



Maroubra Beach, AU

Model Estimated Ocean Heat Uptake, Transport and Storage Rates Over 1972-2017

Maurice F. Huguenin^{1,2}, Ryan M. Holmes^{1,3} and Matthew H. England^{1,2}

¹Climate Change Research Centre and Australian Research Council Centre of Excellence for Climate Extremes, University of New South Wales, Sydney 2052, NSW, Australia

²Australian Centre of Excellence in Antarctic Science, University of New South Wales, Sydney, New South Wales, Australia

³School of Mathematics and Statistics, University of New South Wales, Sydney 2052, NSW, Australia

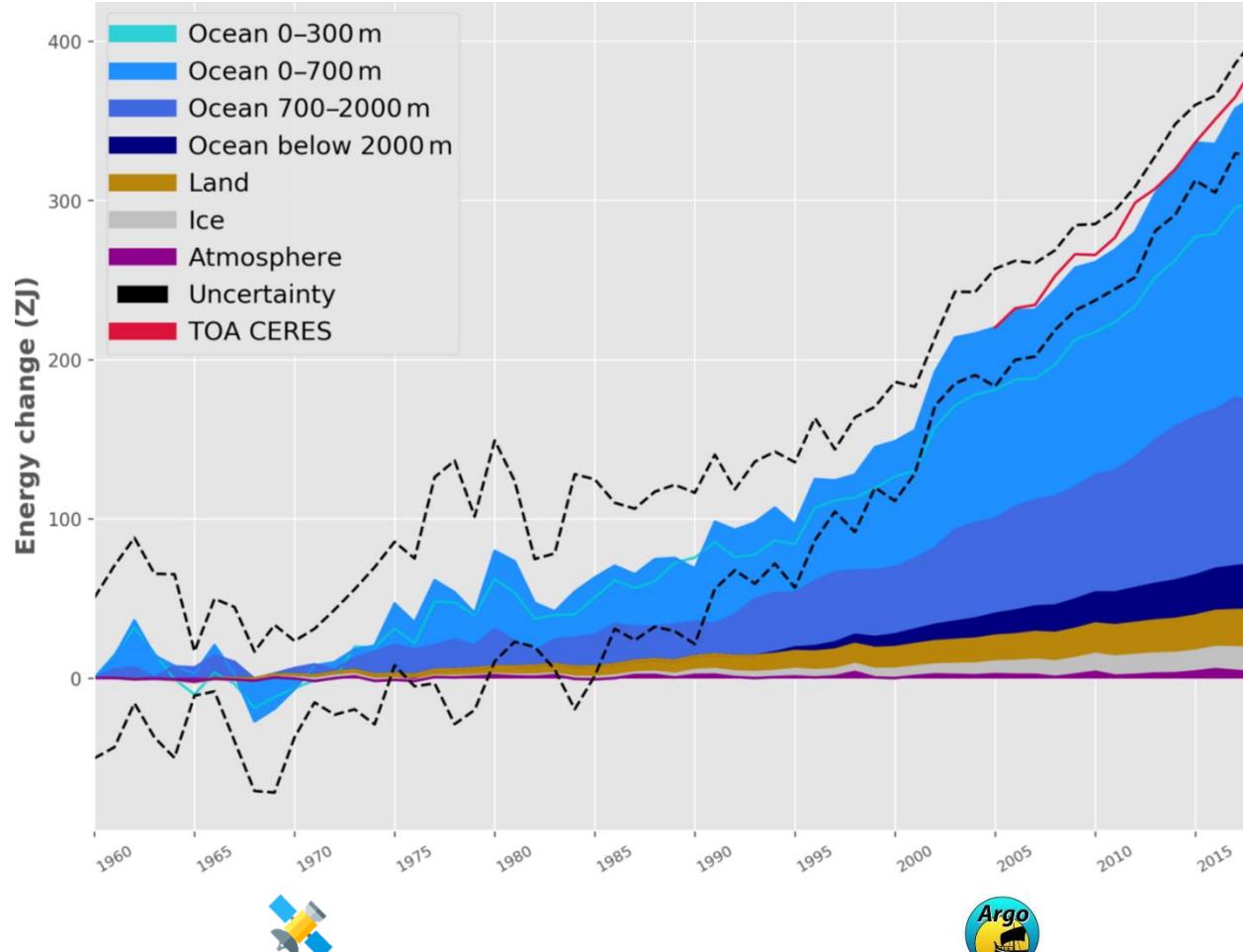


Australian Government
Australian Research Council

 **climate extremes**
ARC centre of excellence **Climate Change**
Research Centre

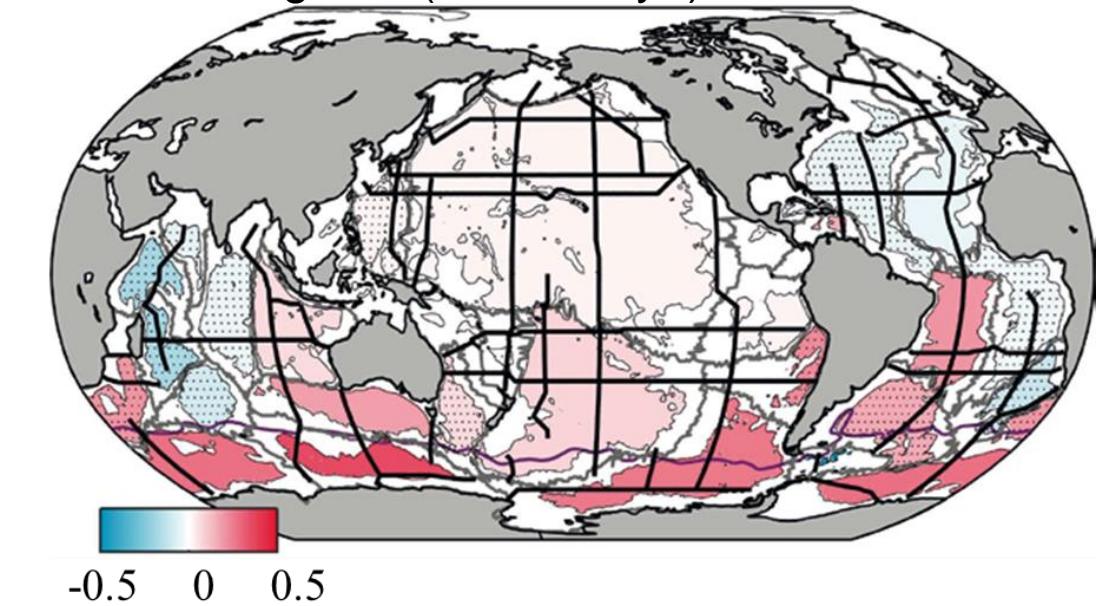
Importance of Ocean Heat Content

Earth heat inventory relative to 1960 ($ZJ = 10^{21} J$)



von Schuckmann et al. (2020)

Warming rate ($^{\circ}\text{C century}^{-1}$) below 4000 m



IPCC SROCC, Ch. 5, Fig. 5.4b, Allison et al. (2019)

Where has heat entered the ocean?
Where is it today?

Global Ocean-Sea Ice Model

- ACCESS-OM2 ([Kiss et al., 2019](#))
- 1° horizontal resolution
- 50 vertical levels
- KPP vertical mixing ([Large et al., 1994](#))
- JRA55-do 1958-2018 ([Tsujino et al., 2018](#))



gadi@nci.org.au

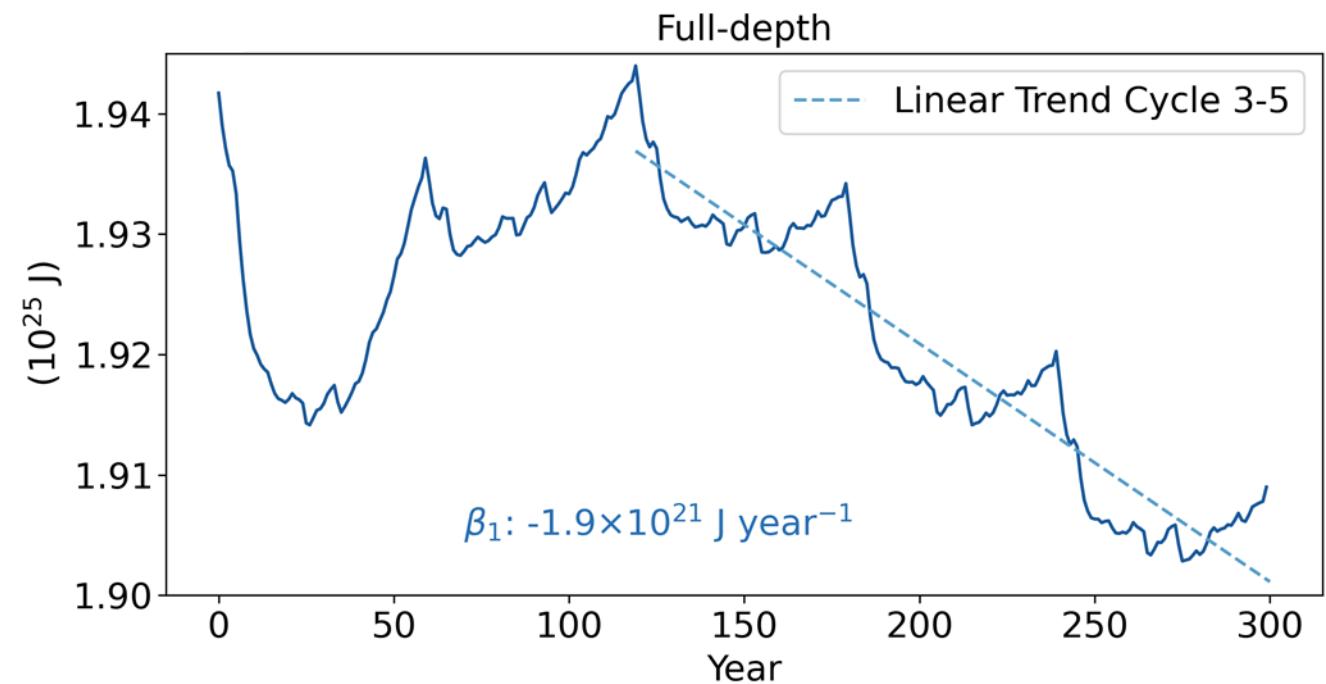
Spin-Up so Far

Interannual Forcing (IAF)
1958-2017

issues:

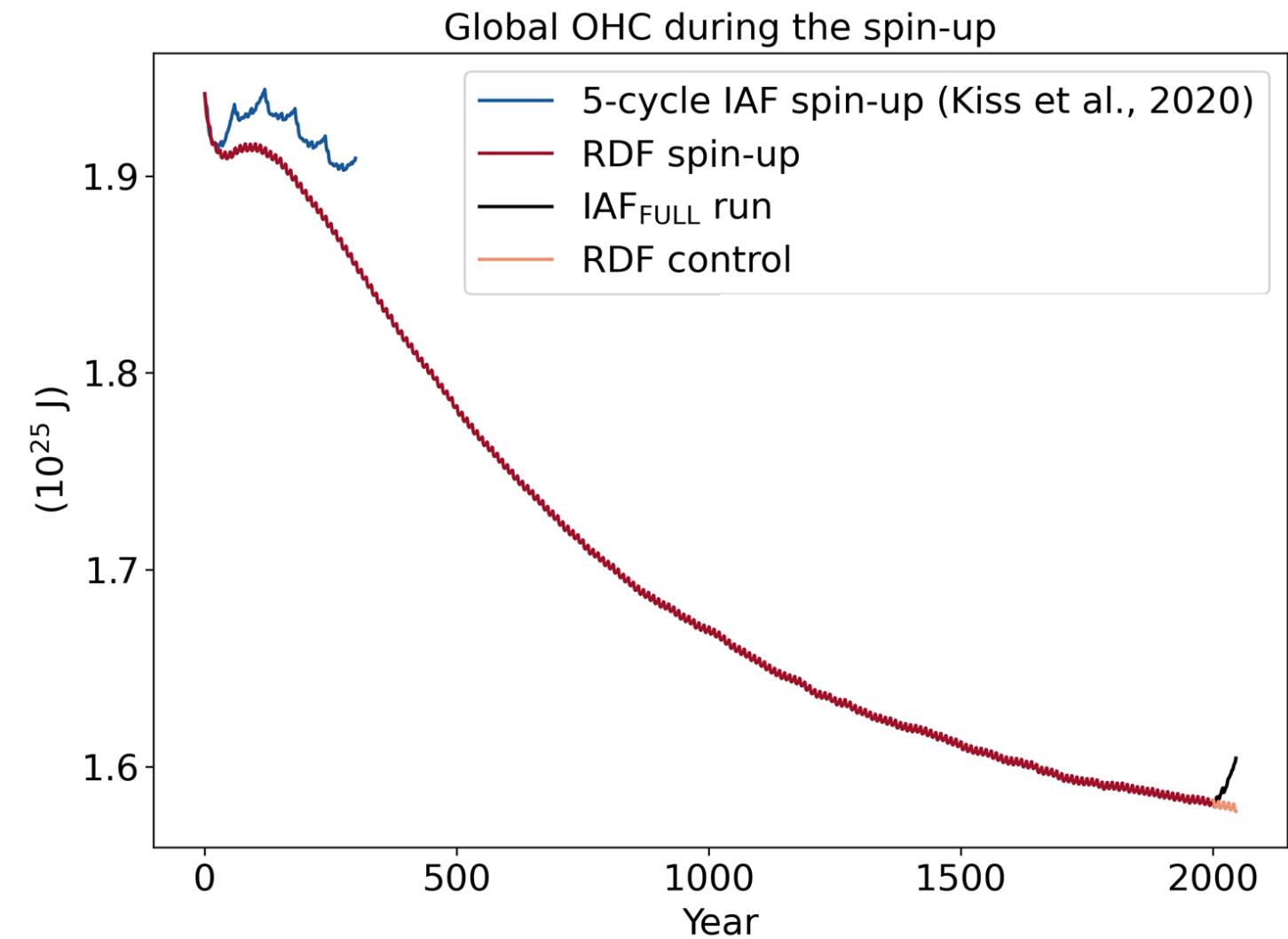
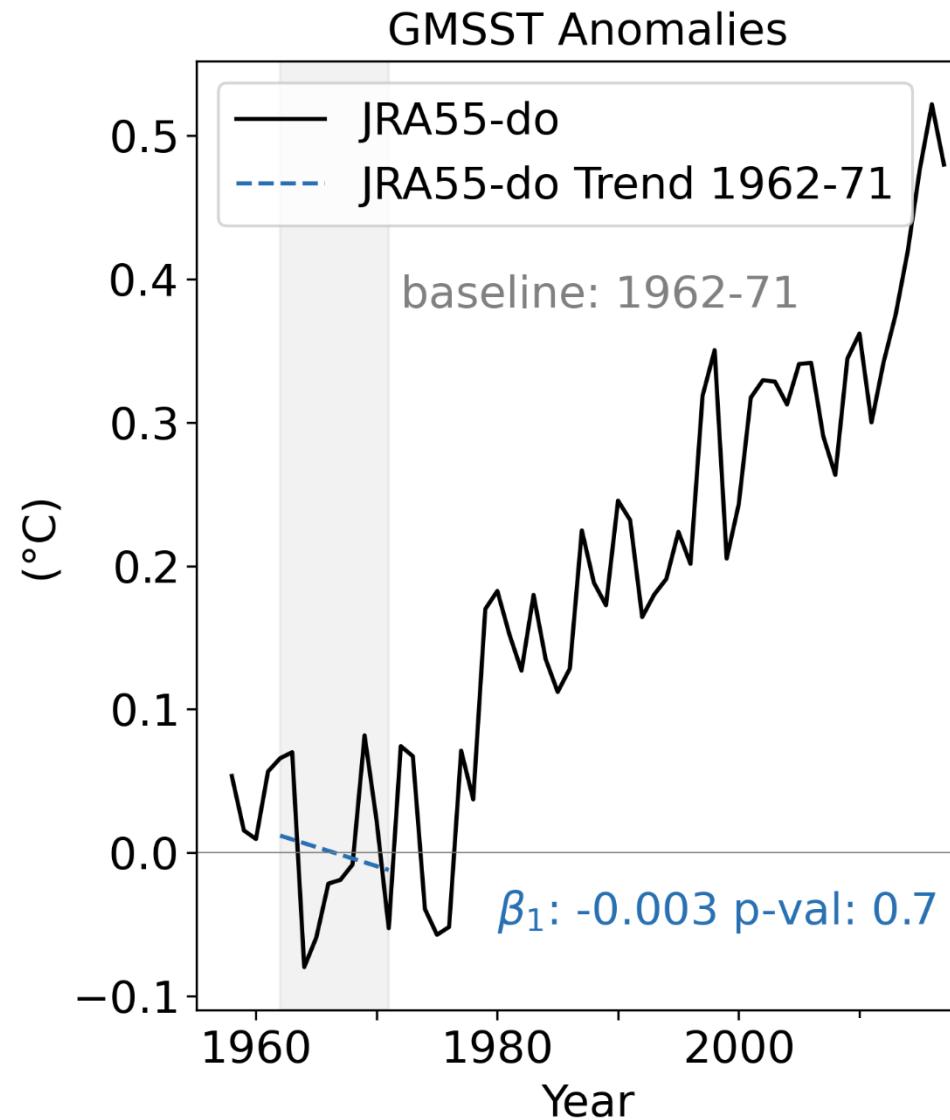
- shock to the model after each cycle
- model drift?

Global OHC during the Spin-up (Kiss et al. 2018)

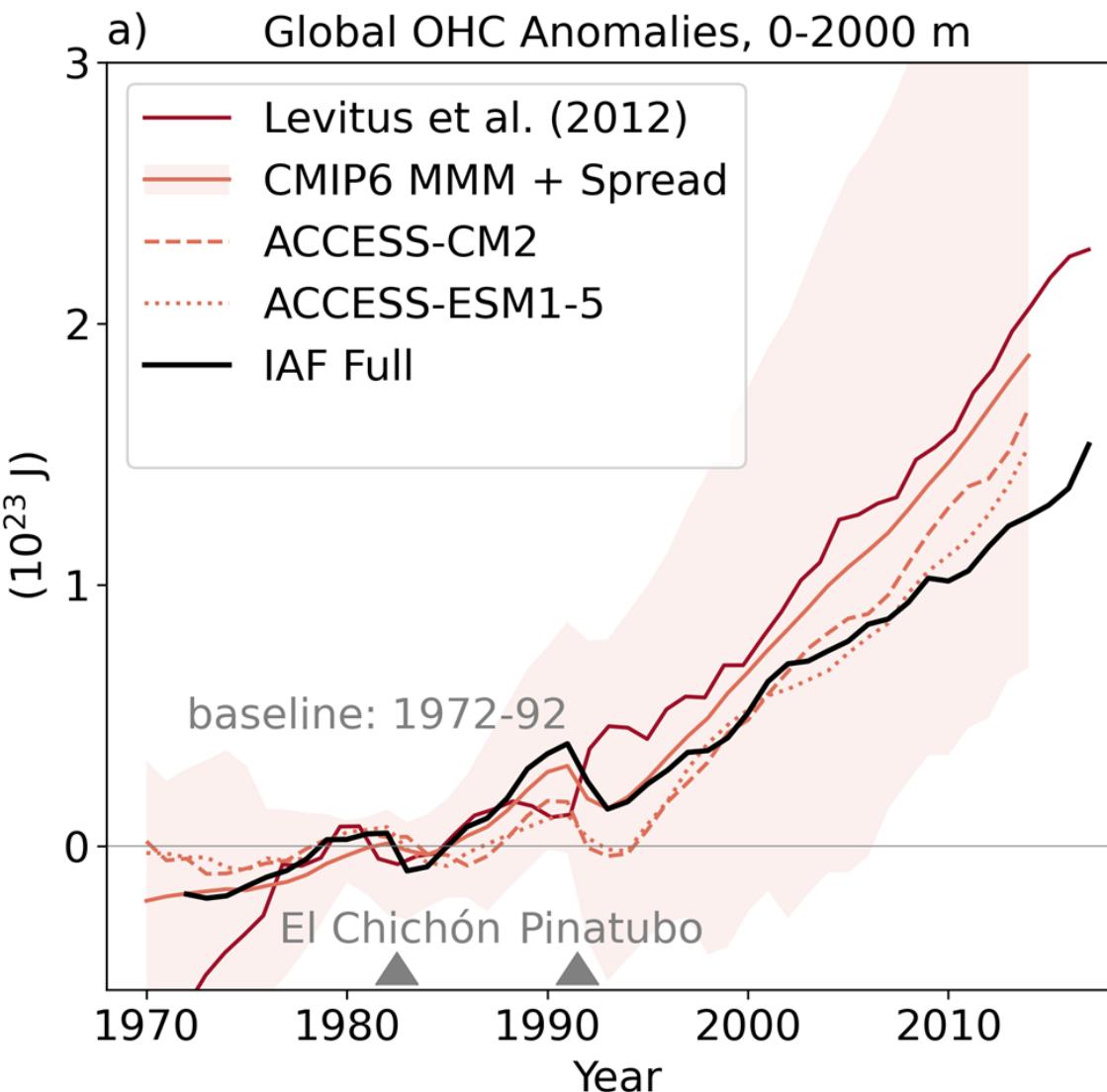


New Spin-Up

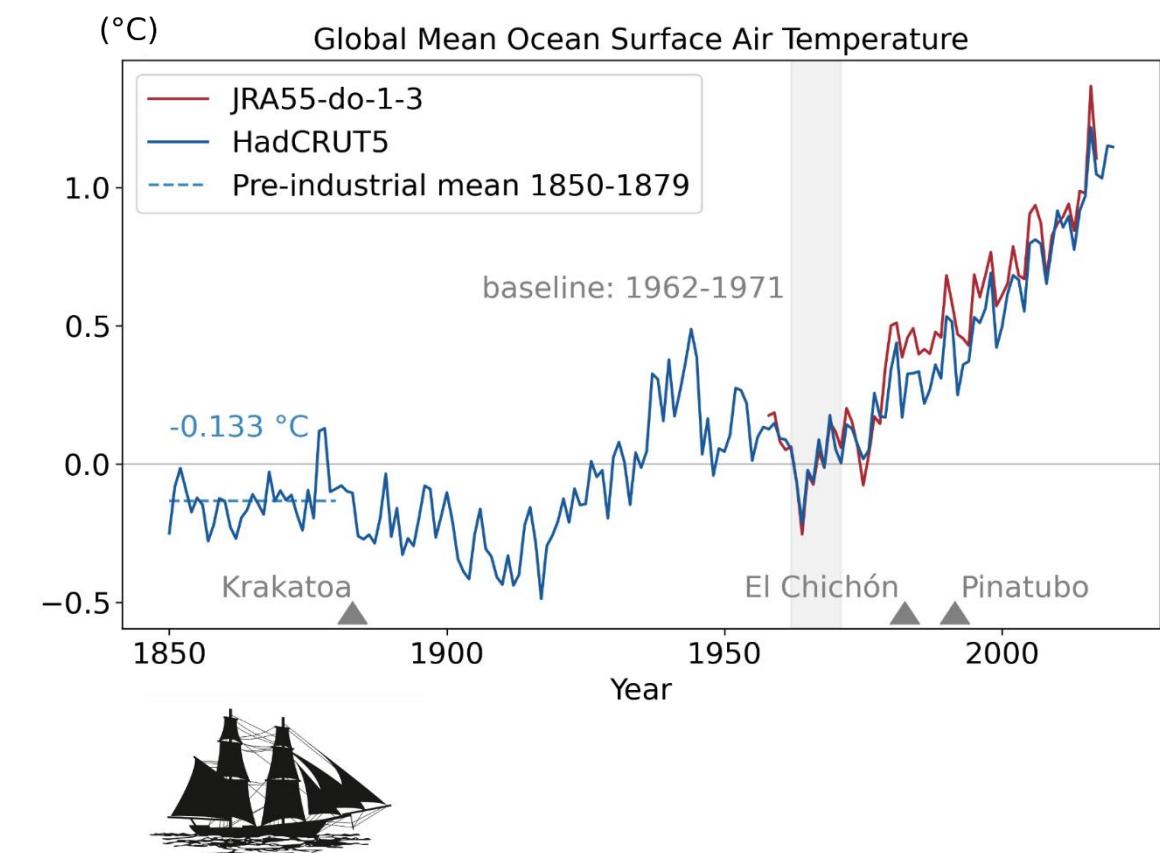
Repeat Decade Forcing (RDF) 1962-71



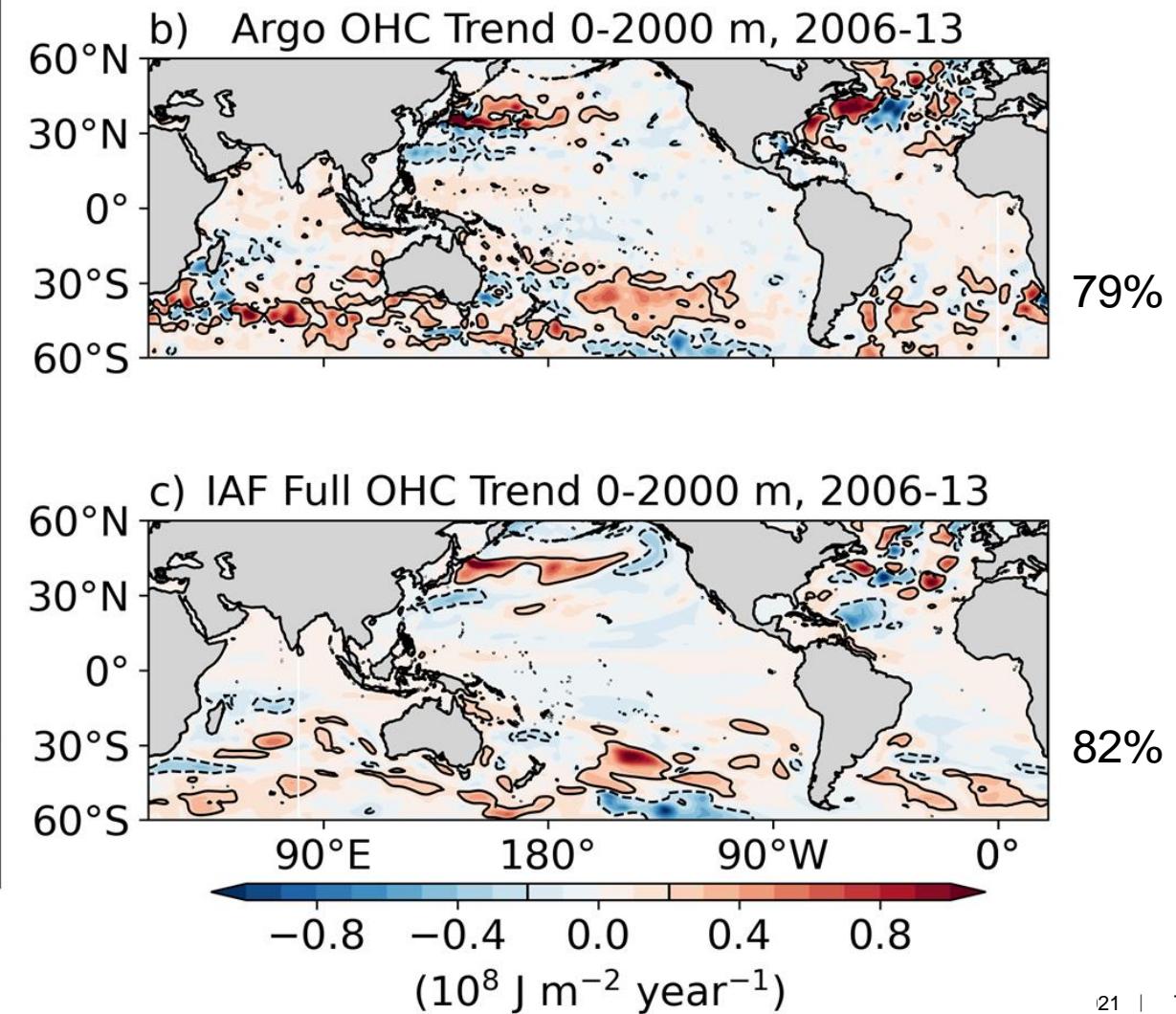
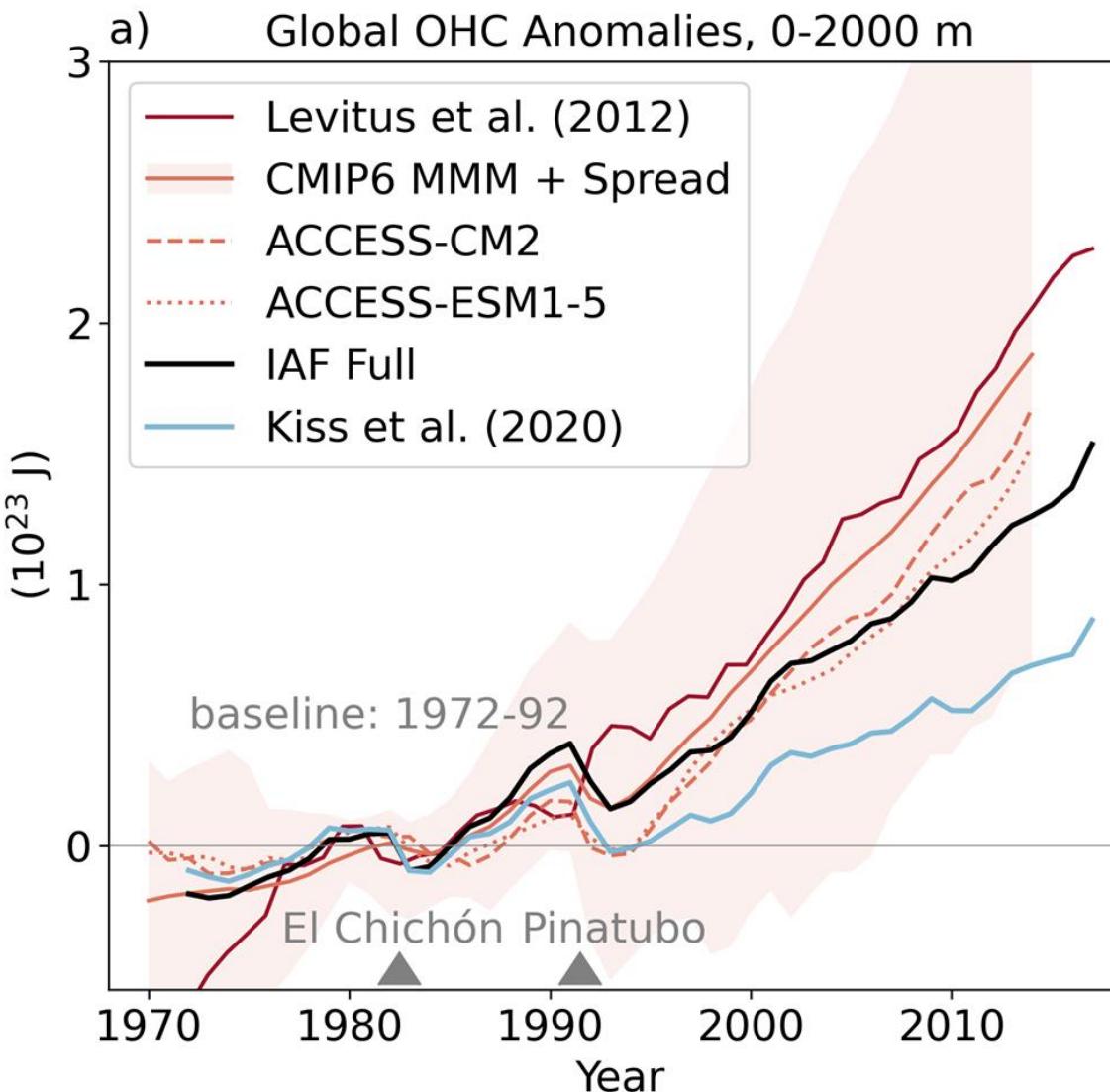
Validation



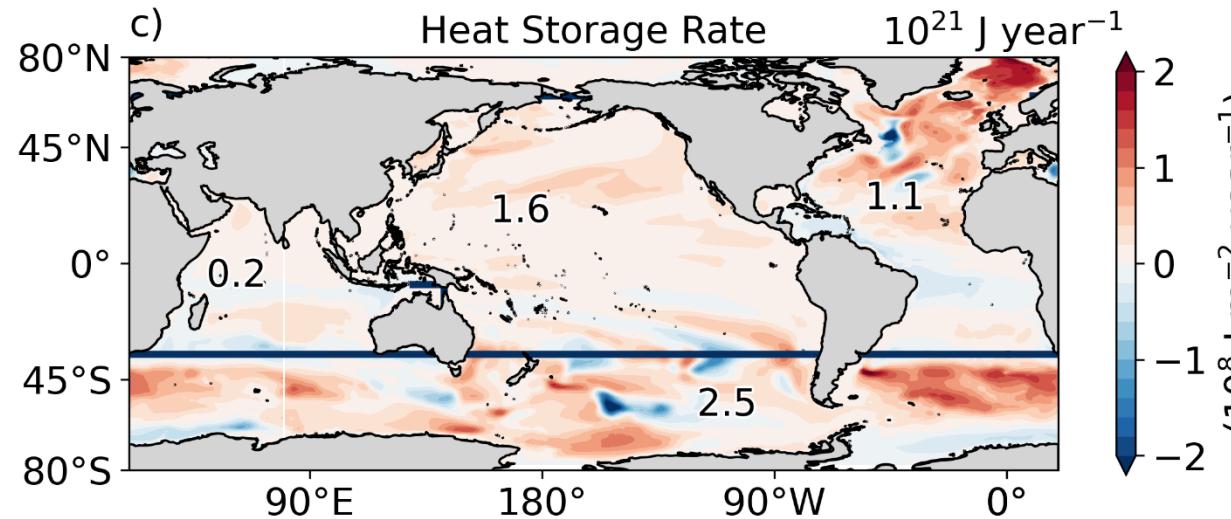
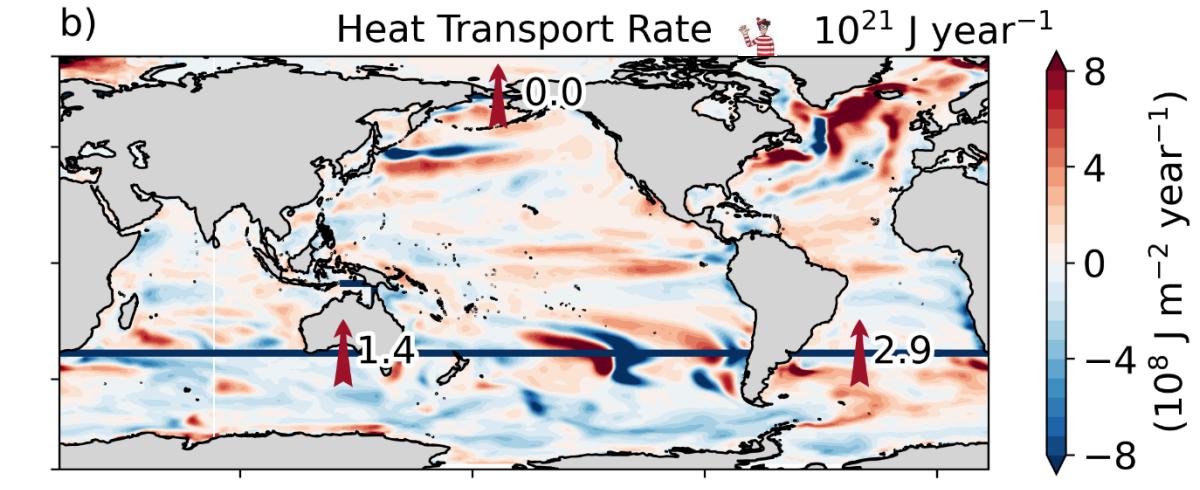
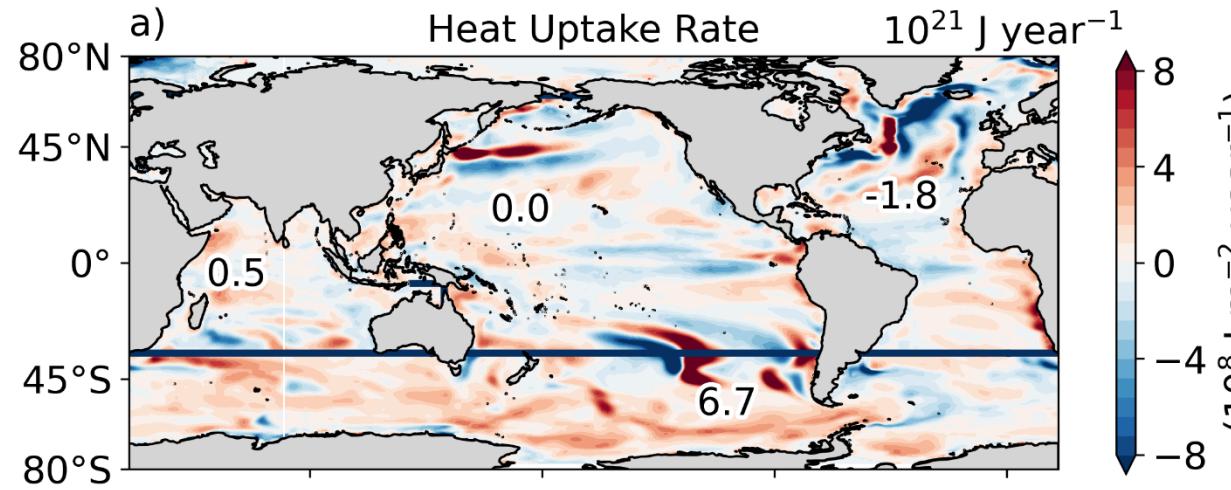
Pre-industrial Offset



Validation

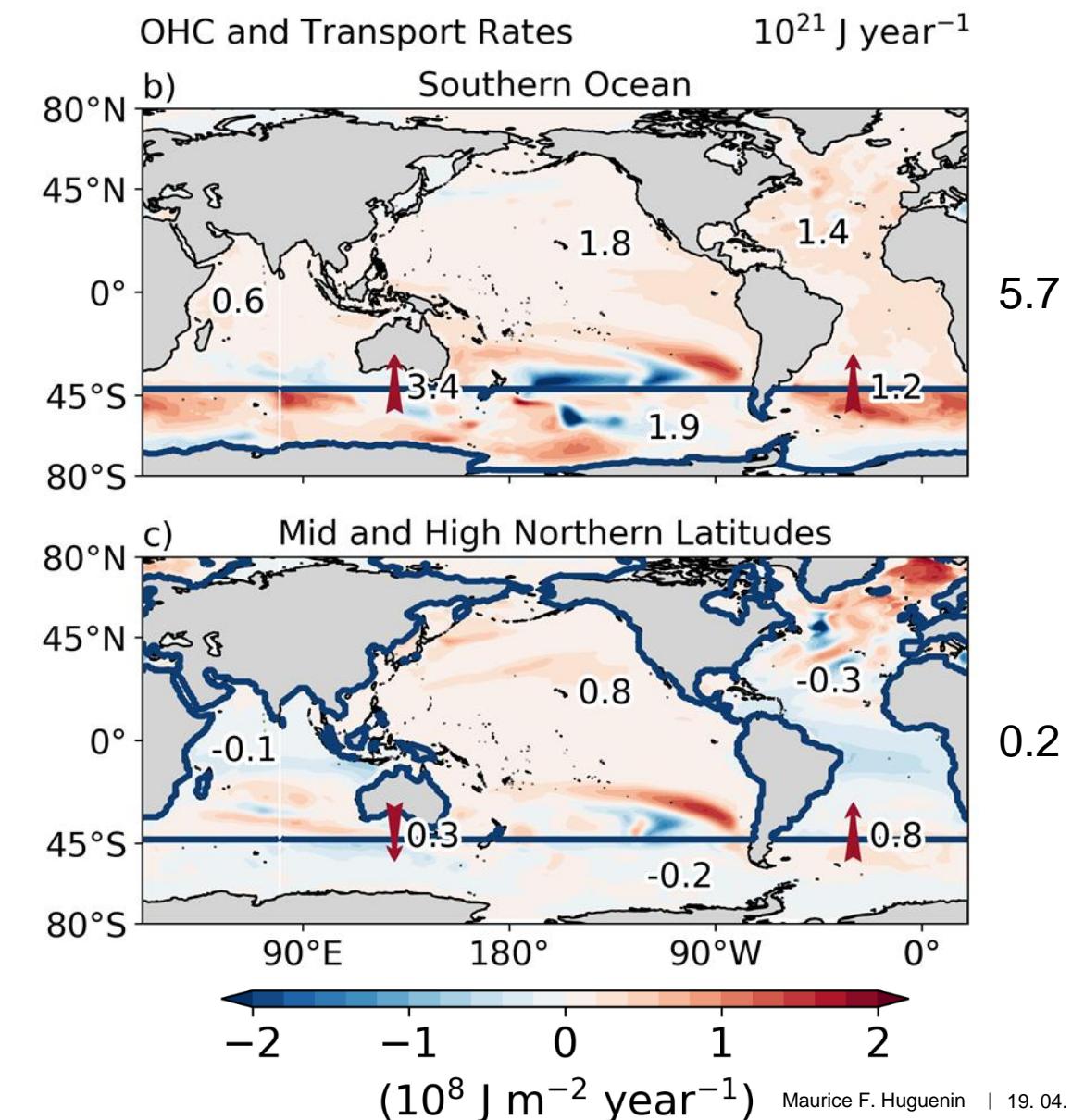
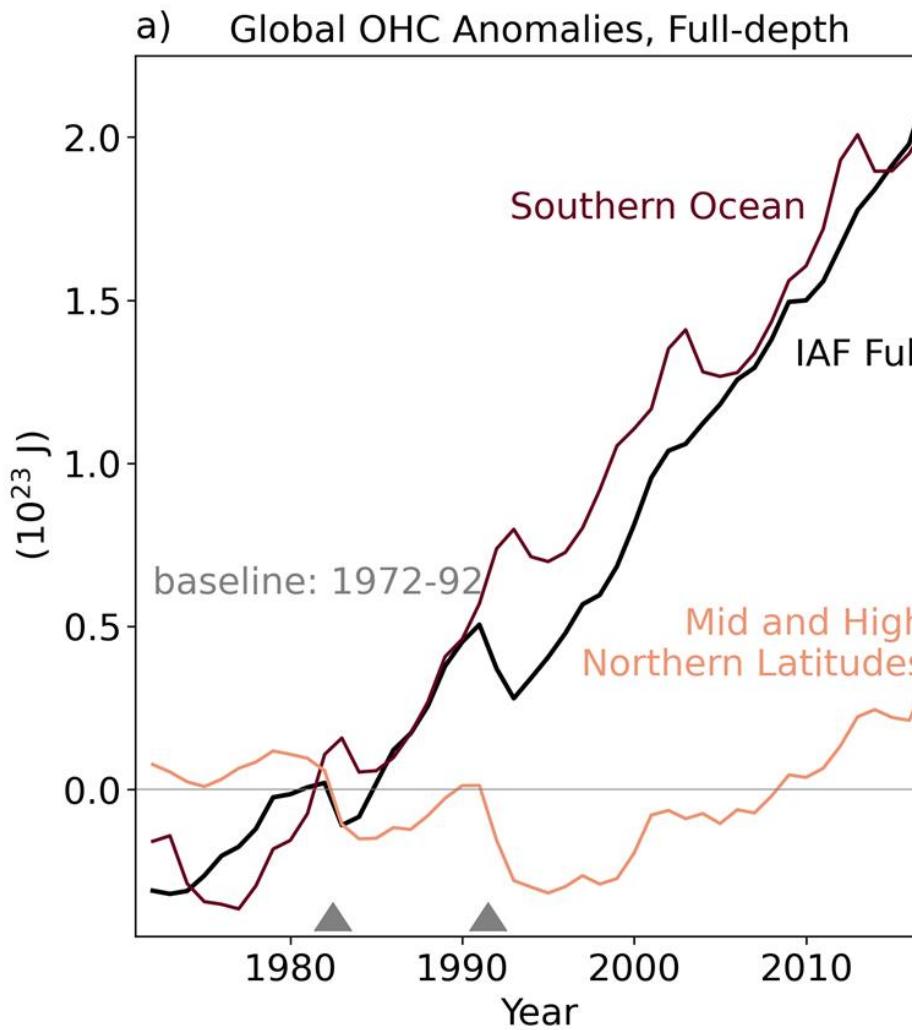


Heat Uptake, Transport and Storage Rates

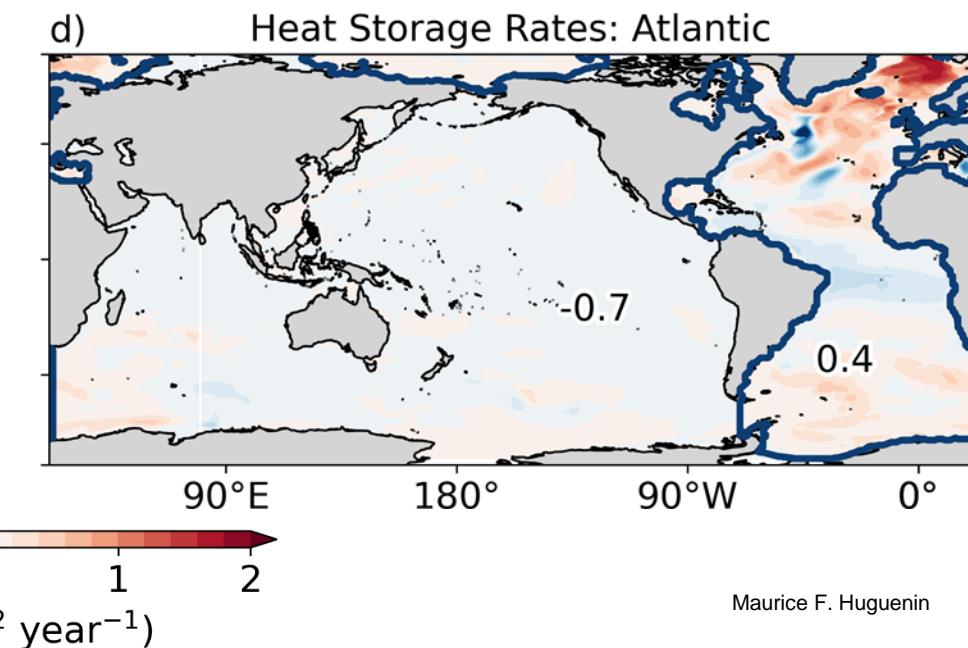
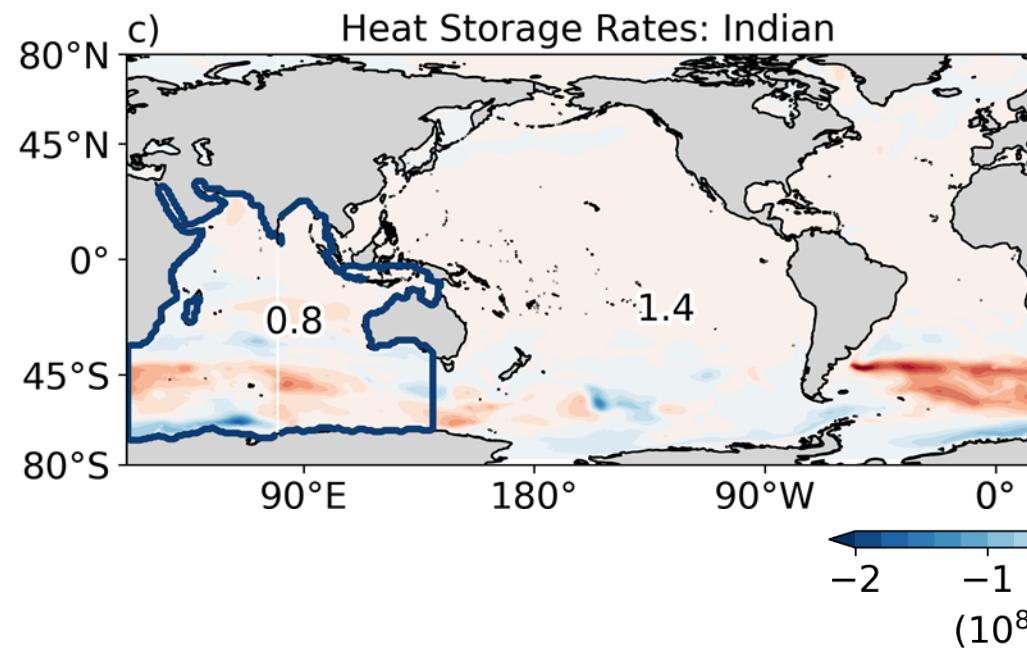
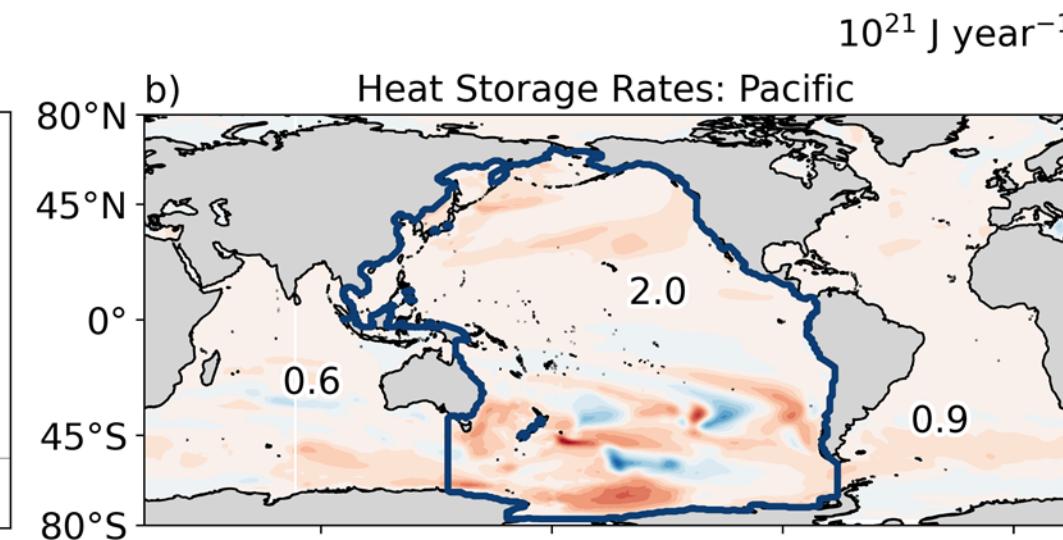
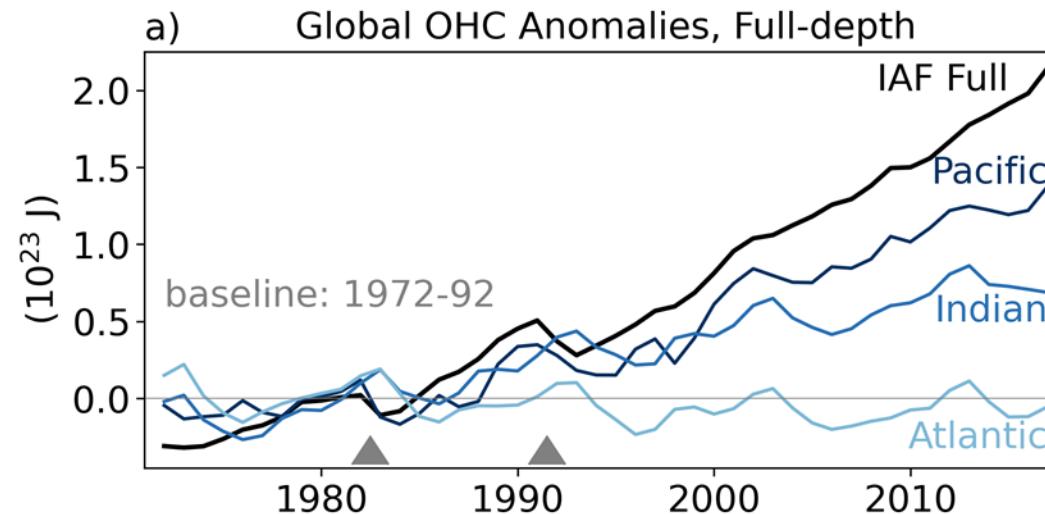


- Southern Ocean dominates anomalous heat uptake
- 50% of heat signal goes into Atlantic Ocean
- 2/3 then released across the surface

Regional Contributions



Regional Contributions



Take-Home Messages



- We present a **new** ocean-sea ice model **spin-up** using **repeat 1962-71 forcing** to establish a state before the recent ocean heat uptake occurred
- **43%** of the anomalous heat **taken up** in the **Southern Ocean** since 1972 **goes** into the **Atlantic**, where **two-thirds** is **lost** across the surface
- Simulations forced with **tropical** atmospheric **trends** show **weak** ocean **heat content** trends, suggesting long-term tropical heat **uptake** is **minor**