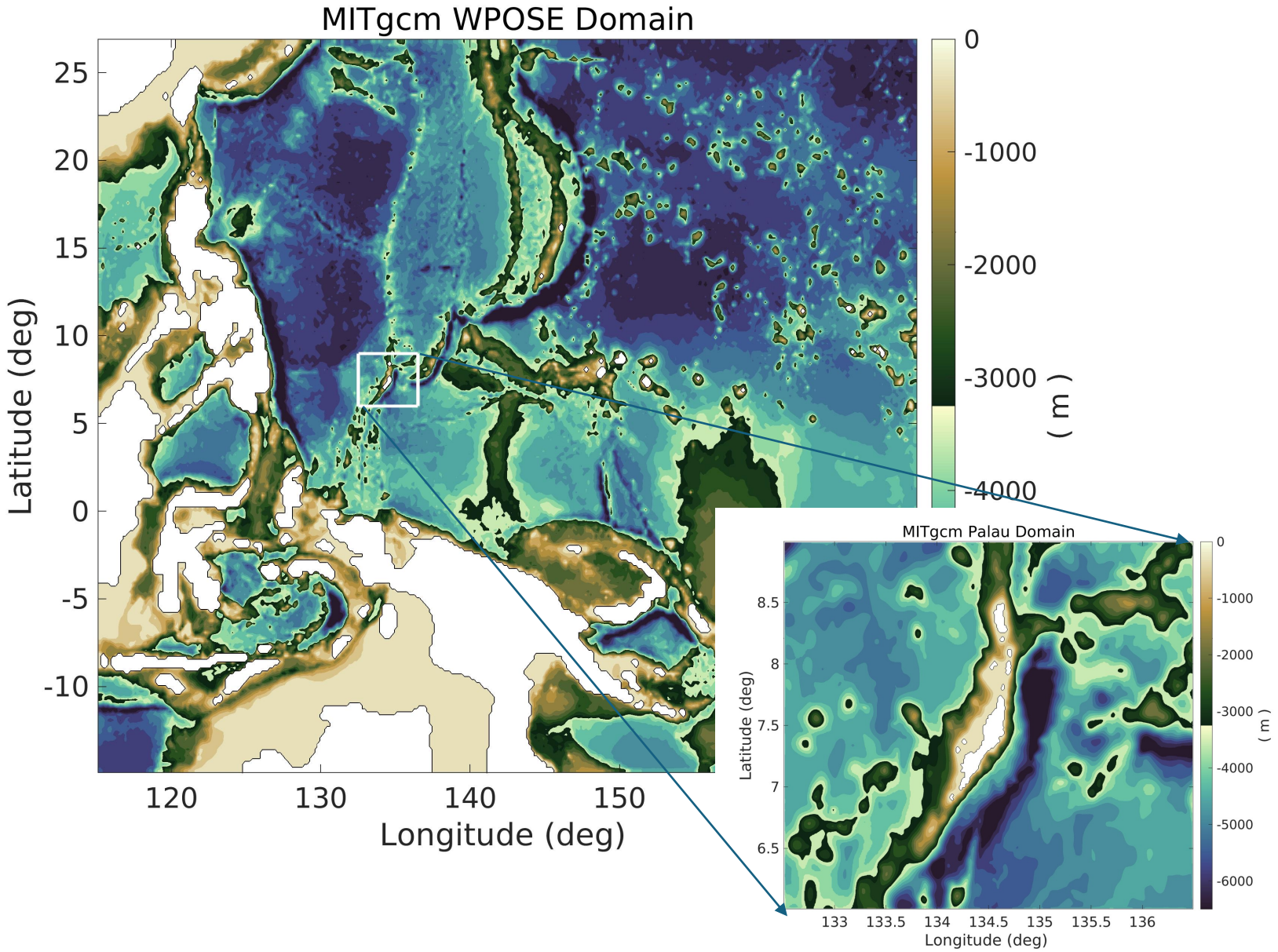


Pinkel et al. (2023) GRL

TPOSE: 0°N,140°W, October 2012



Northwest Pacific Ocean State Estimation



Towards nesting high-resolution models of Palau and Rota Islands

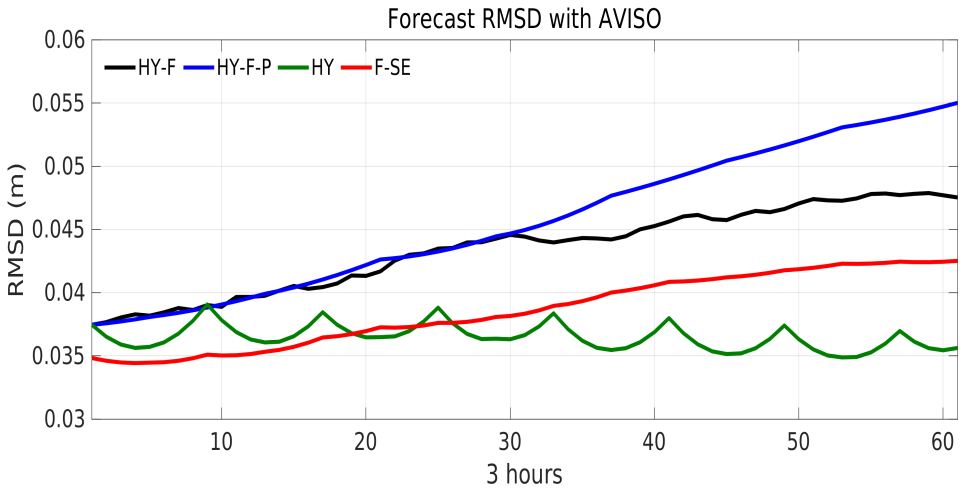
Northwest Pacific Ocean State Estimation

NWP model

Resolution: **1/6^0, 50 z-levels**

Obs: **SSH and SST**

Assimilation window: **7 days**



HYCOM persistence forecast

HYCOM forecast

State estimate forecast

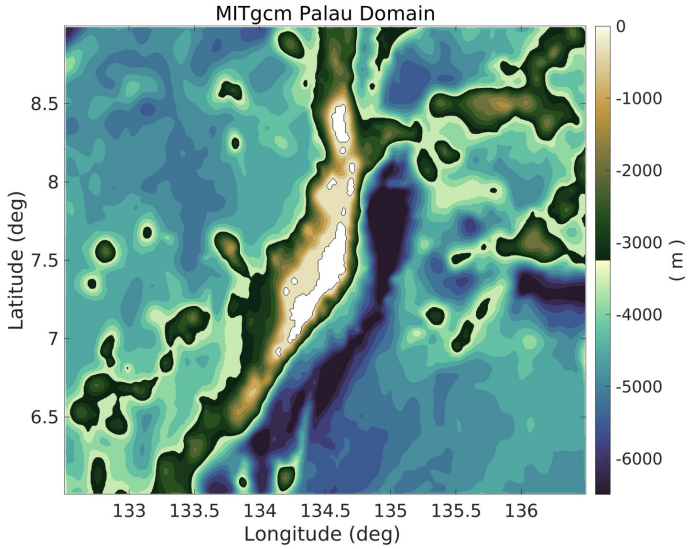
HYCOM analysis

Palau model

Resolution: **1/96^0 (~1 km), 50 z-levels**

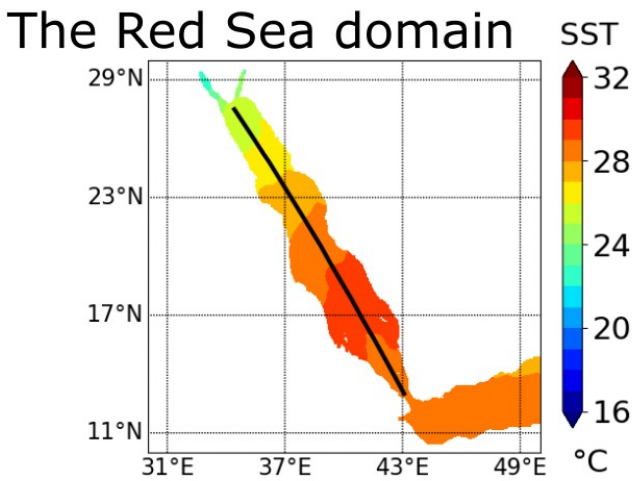
Obs: **HFR, moorings, wave gliders**

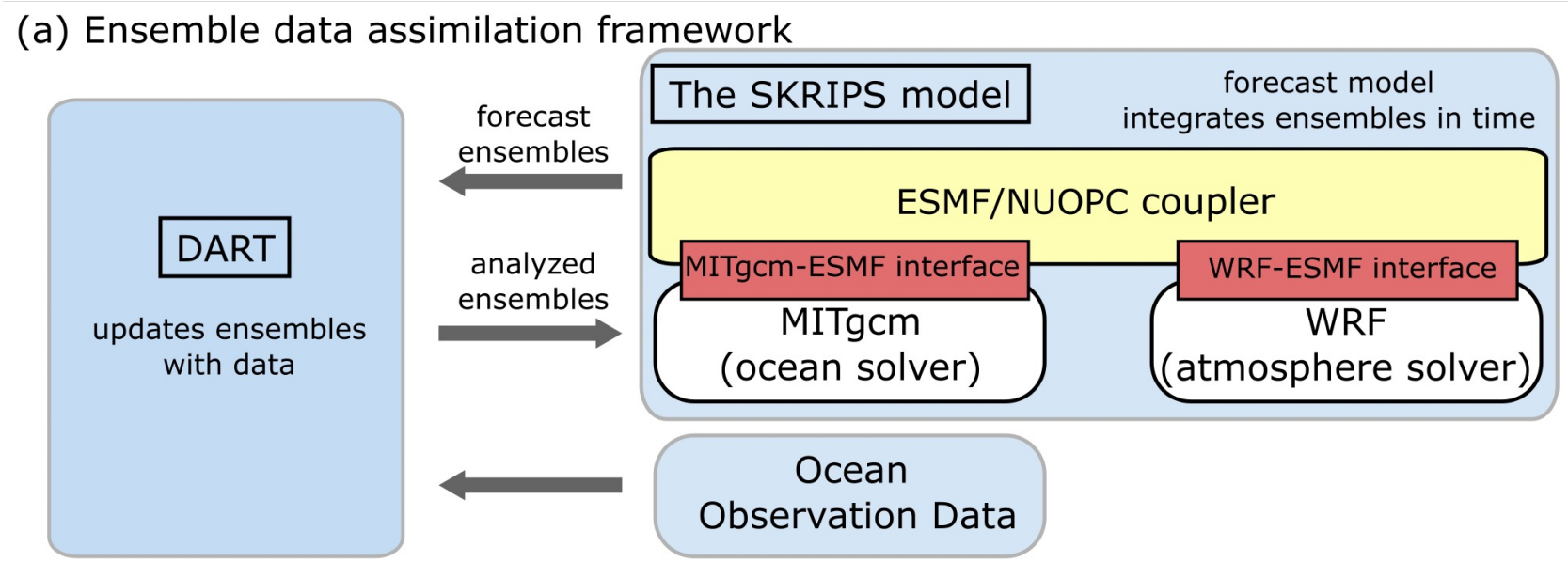
Assimilation window: **7 – 14 days**



Understand wind-current response around islands

Red Sea Coupled MITgcm-WRF





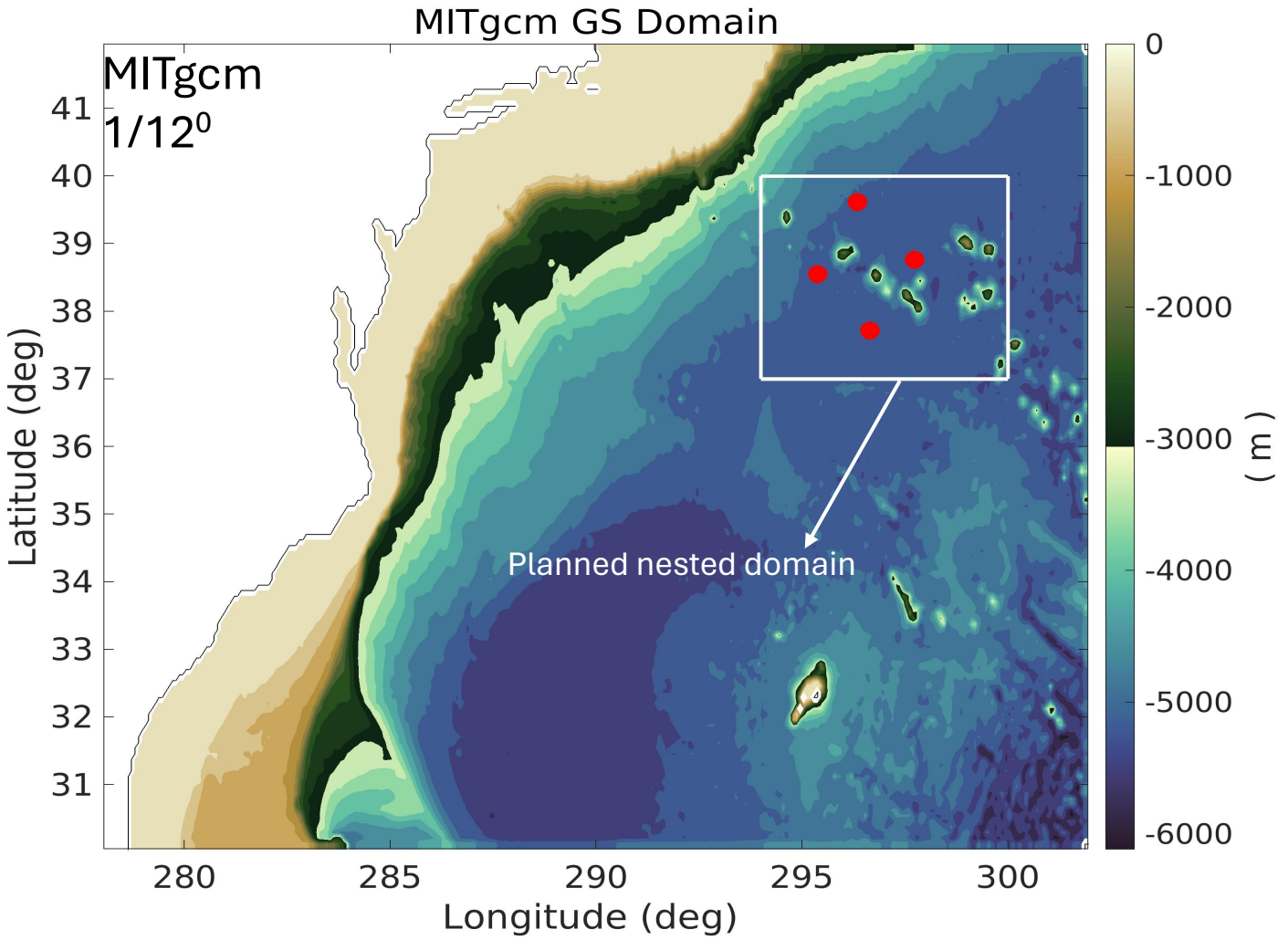
Evaluating the impact of ocean data assimilation on seasonal to sub-seasonal forecasts

Sun et al. (2024). **Enhanced Regional Ocean Ensemble Data Assimilation Through Atmospheric Coupling in the SKRIPS Model.** Submitted to Ocean Modelling

Gulf Stream State Estimation and Prediction

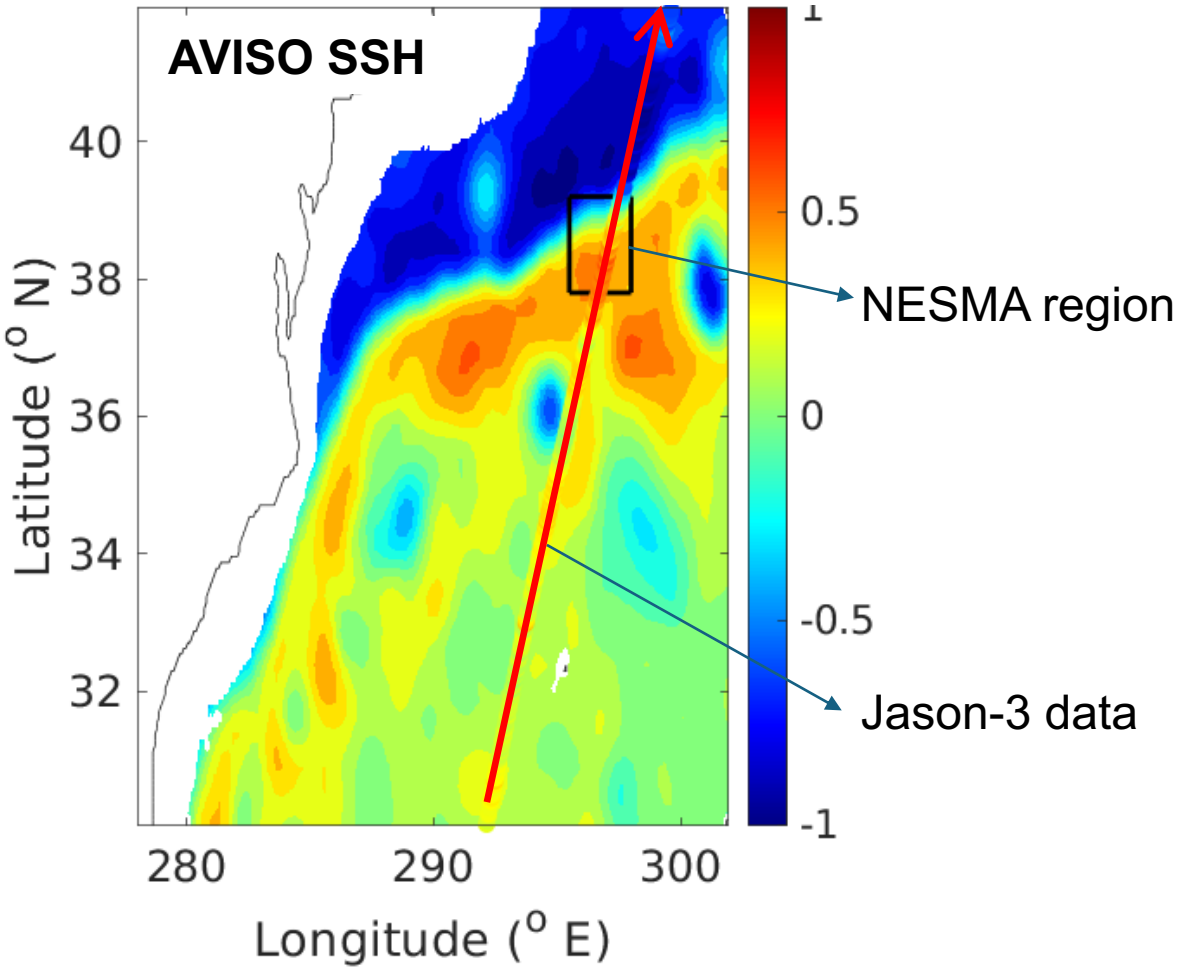
New England Seamounts Experiment (NESMA): understand sound propagation in the ocean. How does the Gulf Stream interact with a series of seamounts? Implications for how ocean transports heat and dissipates its energy.

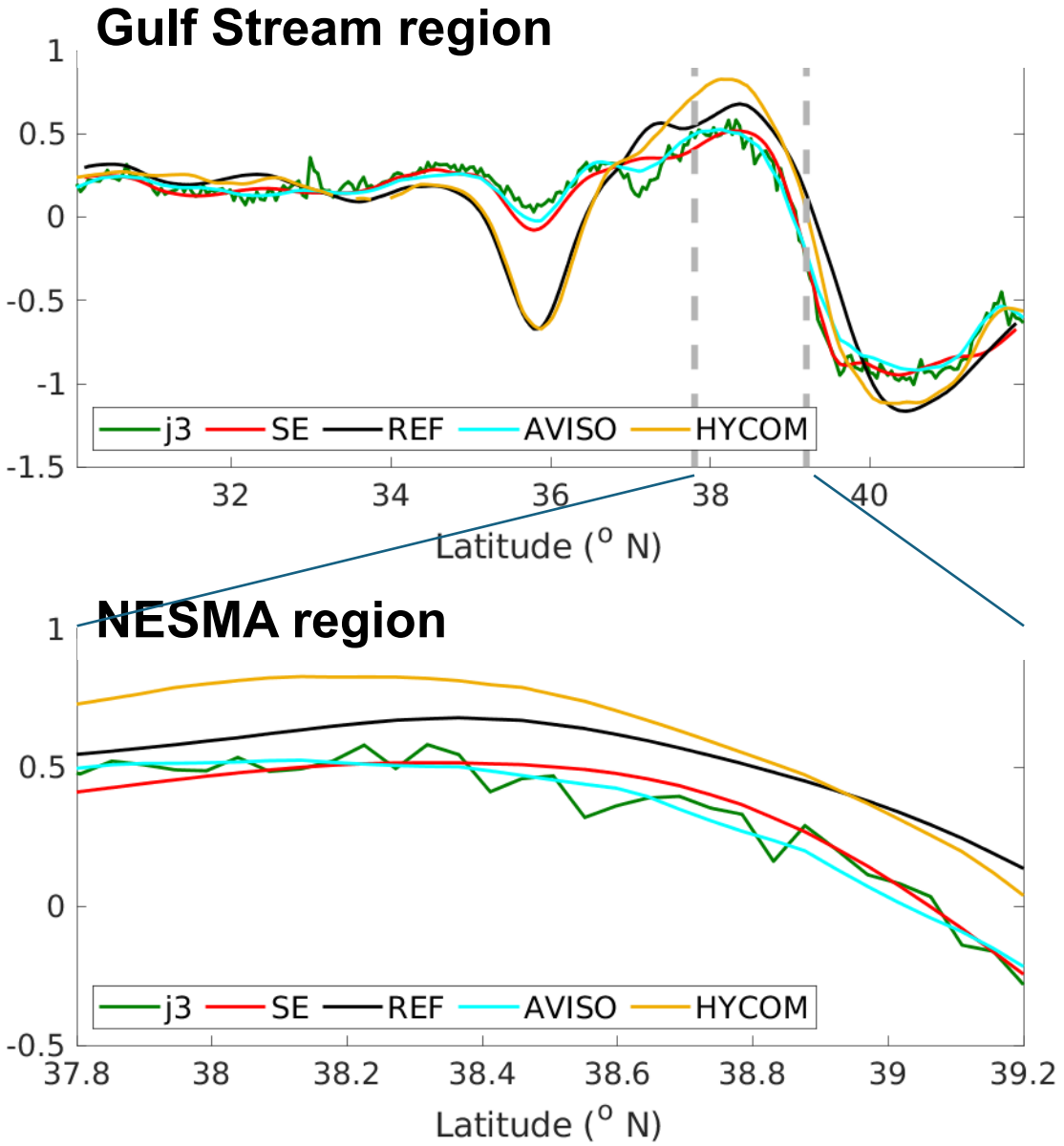
Assimilating acoustic data to improve physical state estimation in strong eddy field



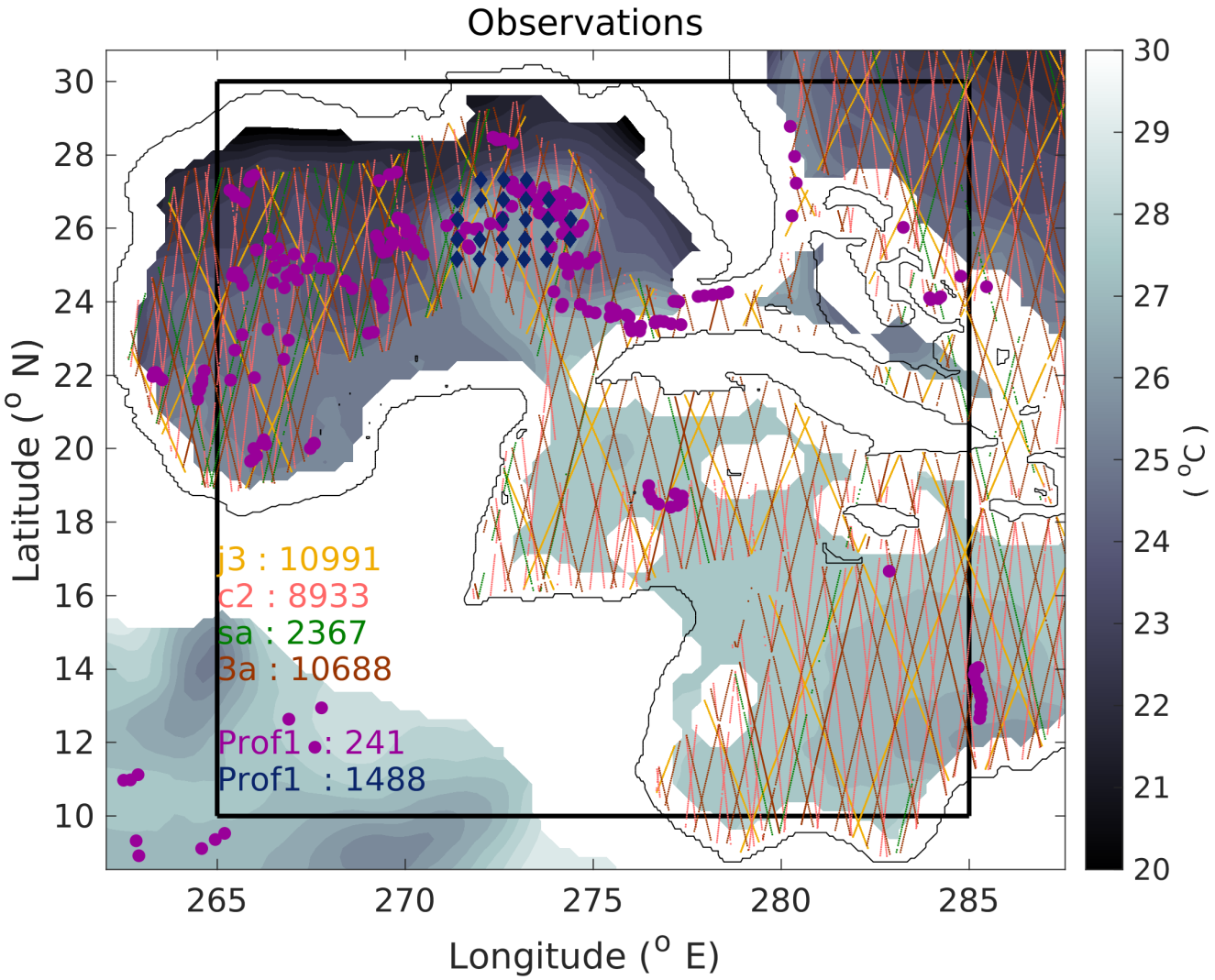
Gulf Stream State Estimation and Prediction

Jason-3 along-track comparison on May 2, 2023





Gulf of Mexico State Estimation and Prediction

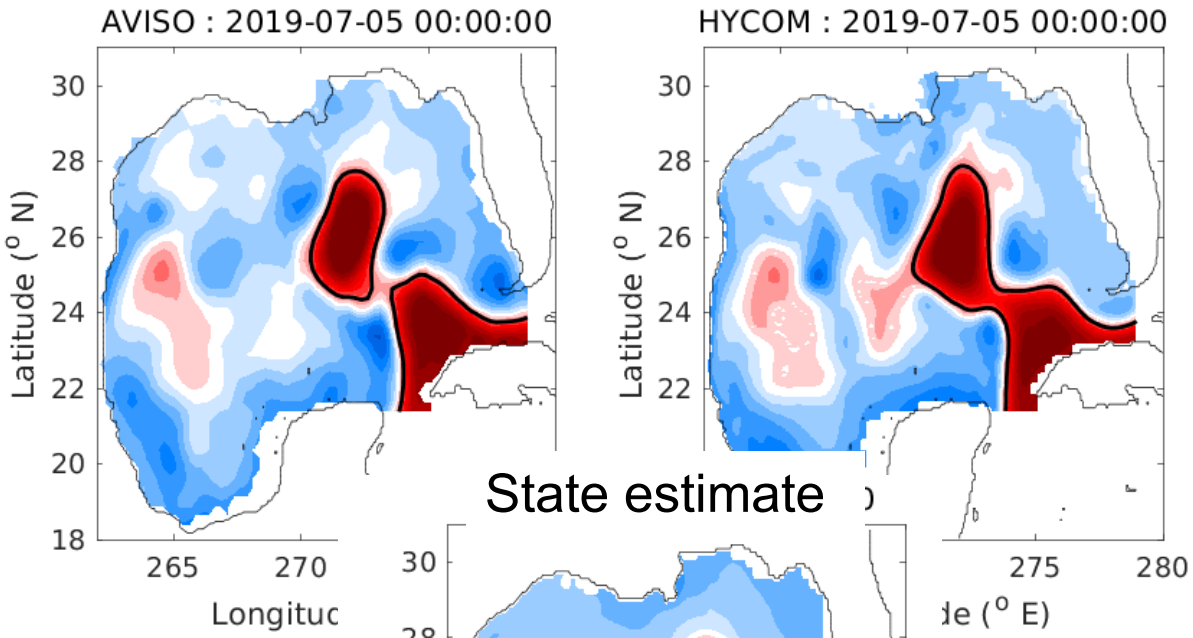


Observing system design for loop current analysis and prediction

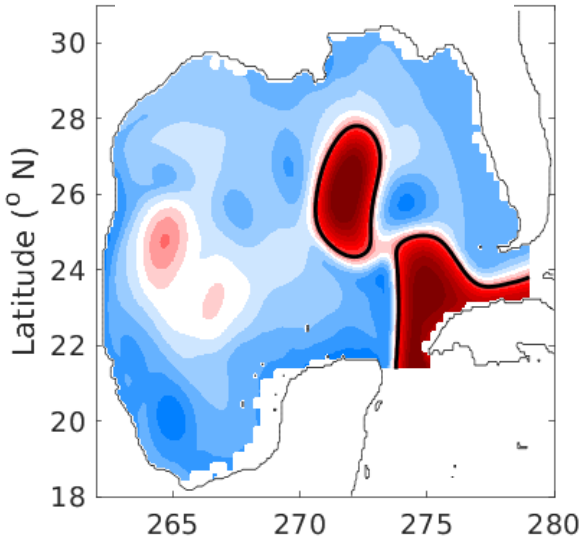
- SSH along-track anomalies
- Gridded OI-SST
- Argo program T/S profiles
- CPIES T/S profiles

Gulf of Mexico State Estimation and Prediction

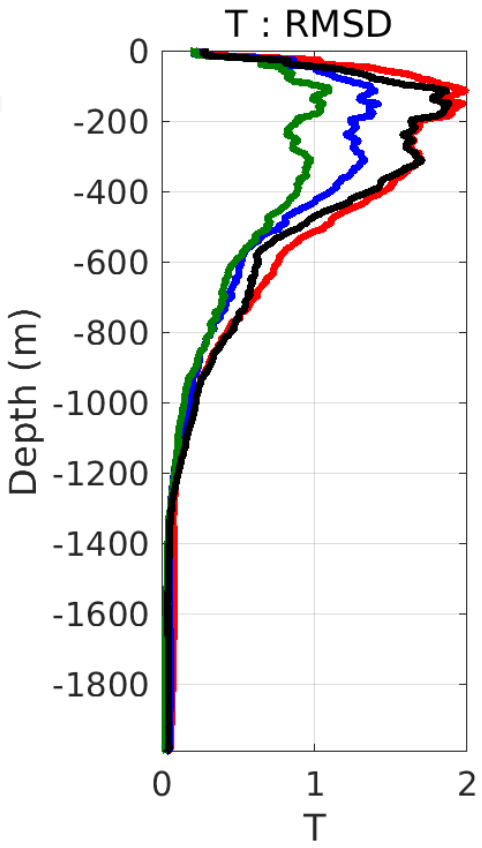
Loop current eddy separation event, 7/5/2019

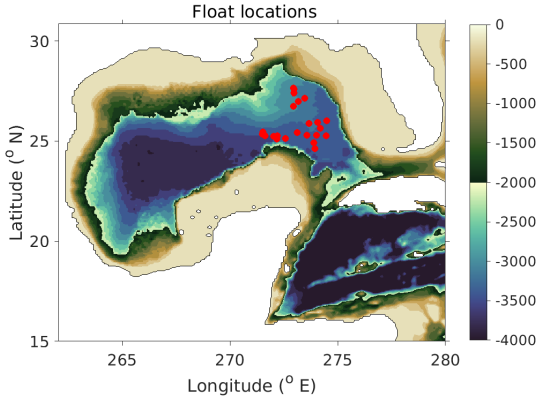


State estimate



Validation against WHOI-Argo floats (independent data)





Reference (HYCOM)

D1: SSH + SST

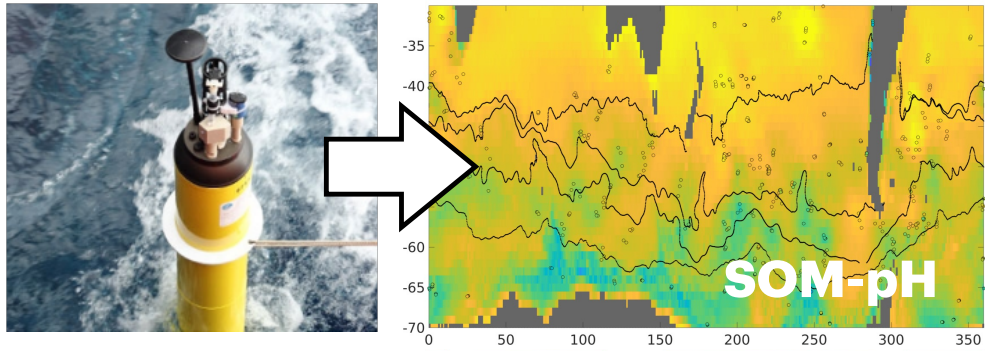
D2: SSH + SST + Argo T/S

D3: SSH + SST + Argo T/S + CPIES T/S

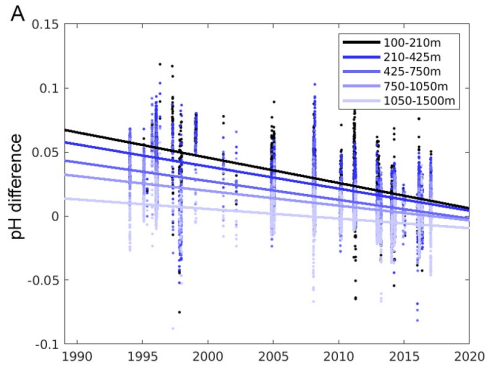
BGC-Southern Ocean State Estimate (B-SOSE)

Detecting ocean acidification trends by comparing pH observations to a bias-corrected B-SOSE climatology

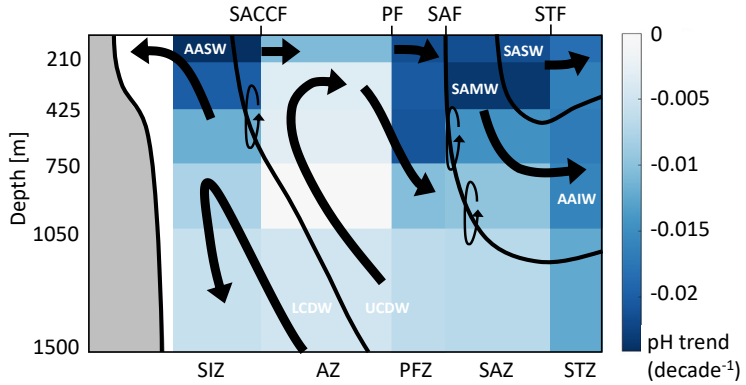
BGC-Southern Ocean State Estimate (B-SOSE)



1) we make a **bias-corrected pH climatology** [available at http://sose.ucsd.edu/] by removing the objectively mapped misfits between B-SOSE and bcg-Argo float data



2) we compare that pH climatology to ship data to **detect trends** (**up to -0.02 per decade**) in 5 frontal zones and 5 depths



3) we can explain the trends in the context of the meridional **overturning circulation**. Deep upwelling waters have the smallest trends (light blue); waters exposed to the atmosphere have the largest (dark blue).

Mazloff et al. (2023). **Southern Ocean Acidification Revealed by Biogeochemical-Argo floats**. JGR-Oceans

Output available:

ecco.ucsd.edu or contact us

We are always looking for more ways to engage with the ECCO community!

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