
WELCOME
DAY 10

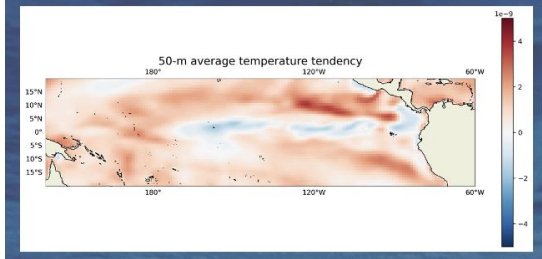
ECCOv4r5-Based Analysis of Cooling Trends in the Upper Tropical Eastern Pacific (CROCODILE)

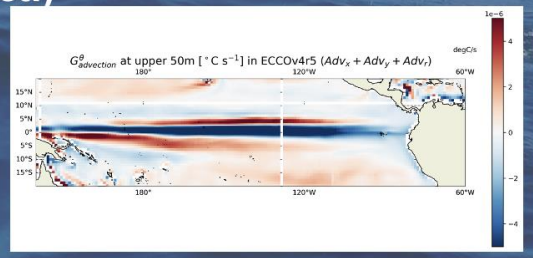
Feng Jiang, Andrea Mosso, Antonio Robles, Suman Shekhar, Zhangzhe Zhao

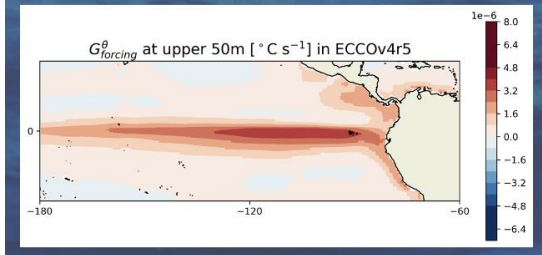
Tuesday Progresses!

- ✓ 1. The water properties of upper Pacific has been analysed.
- ✓ 2. Analyzing the Adjoint of the cooling of the Tropical Pacific
- ✓ 3. We have calculated the heat budget by using ECCO v4r5 (not closed yet!)

$$\frac{\partial \theta}{\partial t} = -\nabla \cdot (\theta \mathbf{u}) - \nabla \cdot \mathbf{F}^{\theta}_{\text{diff}} + F^{\theta}_{\text{forc}}$$





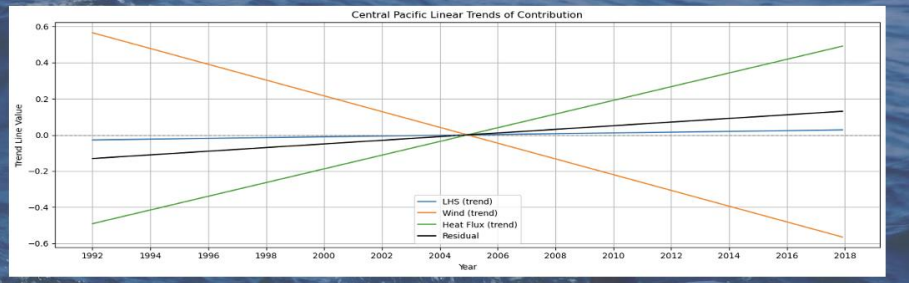


Advection term contributes to the decrease of 50m temperature; the forcing term plays an opposite role.

Today's Plan

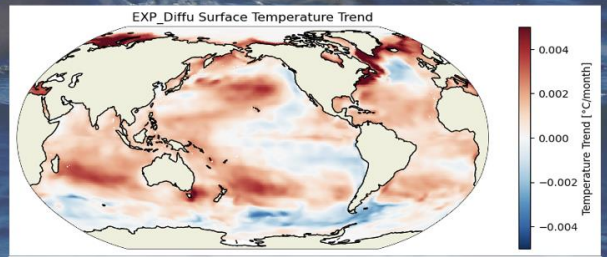
- ➔ Analysis sensitivity experiment output (Other experiment is running!)
- ➔ Try to do the budget closure!

EMU attribution tool

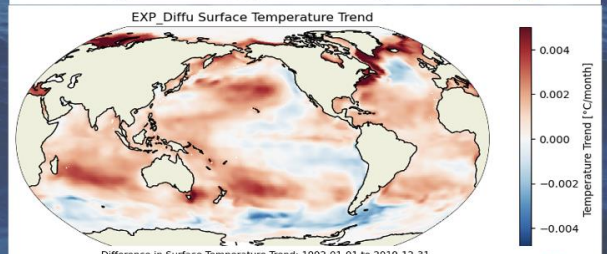


Sensitivity experiment

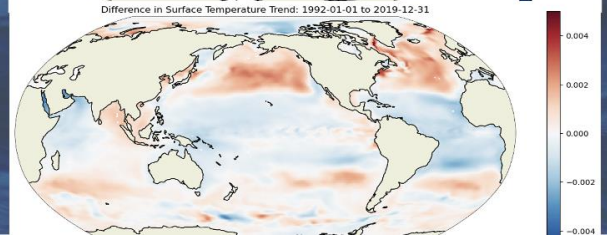
Reference



Half Vertical Diffusivity



Difference

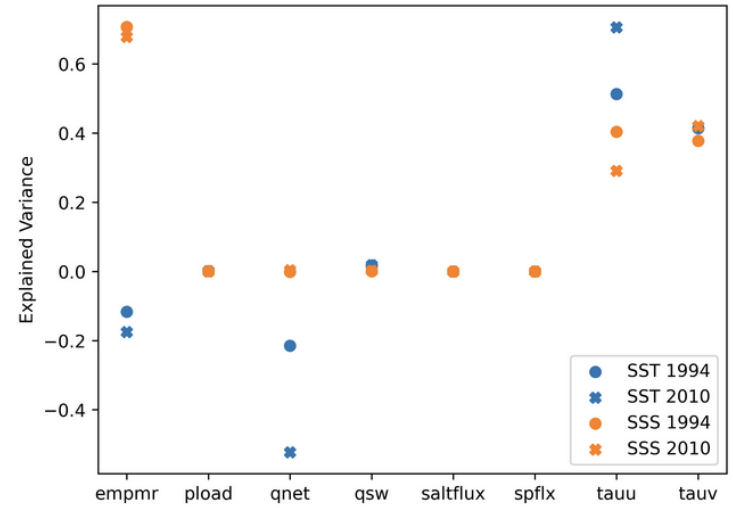


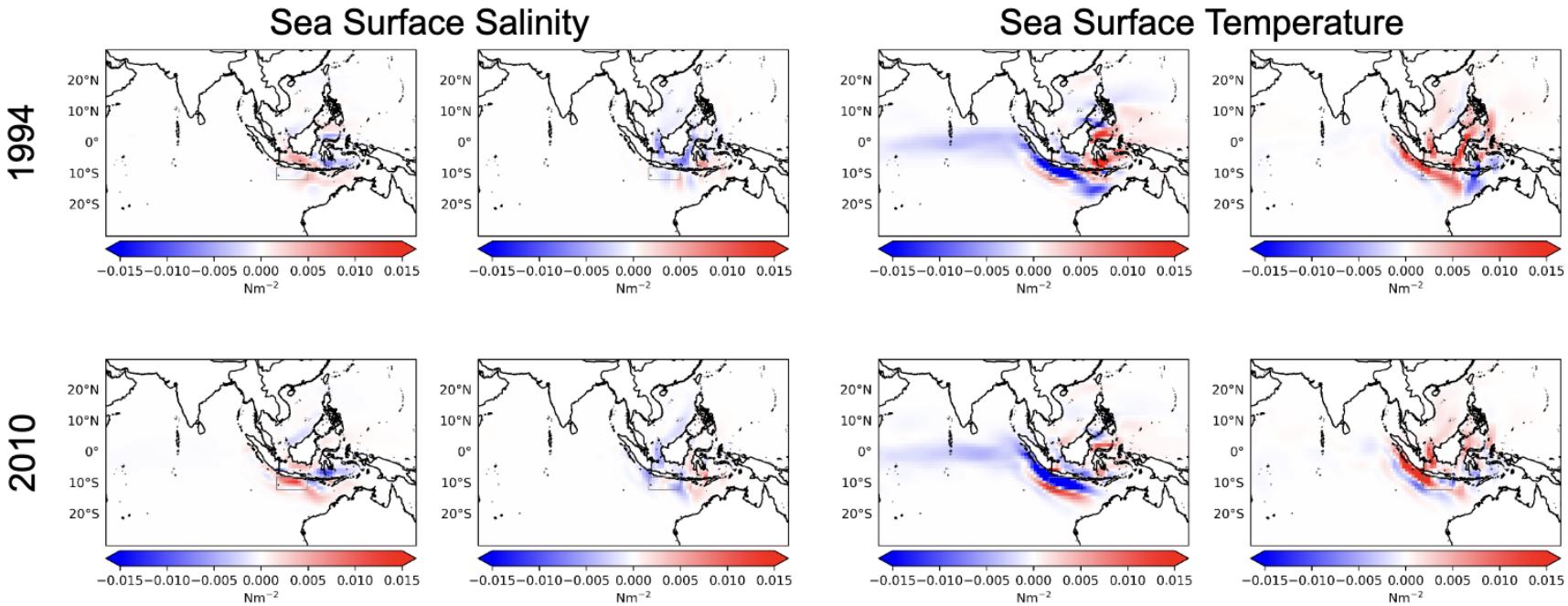
ECCO-UP

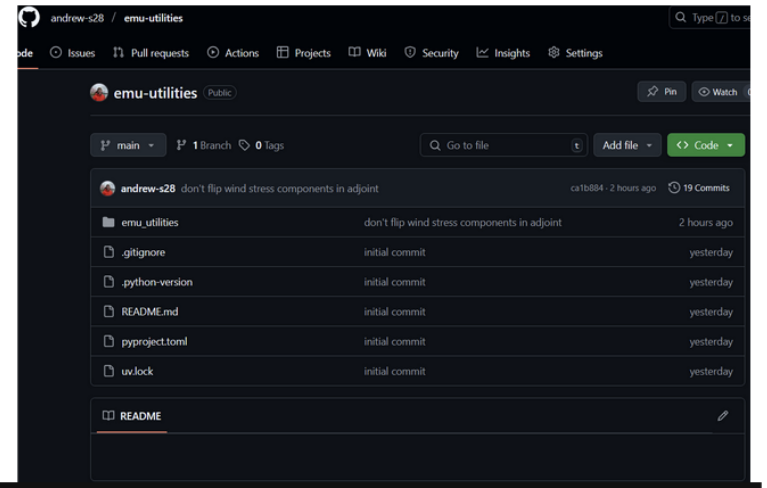
- Plotted and interpreted adjoint gradients and 1d convolutions
  - Wind stress important for both SST/SSS interannual variability
  - Spatial patterns quite similar between very different years
- Started an adjoint tracer run

To-do:

- Plot 2d convolutions
- Examine tracer results
- ???



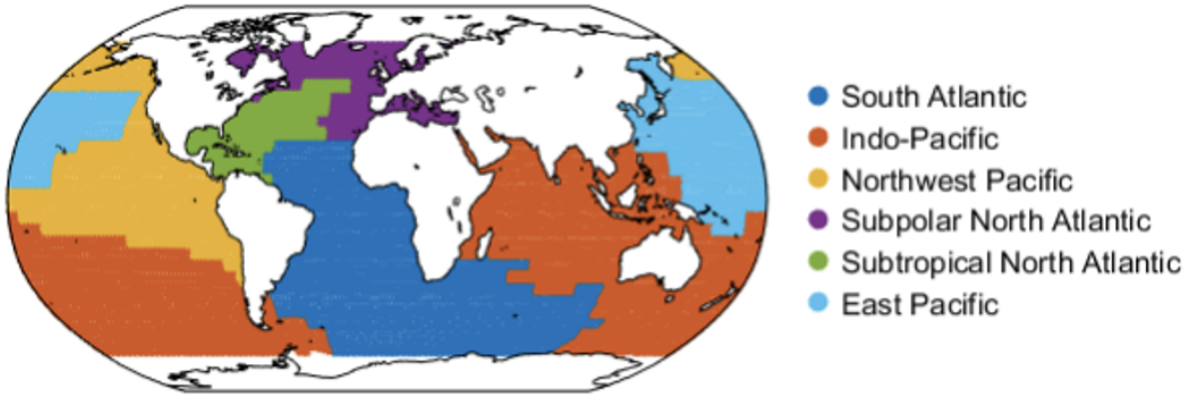





```
ds_conv_t_94 = convolution.load_1d_conv_gradient(SST_ADJ_T_94_PATH)
```

st**ER**ic **IN**vestigations **(ERIN)**: how well does ECCO capture the steric sea-level signal?

AIM: To compare the steric sea-level component from the ECCO model to that from the most recent global mean sea-level (GMSL) reconstruction [Dangendorf et al., 2024]



YDAYs PROGRESS:

- Subdivided into basins used in the reconstruction (originally from Thompson and Merrifield [2014])
- Spatial correlation for each individual region

South Atlantic	0.37
Indo-Pacific	0.69
Northwest Pacific	0.98
subpolar North Atlantic	0.68
subtropical North Atlantic	0.91
East Pacific	0.94

PLAN:

- Look at areas where the correlation is worse? – boundary currents? SA basin?
- Interpretation of existing figures for presentation
- Reading to assess probable causes of the discrepancies

FLOW
First Learn tO Walk

Karina Ramos Musalem, Noah Rosenberg

Project goal: Do a small state estimation by building on Budyko-Sellers proof of concept

Wednesday 5-28 Status

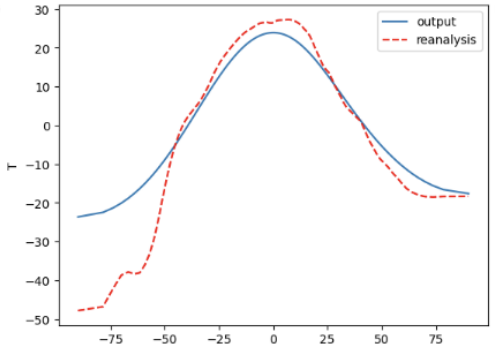
- Added Emissivity as a control
- Implemented L-BFGS (Noah) and migrated to python
- Added Wolfe constraints and adjusted stepping to get faster convergence
- Continued to implement time dependence in order to target solar cycles (Karina)

Next Steps:

- Figure out how to target temperature in time-dependent setup
- Scale up problem
- Add in covariances to get smoother controls varying with latitude
- Clean up and comment on Jupyter notebook

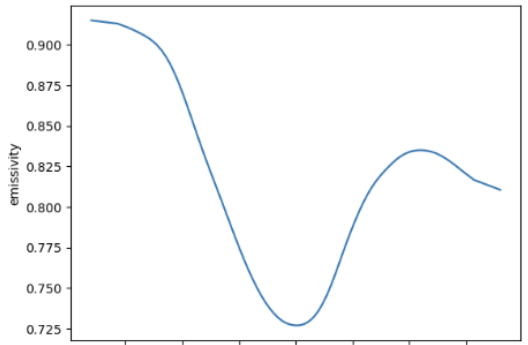
BFGS

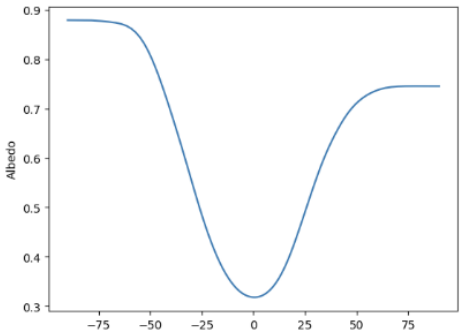
```
Cost function at step 1: 199.63853454589844
Cost function at step 2: 199.61865234375
Cost function at step 3: 87.78445434570312
Cost function at step 4: nan
```



L-BFGS

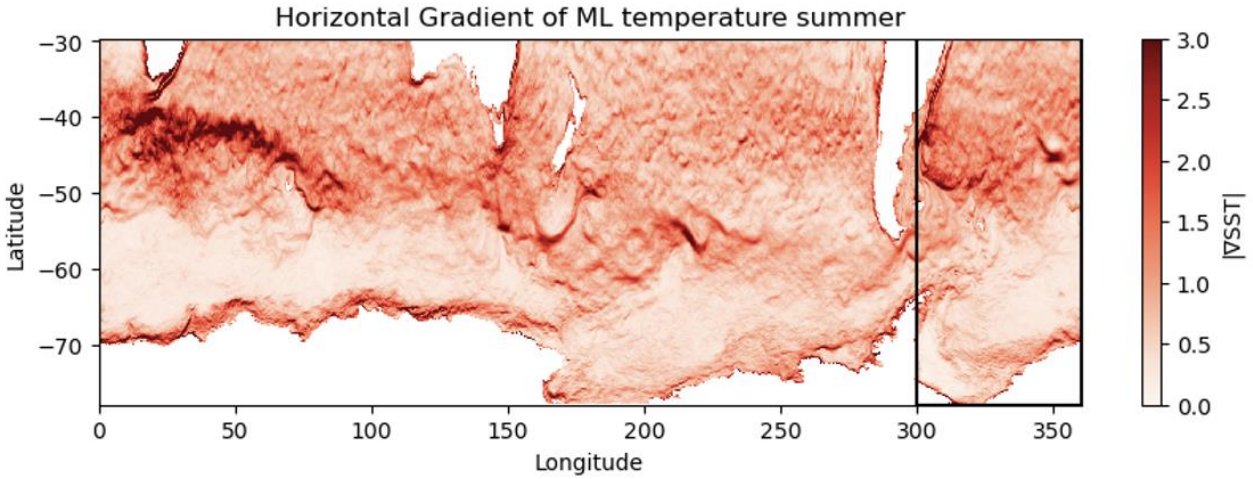
```
Cost function at step 1: 199.45089721679688
Cost function at step 2: 201.53704833984375
Cost function at step 3: 73.8036880493164
Cost function at step 4: 80.10093688964844
```





Anna Lo Piccolo

Frontal **T**ransport of Tracers in the Southern Ocean (**FRONT**)



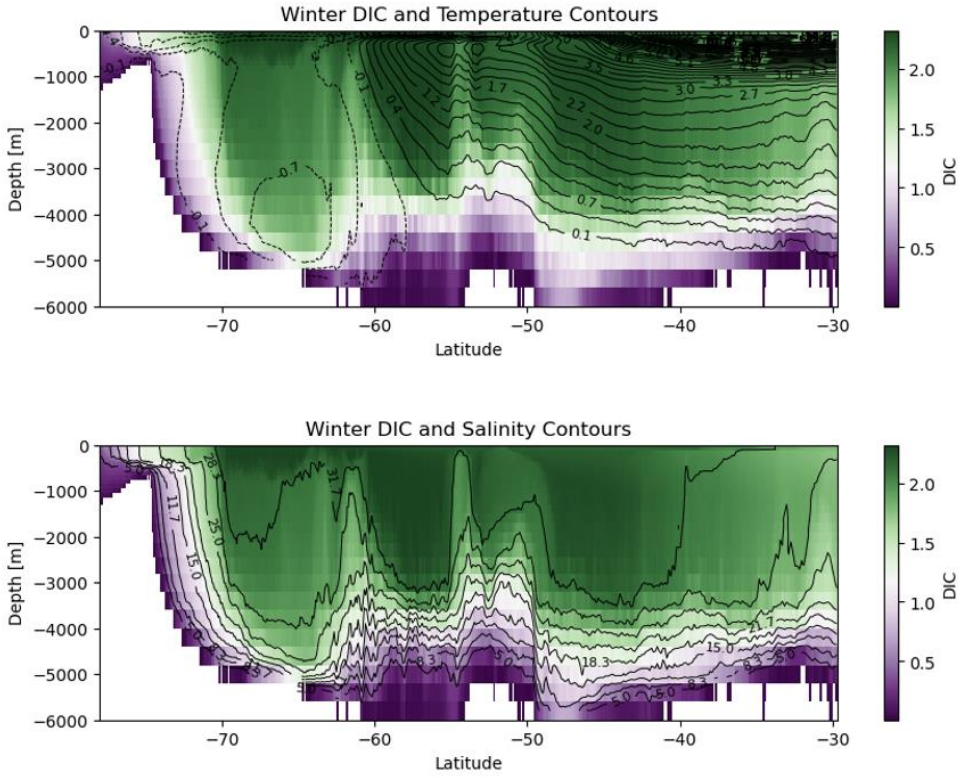
B-SOSE 156 iteration 1/6 degree

Evaluated magnitude of fronts:

- Climatology of MLD
- Horizontal gradients of temperature and salinity in the ML fronts
- Defined climatology, then distinguished summer and winter

Meridional distribution of DIC in the Atlantic sector:

- Only started
- Some things I don't understand
- Seems to correlate with salinity
- Still working on this



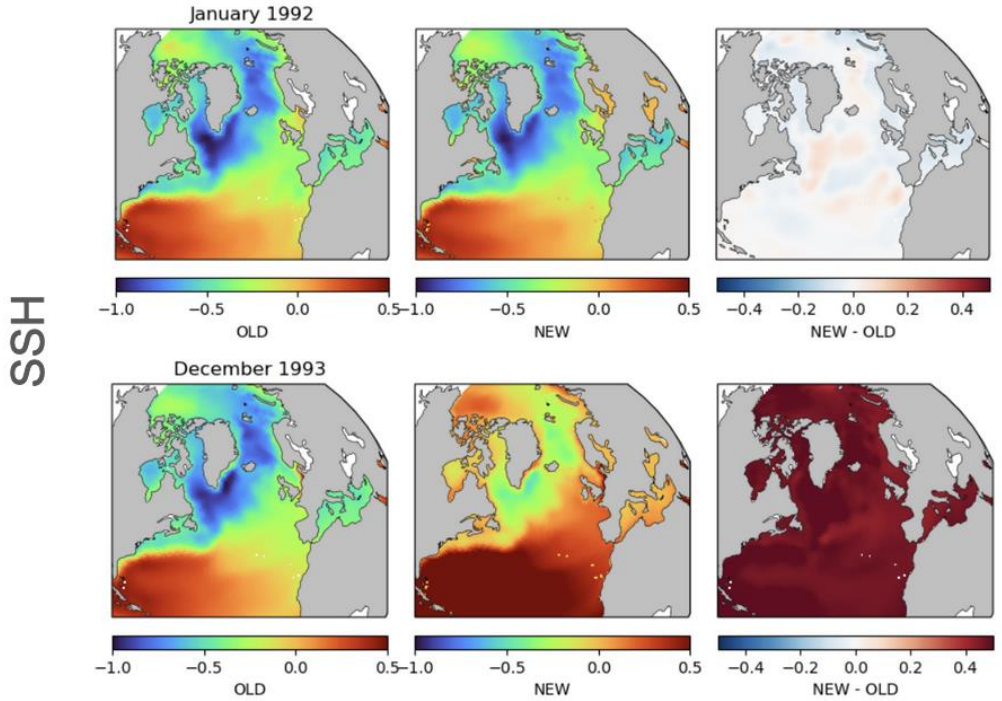
Plan for today:

- Map DIC at different depths all Southern Ocean basin
- Analyze advective and diffusive transport of DIC from diagnostics
- Distinguish mean and eddy component → effect of fronts?

ICEUP

Iceberg **C**ontribution for **E**CCO **U**pdate and **P**erformance

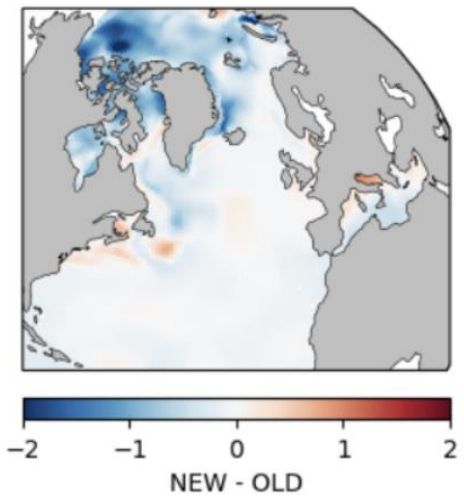
- I want to run all 30 years of ECCOv4r4 with my new runoff file
- Yesterday I did some test (2 years run of ECCOv4r4)
  - i found some mistakes…



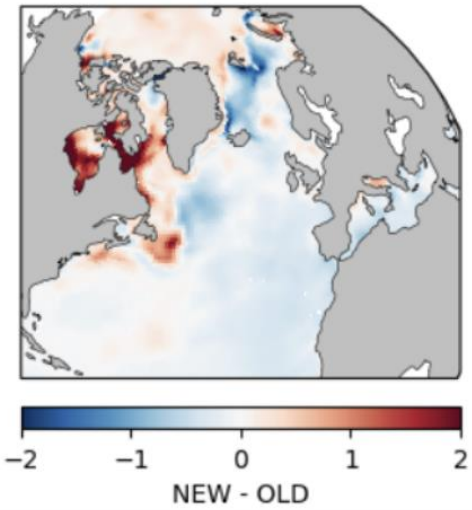
- I fixed the mistakes!

Results 1.5 years in to simulation, August

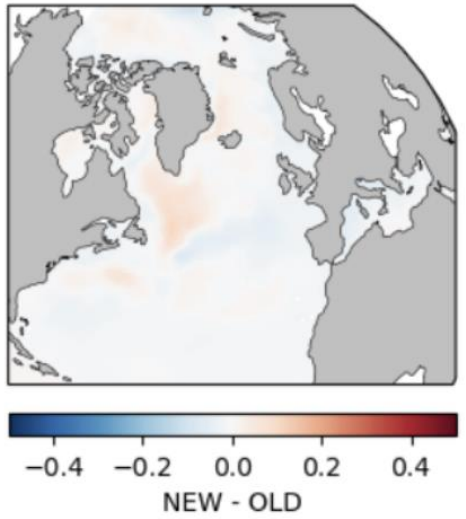
Salinity (new-old)



Temperature (new-old)



SSH (new-old)



Mackenzie Freshwater Layers Uncover River Runoff-Ice Evolution (McFLURRIE)

Marie Zahn, Cara Williams, Oceanne Bousquet, Mike Wood

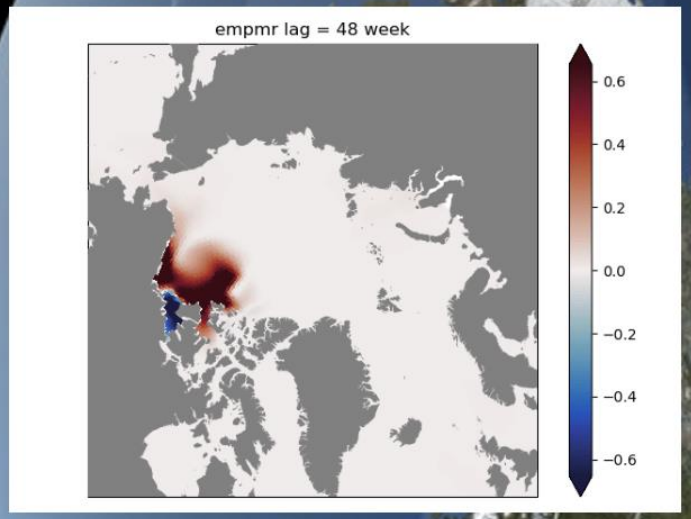
Yesterday:

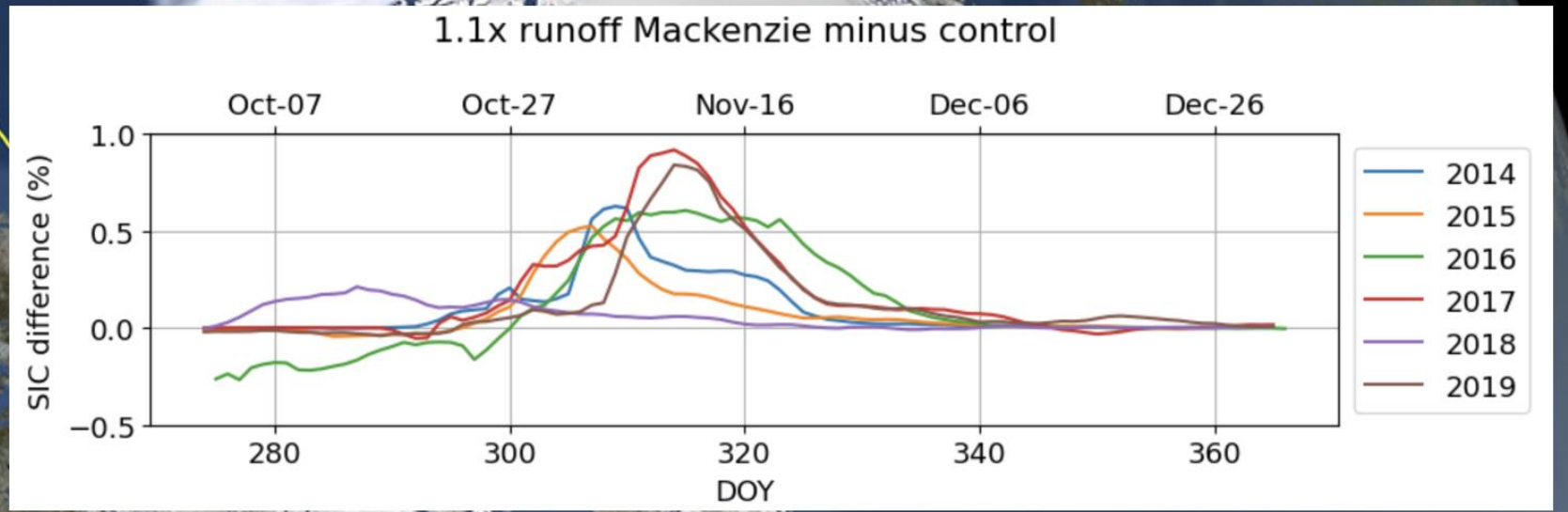
- Looked at adjoint sensitivities of salinity near the mouth of the Mackenzie river
- Looked at the change in salinity, sea ice area, sea ice thickness
- Ran a convolution of salinity at the mouth of the Mackenzie river

Today:

- Plot up and understand the convolution results
- Look into ocean heat content and stratification changes between runs
- Start planning out our presentation

2015 EMPMR sensitivity





Physical Processes Impacting Regional Sea Level (PISeaL)

Yueyang Lu, Odilon Houndegnonto

- Sea level partition: manometric (η_m) and steric (η_s) components:

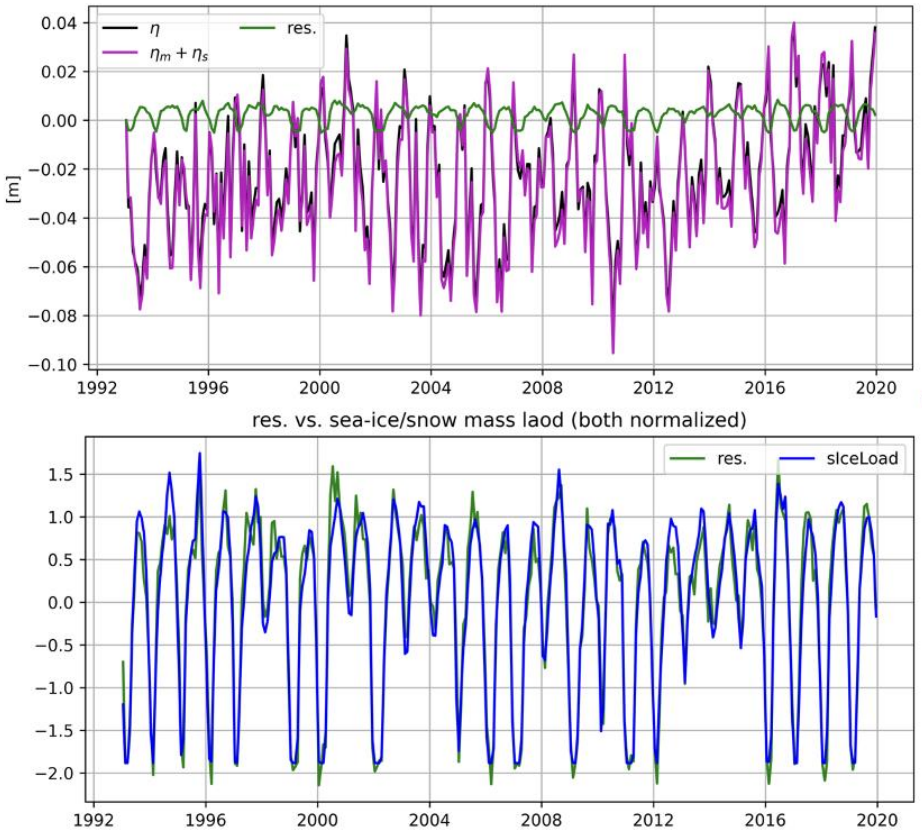
$$\eta = \frac{p_b}{\rho_0 g} - \frac{1}{\rho_0}\int_{-H}^{0}(\rho - \rho_0)\,dz^* + \boldsymbol{res}\,(?)$$

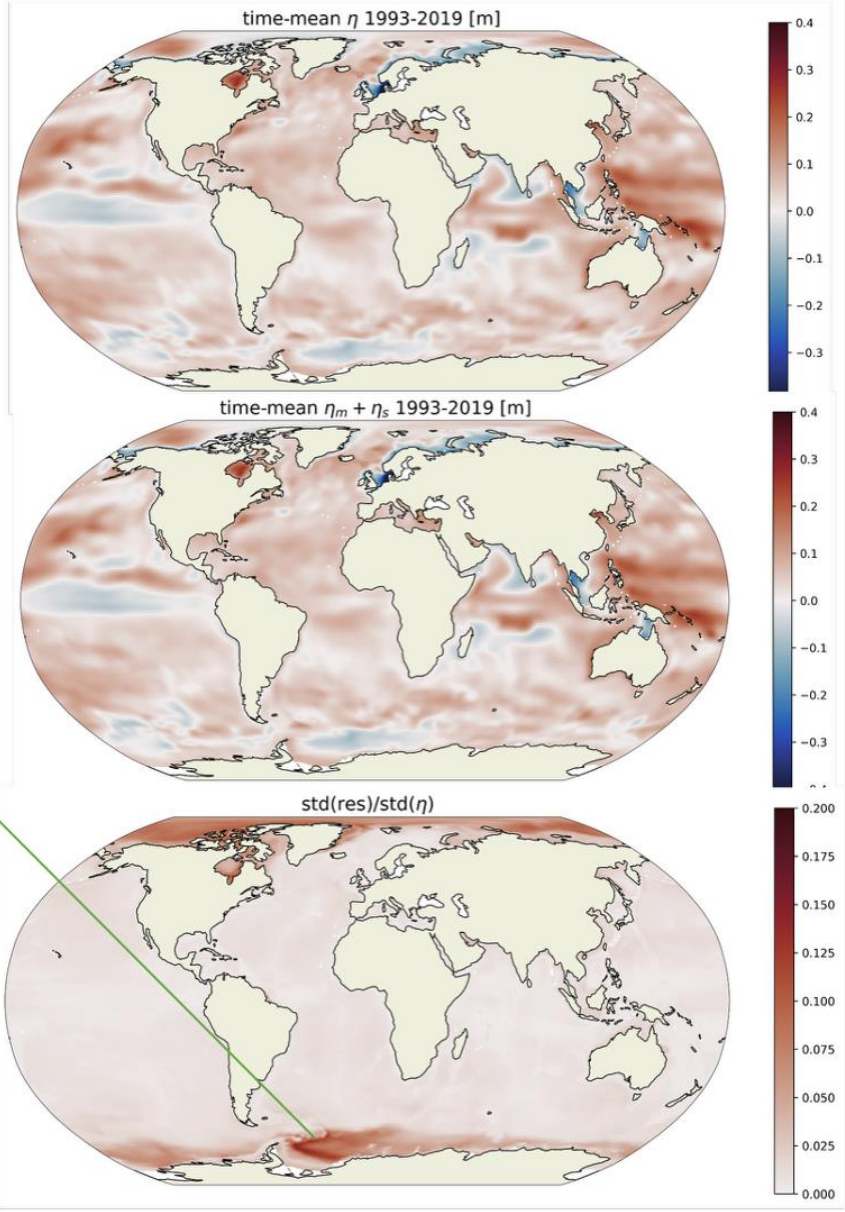
Progress:

- Identified that the **residual** is linked to sea ice evolution and its impact on the sea level

Next steps:

- To add the corresponding correction to the sea level decomposition





PUFFIN: DeeP Western BoUndary Current Flux and Forcing MechanIsms iN ECCO

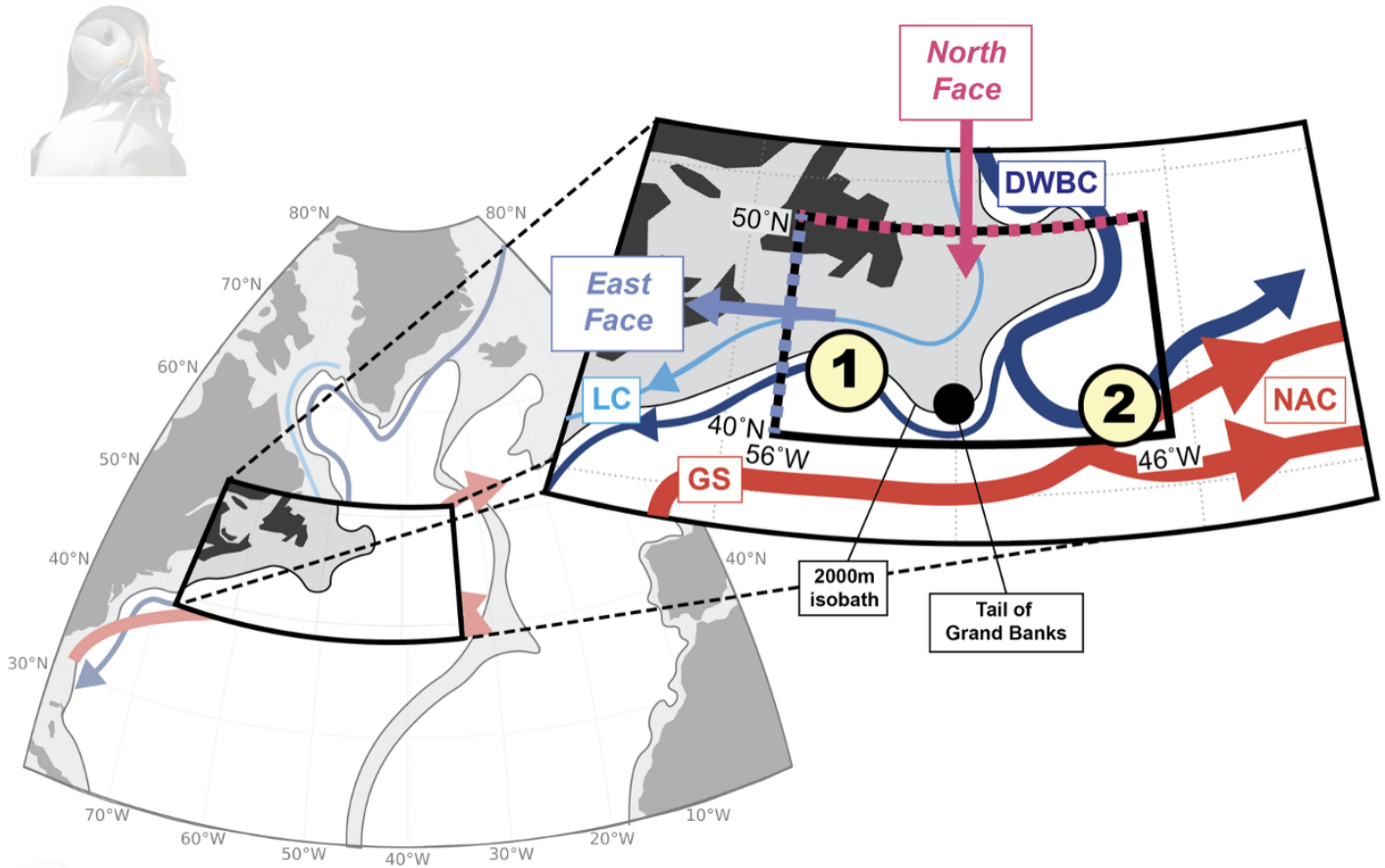
✅ **Spent some time thinking & visualizing…**

- How does the DWBC look in ECCO near the Tail of the Grand Banks?
  Choose TGB control volume and calc flux values, match with lit. values ✅
- As it rounds the TGB the DWBC bifurcates; a portion is advected eastward with the NAC, and a portion continues southward onto the Scotian Shelf. Do we see this in ECCO?
  DWBC Flux balance around TGB ✅
- How much of the variability of DWBC flux onto the Scotian Shelf (across the East Face) is explained by the variability of the DWBC flux upstream of the TGB?
  Correlation between north and east faces, EMU attribution tool ✅
- What mechanisms drive the variability in DWBC volume transport? Do these vary between the North and East faces?

EMU adjoint tool → **Today!** 💖🦦🤓

(If there's time…)

- How does the DWBC in the ECCOv4r4 compare to the one in ASTE? → **Today?**



Lilli Enders May 28

SASSIE inspired Heat Budget of the Arctic Ocean (SHEBA)

Ali Siddiqui,
Marie Zahn

Evaluate the heat budget of the Arctic ocean using ECCOv4r5 and SASSIE ECCO LLC1080

Week 2, monday

- Closed the heat budget in ECCOv4r5 using previous notebooks.
- Unsuccessful as of last night to store data in efs_ecco/asiddiqu

Week 2, tuesday

- Success at storing heat budget terms in netcdf in efs_ecco/asiddiqu.
- Success at Heat budget closure in LLC1080 using Marie's notebooks and started looking at Arctic budget terms in v4r5.
- Caveat that surface mass corrections for linear surface conditions and missing non local KPP term lumped with residual
- ~~Perform a reynolds decomposition for the advectiom term in v4r5 and play around with different control volumes in the Arctic~~

Week 2, wednesday

- Store LLC1080 budget terms in efs_ecco/asiddiqu
- Finally some science!
- Play around with different control volumes in the Arctic and compare the two model runs.

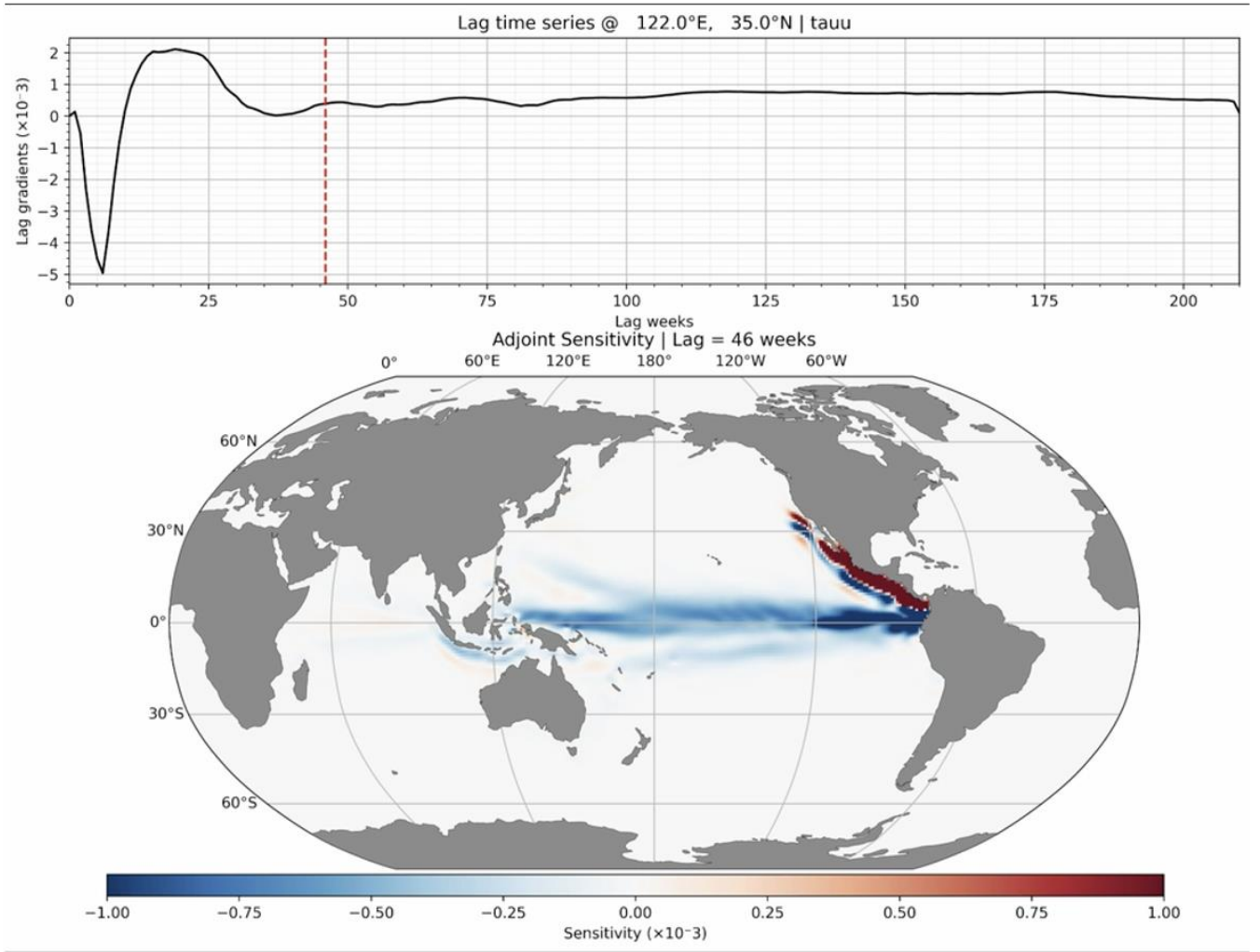
May 28th, 2025

Adjoint Sensitivities & Heat/Volume Budgets in ECCO for RegionaL Investigation Over the California Current System (SHERLOCCS)

PROJECT UPDATES; MAY 27

SUMMARY; MAY 27

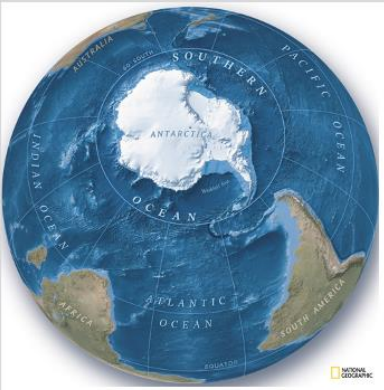
- Starting push scripts and notebooks to GitHub!
- Obtained more adjoint gradients for SST anomalies over model domain!
- Visualized sensitivities to different forcings



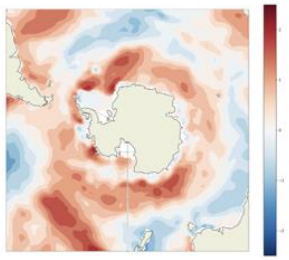
THE PLAN; MAY 27 –May 28

- Analyze adjoint sensitivity run results (surface & subsurface)
- Run some perturbation experiments!
- Organize GitHub page: describe research question & approach, document progress

Caeli Griffin, Anthony Meza, & Yue Wu



SO-WARM: **S**outhern **O**cean - extreme **W**arm event **A**nalysis of dynamical **F**orcing and i**M**pacts



Objectives:

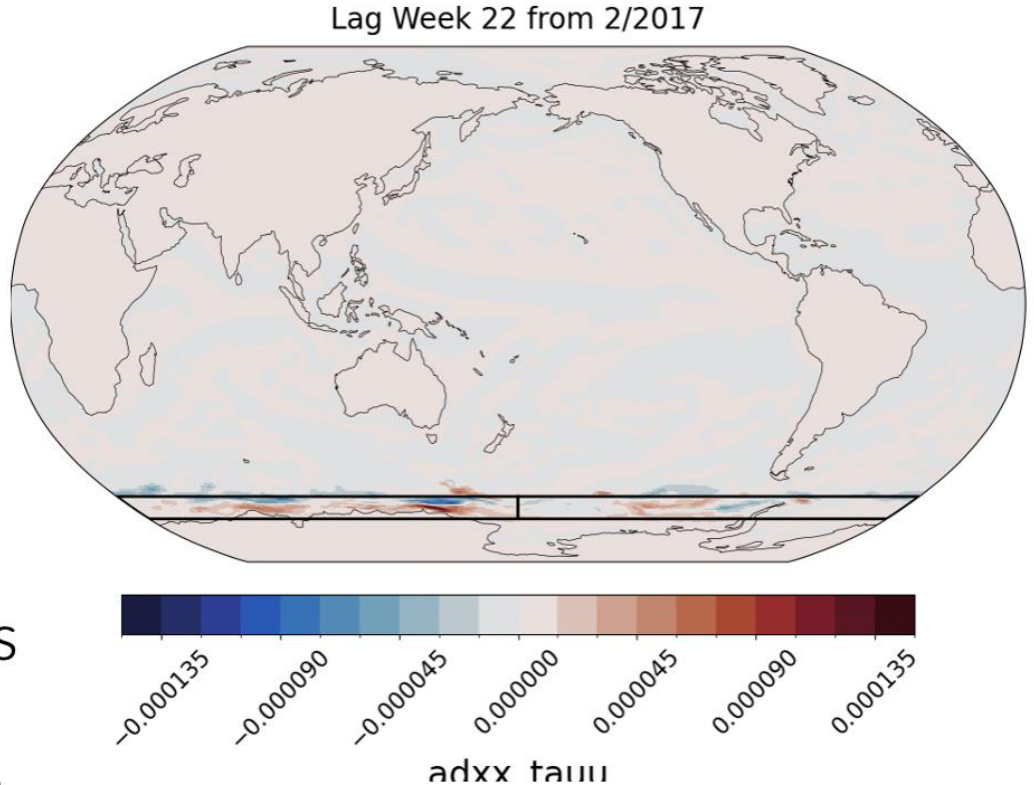
Dynamics and impacts of strong summer 2017 MHW in SO (Dec 2016- Feb 2017)

Progress:

1.Adjoining surface experiment (0-50)
2.Adjoining subsurface experiment (200-500m)

Next:

1.Assess Ocean Heat Content/stratification/windstress anomalies (1992-2017)
2.Analyse uniform windstress perturbation experiment

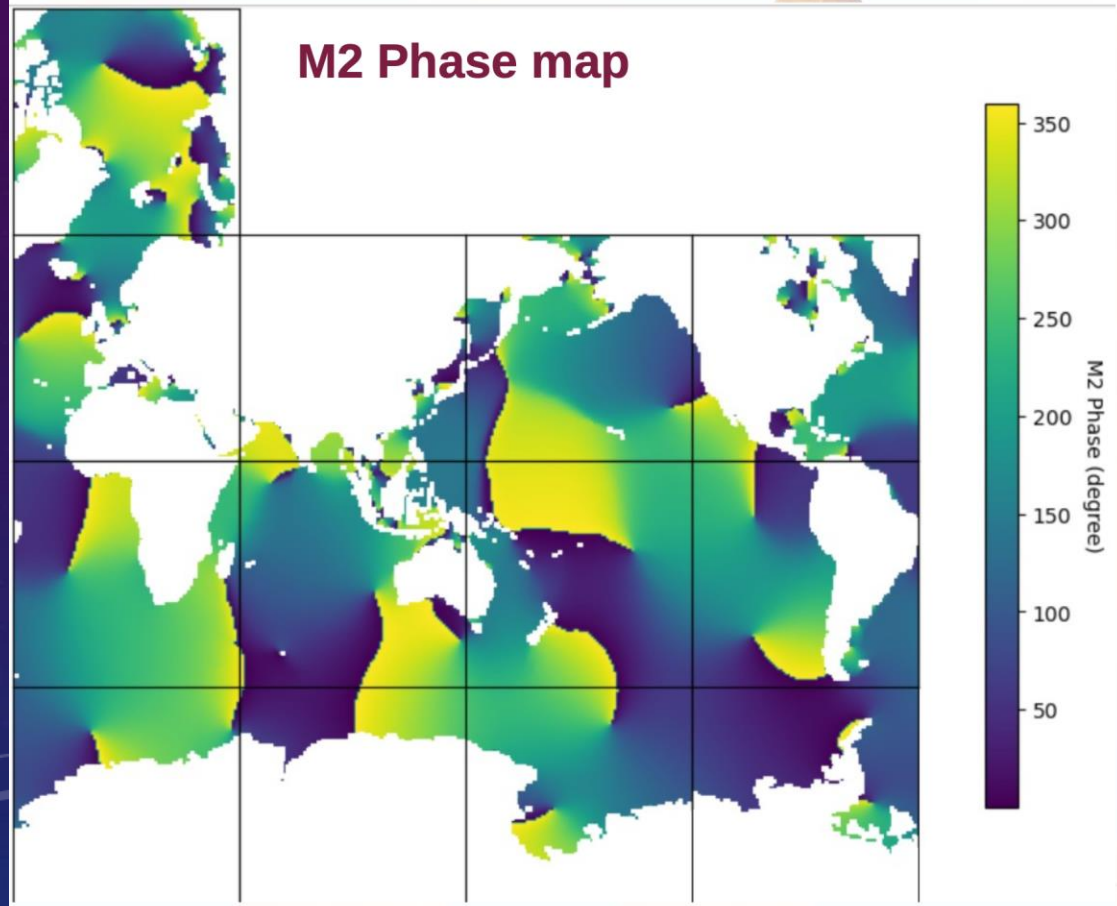


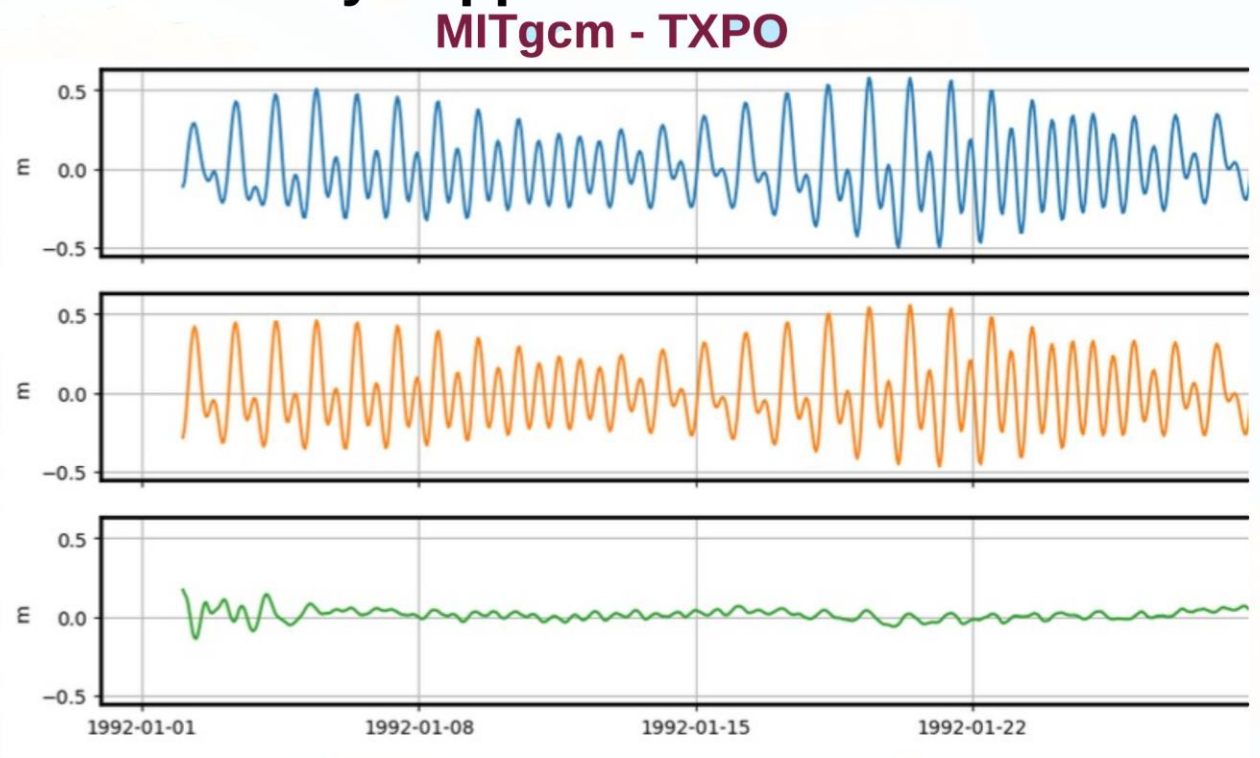
Turning on the Tides (ToTs)

Hinne Van Der Zant, Hugo Plombat, Rebecca Zaja, Yumi Abe, Clément Bertin

Progress:

- Amplitude and phase map of M2 tidal constituent
- Our tidal time series closely fits the TXPO altimetry supported tidal model





Today:

- Compare the M2 Amplitude and Phase maps
- Inspect Internal tides with Salinity/Temperature vertical sections