Drivers and distribution of ocean heat uptake over the last half century

Maurice F. Huguenin[1,2,*], Ryan M. Holmes[1,3,4] and Matthew H. England[1,2]

[1]Climate Change Research Center and ARC Centre of Excellence for Climate Extremes, University of New South Wales, Sydney, Australia
[2]Australian Centre for Excellence in Antarctic Science, University of New South Wales, Sydney, Australia
[3]School of Mathematics and Statistics, University of New South Wales, Sydney, Australia
[4]School of Geosciences, University of Sydney, Sydney, Australia
[*]E-mail: m.huguenin-virchaux@unsw.edu.au

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- Since the 1970s, the **ocean** absorbed **almost all** of the **excess energy** in our climate system. However, our **knowledge** of where heat uptake has occurred and where this heat is stored today is **limited** by **sparse observations**.
- Here we use the global ocean-sea ice model **ACCESS-OM2*** forced by the observationally constrained atmospheric fields** *Kiss et al. (2020), **Tsujino et al. (2018)

New spin-up approach

- No control run and abrupt shifts in OMIP-style spin-up
- How to account for model drift?

- **New** 2000-year pre-industrial **spin-up**
- Repeat 1962-71 forcing, but with 0.163°C* and –7 W m^{-2}** offset

*HadCRUT5 (Morice et al. 2021), **IPCC AR5 SPM

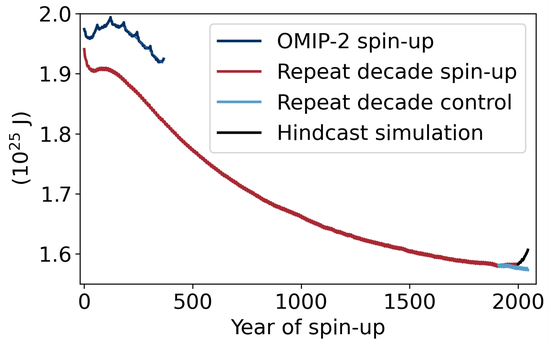

Fig. 1. Global ocean heat content during the spin-up.

Considerably improved ocean heat uptake estimate

- New hindcast **captures** observed evolution of **ocean heat uptake better** than most previous ocean-sea ice simulations

- **OMIP-2**, when **following our method**, would better capture the observed trend

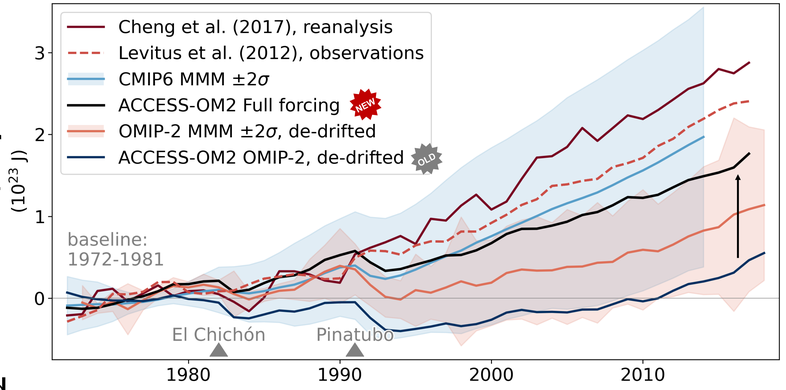

Fig. 2. Recent global ocean heat content anomalies, 0-2000 m.

Role of surface wind and thermal property changes

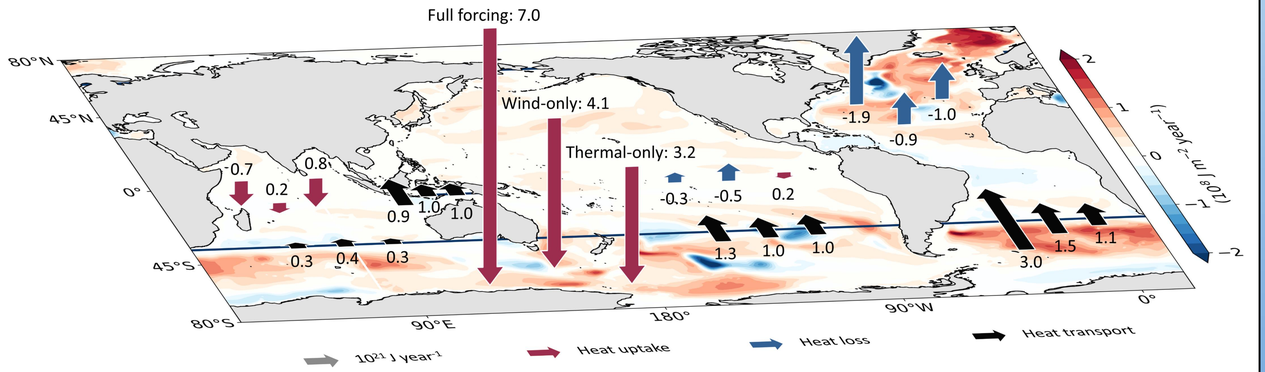

Fig. 3. Schematic summarising anomalous global ocean heat uptake and transport over the last half century in the hindcast simulations with full, wind- and thermal-only forcing.

- Recent surface **wind** and **thermal** property **trends** can explain **50%** of ocean warming signal
- Isolated over the **Southern Ocean**, these trends account for nearly all of the global heat uptake

- Southern Ocean heat uptake facilitated by **cool sea surface temperatures** & **sensible heat fluxes** when thermal forcing is held fixed
- Increased downward **longwave radiation** more dominant **when** winds are fixed and **thermal properties evolve** over time

Stay tuned for more! Huguenin et al. (2022), *submitted*.