SO-WARM: **S**outhern **O**cean - extreme **W**arm event **A**nalysis of dynamical **F**orcing and i**M**pacts
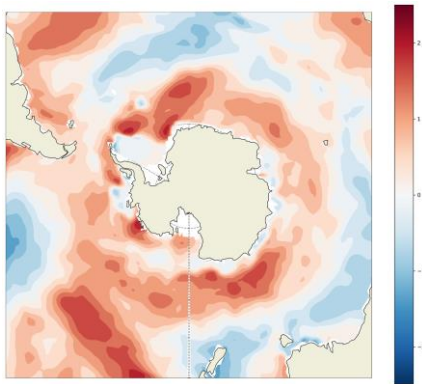
Sofi D. & Kate Z.
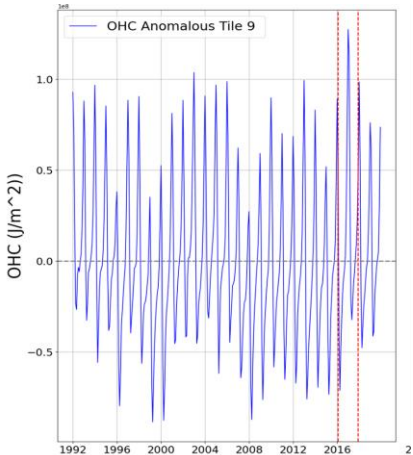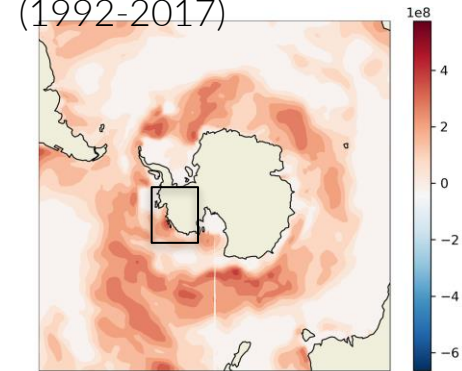
ECCO SUMMER SCHOOL

Objective

1) Driver of the strong summer 2017 MHW? | = **What** cranked up the heat?

2) MHW impact on physical processes (*if any*)? | = Did the MHW *hit the brakes*?

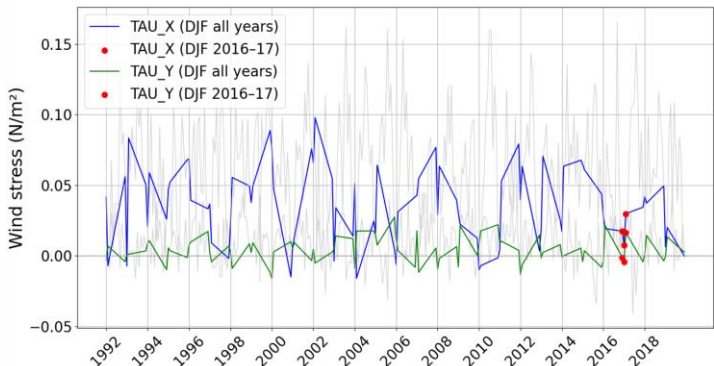# **Methods & Madness**: Feb 2017 unpacked locally (ECCO V4r4/r5)

1. Strongest Ocean Heat Content (0-50m) Anomaly (1992-2017)
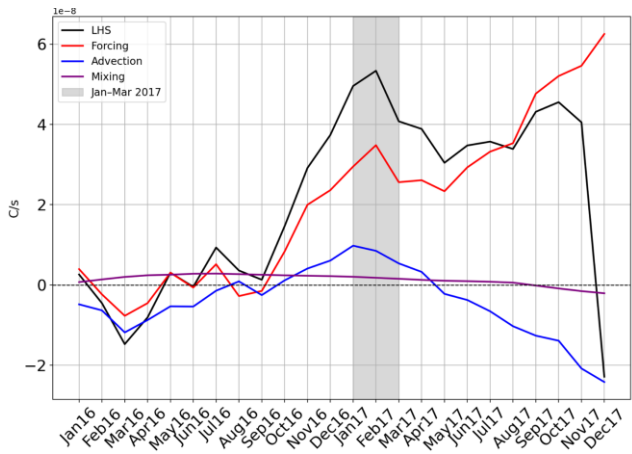

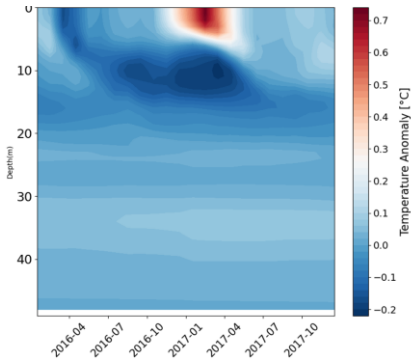**2.** Weak Westerlies (eastward)
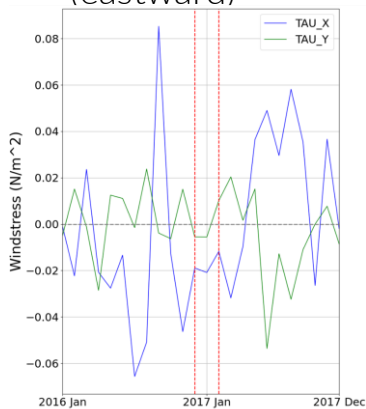
Windstress 1992-2017

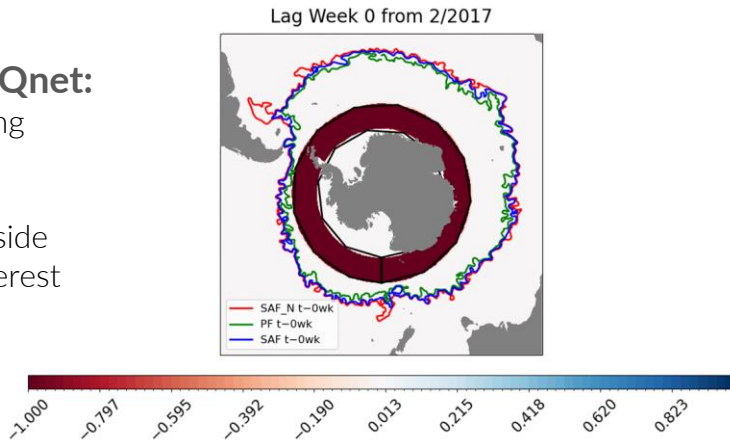**3.** Atmosphere dominates Heat Budget (0-50m)

Temp. Anomaly (1992-2017)

SO.. Who heated up the party?

1.Adjoint Tool: OBJ. Function temperature *(lag up to 18mon, 2015-2017)*

Sensitivity to Qnet:

-Dominant forcing
  mechanism

- Constrained inside
  the area of interest

Lag Week 0 from 2/2017

SAF_N t−0wk
PF t−0wk
SAF t−0wk

Sensitivity to Tauu
Fades quickly

Lag Week 0 from 2/2017

SAF_N Feb 2017
PF Feb 2017
SAF Feb 2017
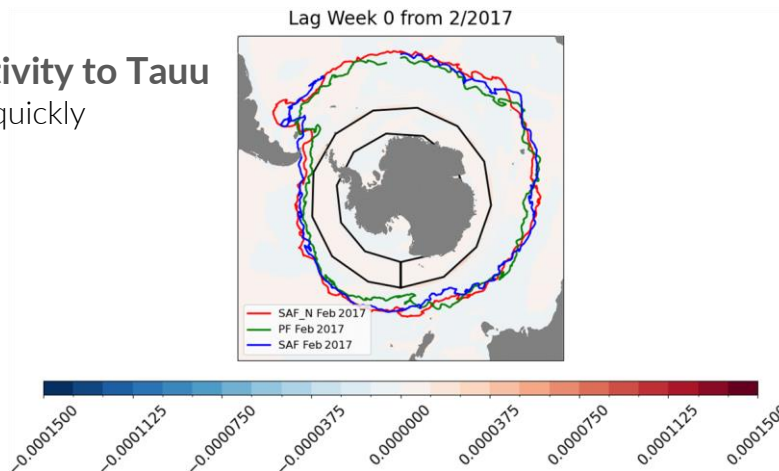
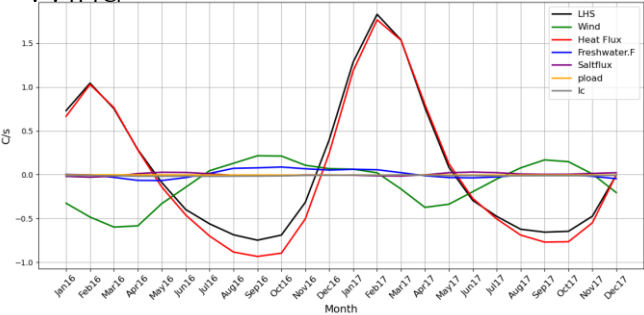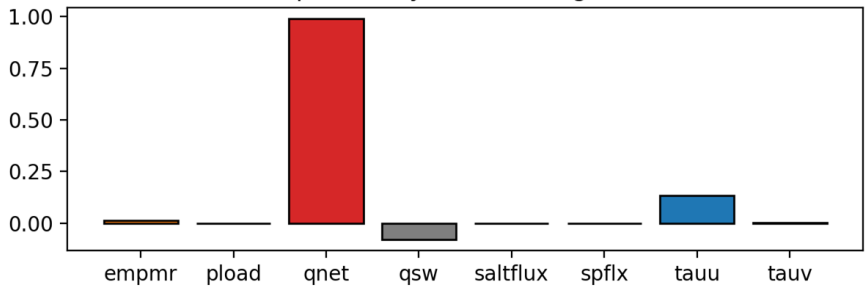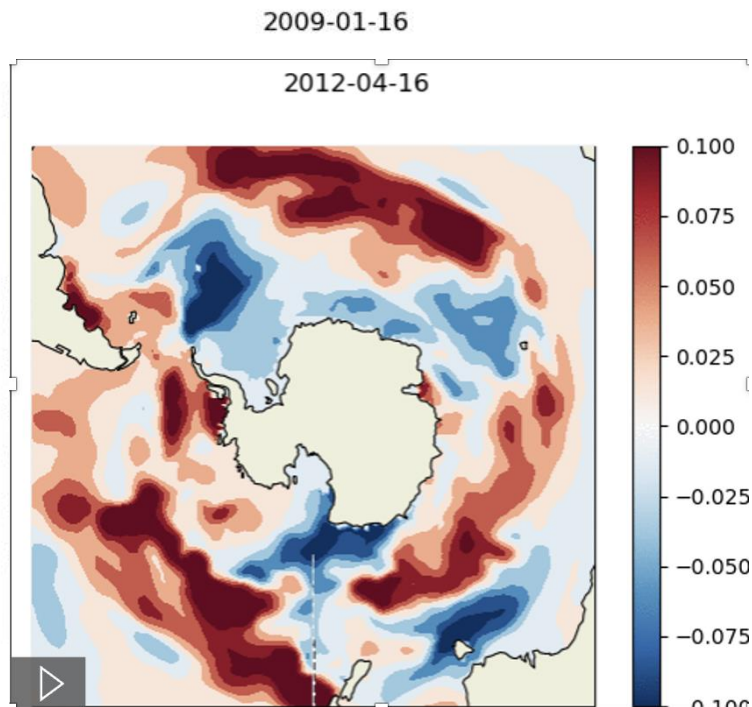## 2.Attribution Tool: ↑ Qnet +↓ Wind

Convolution: Qnet + Wind

Variance of Reconstruction
Explained by Controls (lag=200)

SO did the MHW affect the physics (or not) ?

Perturbation Experiment: Uniform Increase of Eastward winds (-0.03)

Cumulative Temperature (0-50m)

2009-01-16

2012-04-16

Remains to be seen...

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So I came here knowing nothing about:

- Southern Ocean Dynamics
- ECCO model

Challenges

1. **Slow Coding**: Time contracts when coding solo (*Thanks Ou, Yue*)
2. *Getting to know ECCO grid*
2. Too many tasks, not enough time to handle them all (*Thanks Ichiro &Kate!*)

But I learnt so much!!

- *Ocean State estimation principles*
- *Lots of important ARGO out there*
- ***Abyssal Road Trips***: *Traversing the global ocean can be long, bizarre but fascinating*
- ***Submesoscale Shenanigans***: *do not affect stratification in high-res*
- ***Southern Ocean***: *Chaotic, wacky powerhouse of the global ocean*

Skills:

- *Notebook coding: Not used to it but useful*
- *Handling ECCO model output*
- *Run an online Heat budget Tool Attribution, Convolution, Perturbation Experiments*
- *Grasped the broad ADJOINT concept!*

..Which naturally leads to more questions!!

1.How would adjoint sensitivities differ if the target layer was deeper than 0–50 m?

2.What do the heat budget, adjoint sensitivities and convolution diagnostics reveal about a winter MHW?

3.How can I assess the connectivity of my event to historical ocean state variables beyond direct surface forcing?

4.What would be the response of my U, V,W velocity if I had done the right wind stress perturbation experiment??

5. What kind of extreme events would actually *do* matter for the Southern Ocean??