Subsurface warming of West Antarctica during El Niño

Maurice F. Huguenin[1,2,*], Ryan M. Holmes[3,4], Paul Spence[5,6] and Matthew H. England[2]

[1]Climate Change Research Centre and ARC Centre of Excellence in Climate Extremes, University of New South Wales, Sydney, New South Wales, Australia, [2]Centre for Marine Science and Innovation and ARC Australian Centre for Excellence in Antarctic Science, University of New South Wales, Sydney, New South Wales, Australia, [3]School of Geosciences, University of Sydney, Sydney, New South Wales, Australia, [4]Australian Bureau of Meteorology, Sydney, New South Wales, Australia, [5]Institute for Marine and Antarctic Studies and ARC Australian Centre for Excellence in Antarctic Science, University of Tasmania, Tasmania, Australia, [6]Australian Antarctic Partnership Program, University of Tasmania, Tasmania, Australia

[*]E-mail: m.huguenin-virchaux@unsw.edu.au

This poster as .PDF

- Even though West Antarctic **shelf temperatures** are dominated by **decadal-scale** climate **variability**, **ENSO also** likely **impacts** shelf temperatures and basal melting of the ice shelves
- However, **investigating** the isolated role of **ENSO** is **tricky** because it can be **masked** by other modes of variability (SAM, zonal wave-3 variations, the IPO, tides, storms, …)

Isolating the ENSO signal on the West Antarctic shelf

- **ACCESS-OM2-01** Kiss et al. (2020)
  - 1/10° global ocean-sea ice **model** with 75 z* levels
  - **forced** by JRA55-do**,** atmospheric **reanalysis** Tsujino et al. (2018)
  - investigate warming and cooling on the shelf during ENSO

Idealised simulations

- climatological repeat-year forcing[x,y,t] + $\underbrace{\text{ENSO anomalies}}_{\text{(spatial pattern[x,y]} \times \text{time series[t])}}$

Fig. 1b, c × Fig. 1d, e

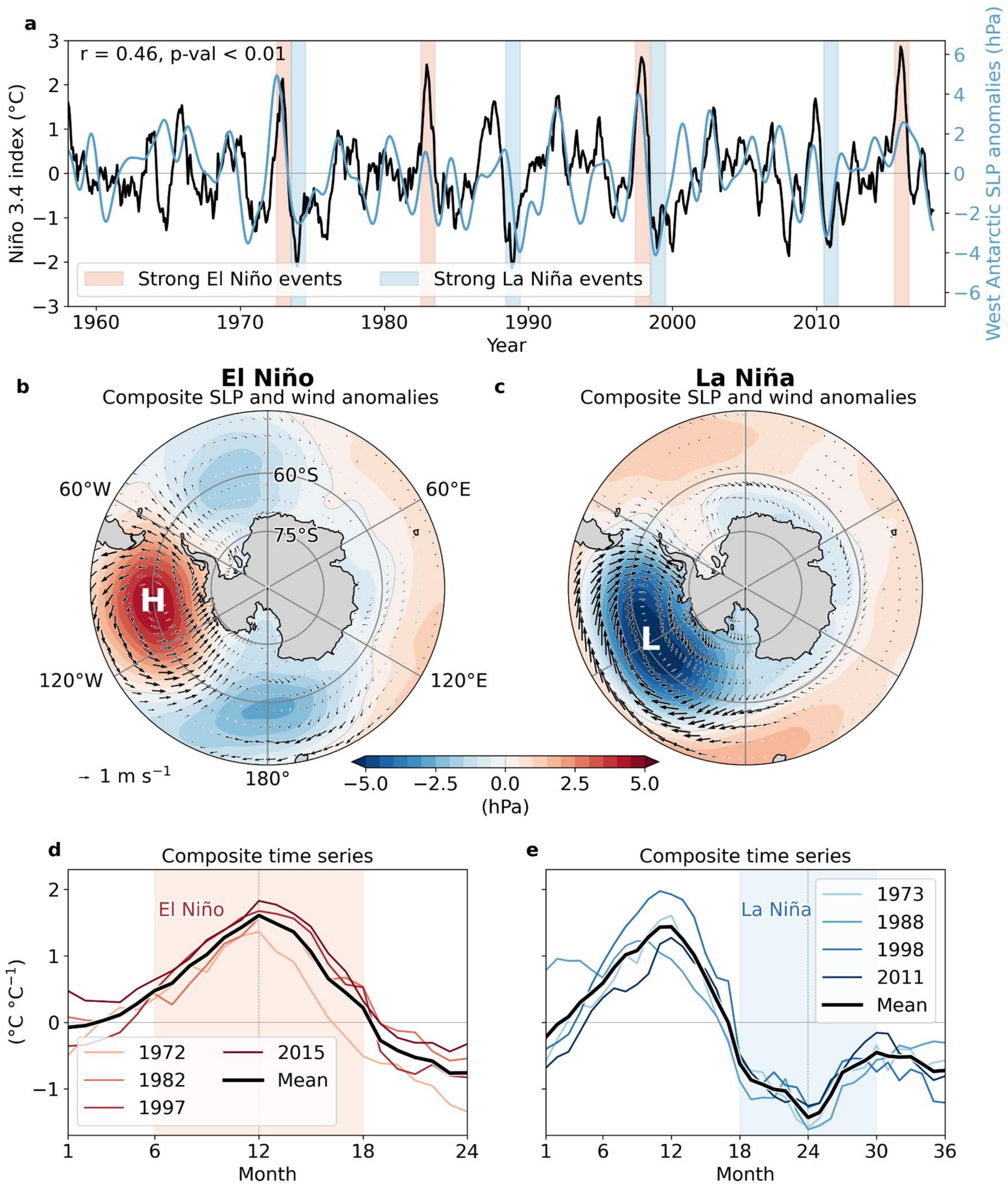

Fig. 1. ***a***, *Time series of the Niño 3.4 index (equatorial Pacific sea surface temperature, °C) and West Antarctic sea level pressure (SLP, hPa) anomalies.* ***b***, ***c***, *Spatial patterns of sea level pressure (hPa) and surface winds (m s^{-1}) during the shaded El Niño (pink) and La Niña (blue) periods in* ***a***. ***d***, ***e***, *Composite time series associated with ENSO sea surface temperature anomalies based on observed events.*

What drives shelf temperature changes during El Niño & La Niña?

Take Home

- **El Niño**: weaker Amundsen Sea Low & weaker coastal easterlies → reduced poleward Ekman transport of cold surface waters → advection of warm Circumpolar Deep Water onto shelf
- **La Niña**: response inhibited by stronger Amundsen Sea Low & stronger surface easterlies

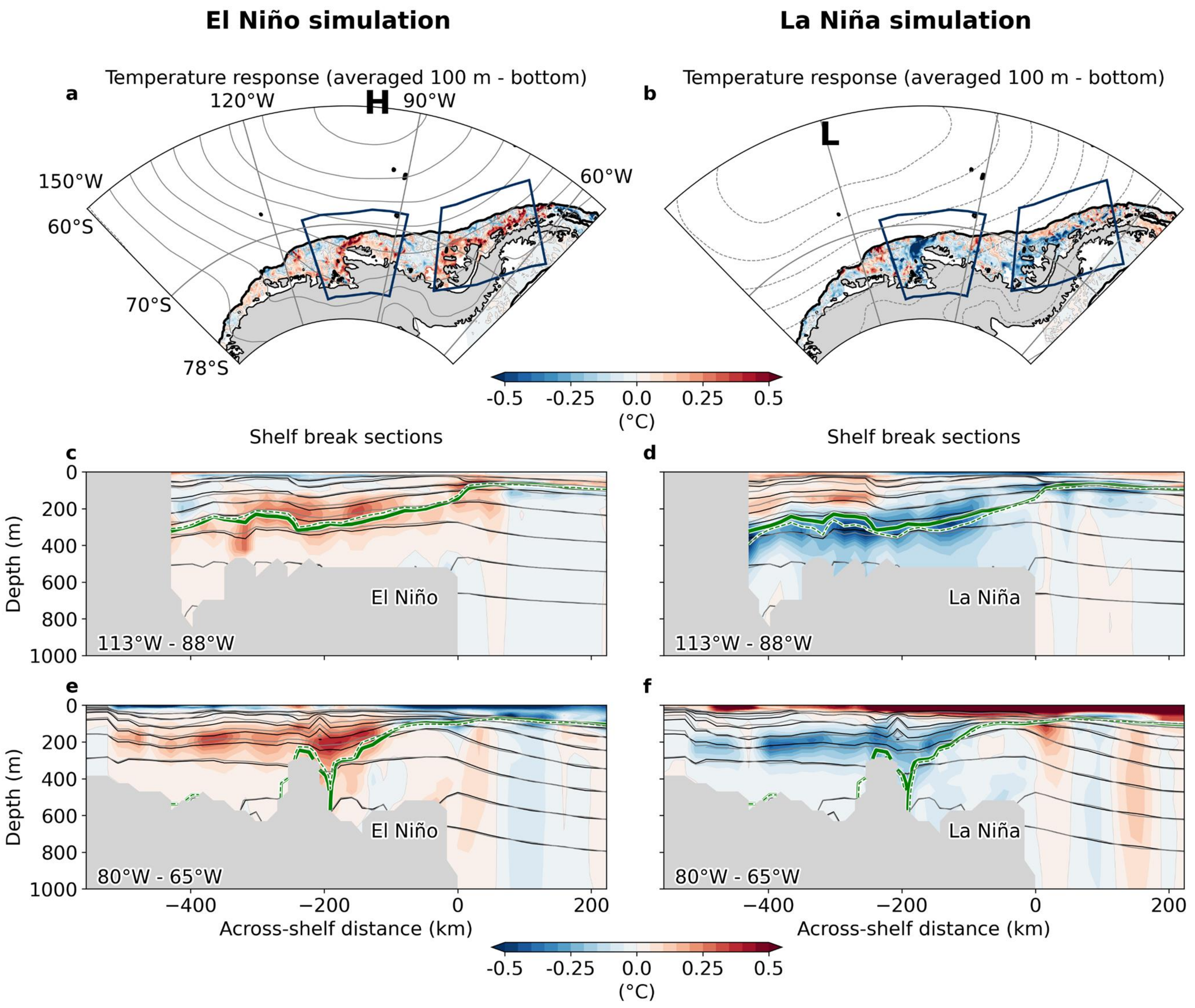

Fig. 2. ***a***, ***b***, *Peak event depth-averaged shelf temperature response (°C).* ***c-f***, *Mean across-shelf temperature responses averaged over the regions outlined in* ***a***, ***b*** *(°C). Black lines are climatological isopycnals.*

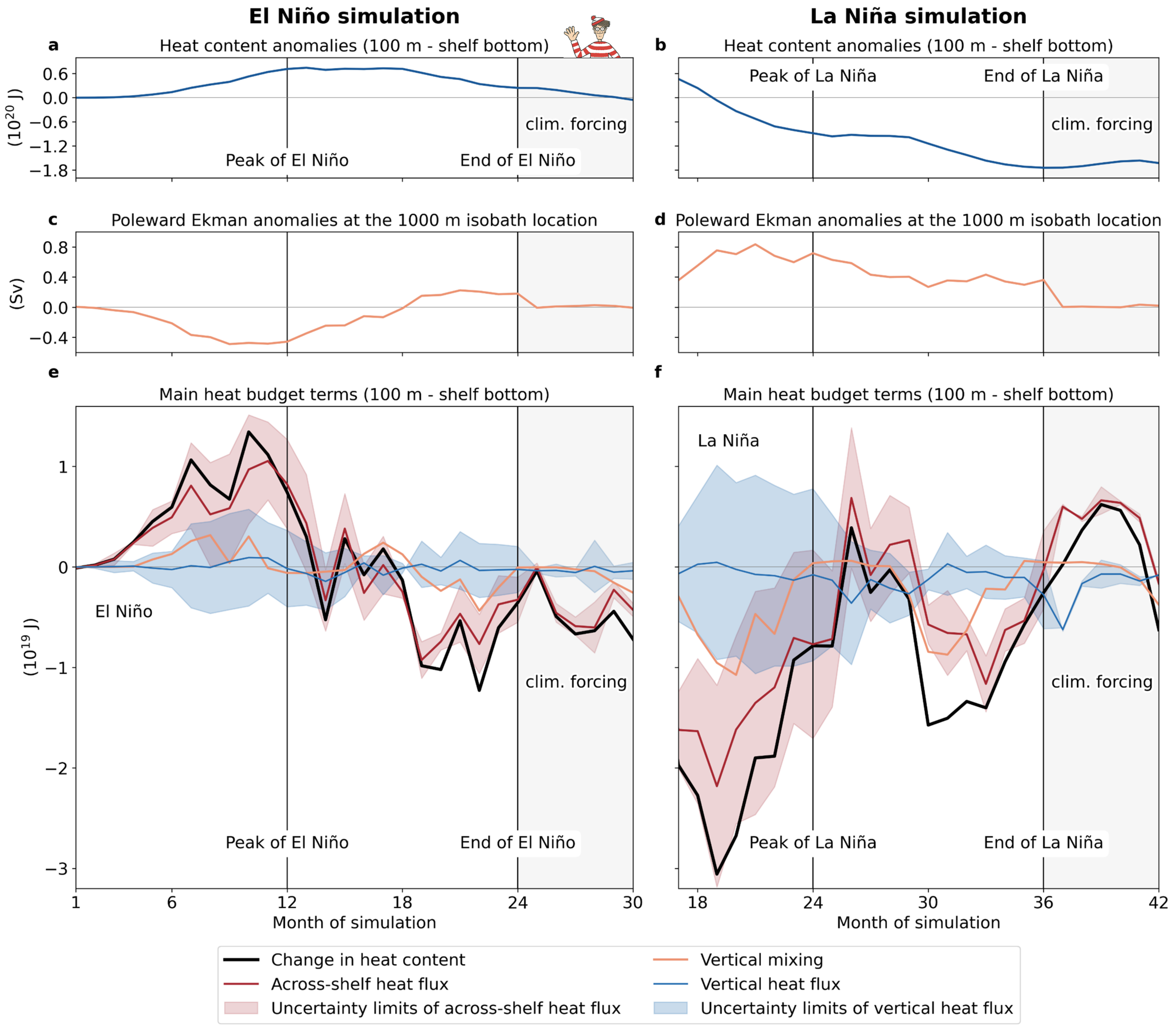

Fig. 3. ***a***, ***b***, *Time series of mean shelf temperature responses (10^{20} J).* ***c***, ***d***, *Poleward Ekman anomalies at the 1000 m isobath location (Sv).* ***e***, ***f***, *Main West Antarctic subsurface heat budget terms (10^{19} J).*