Supplement of The Cryosphere, 20, 1237–1255, 2026
https://doi.org/10.5194/tc-20-1237-2026-supplement

The Cryosphere
Open Access

Supplement of

The changing mass of the Antarctic Ice Sheet during ENSO-dominated periods in the GRACE era (2002–2022)

John Bright Ayabilah et al.

Correspondence to: John Bright Ayabilah (johnbright.ayabilah@utas.edu.au)

Section S1

Following the method proposed by Ren and Jin (2011), we compute indices for Central and Eastern Pacific ENSO events and compare their normalised and cumulatively summed timeseries to those of the Niño 3.4 index.

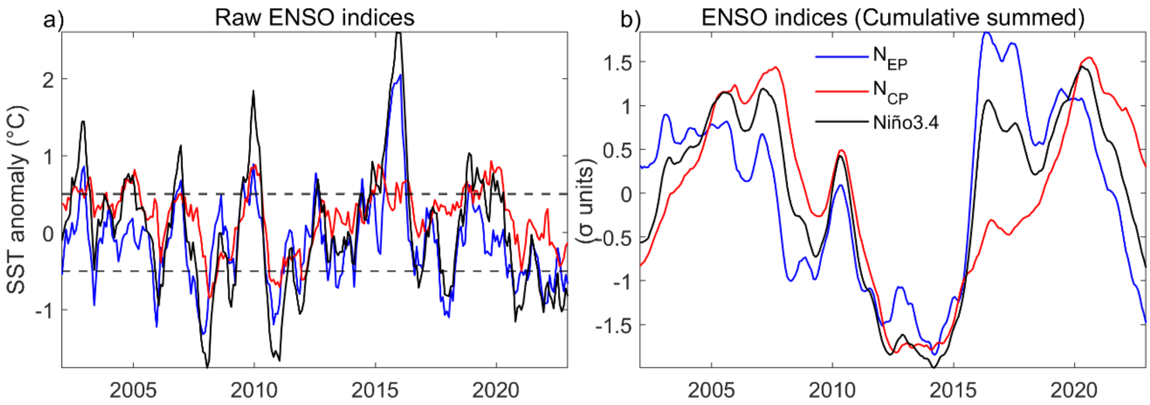

Figure S1. Timeseries of raw (a) and detrended cumulative (b) ENSO metric indices. The Niño Eastern Pacific (NEP, blue), Niño Central Pacific (NCP, red), and Niño3.4 (black) indices are shown.

Section S2

Using composite analysis, we examined the spatial patterns of surface mass balance (SMB) and atmospheric anomalies during ENSO years. To achieve this, we first computed annual SMB accumulation anomalies and the annual mean Niño 3.4 index. El Niño and La Niña years were then selected based on threshold values of above 0.5 and below –0.5, respectively. Composite maps were subsequently generated for each category. This approach provides an additional framework for comparing our results with those derived from regression analysis.

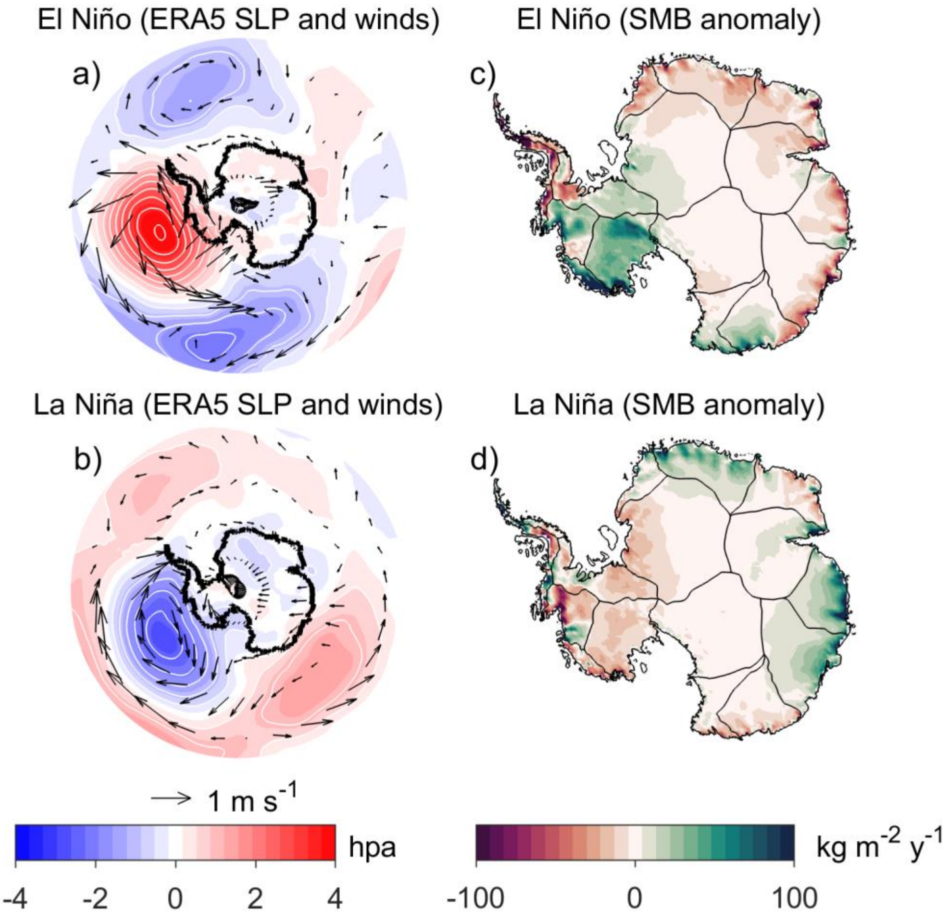

Figure S2. Composite maps showing the impact of El Niño and La Niña events on ERA5 mean sea level pressure (shading and contour, hPa) and 10 m wind anomalies (vectors, m s^{-1}), alongside surface mass SMB anomalies (kg m^{-2} y^{-1}) from RACMO2.4p1 over the period 2002-2022. Panels: (a, b) ERA5 mean sea level pressure and 10 m wind anomalies for El Niño and La Niña, respectively; (c, d) SMB anomalies for El Niño and La Niña, respectively.

Section S3

The relative impact of SMB changes was expressed as a percentage of the climatological mean SMB for each El Niño-dominated period. To achieve this, we computed the mean SMB for each period, compared it to the long-term climatological mean at each grid point, and then expressed the difference as a percentage.

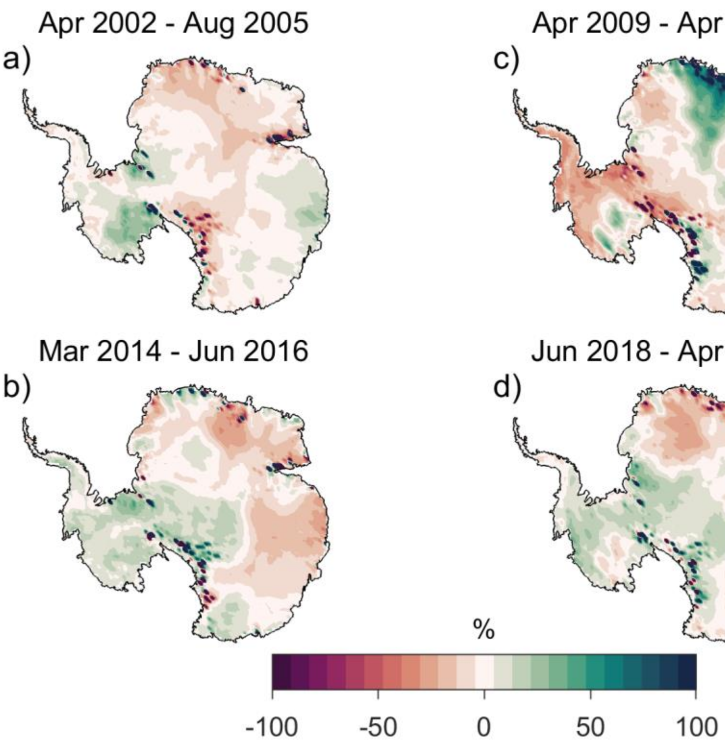

Figure S3. Map of RACMO2.4p1 SMB changes, expressed as a percentage relative to 2002–2022 during El Niño-dominated periods. Panels: (a) Apr 2002–Aug 2005, (b) Mar 2014–Jun 2016, (c) Apr 2009–Apr 2010, and (d) Jun 2018–Apr 2020, corresponding to the defined El Niño-dominated periods.

Section S4

The relative impact of SMB changes was expressed as a percentage of the climatological mean SMB for each La Niña-dominated period. To achieve this, we computed the mean SMB for each period, compared it to the long-term climatological mean at each grid point, and then expressed the difference as a percentage.

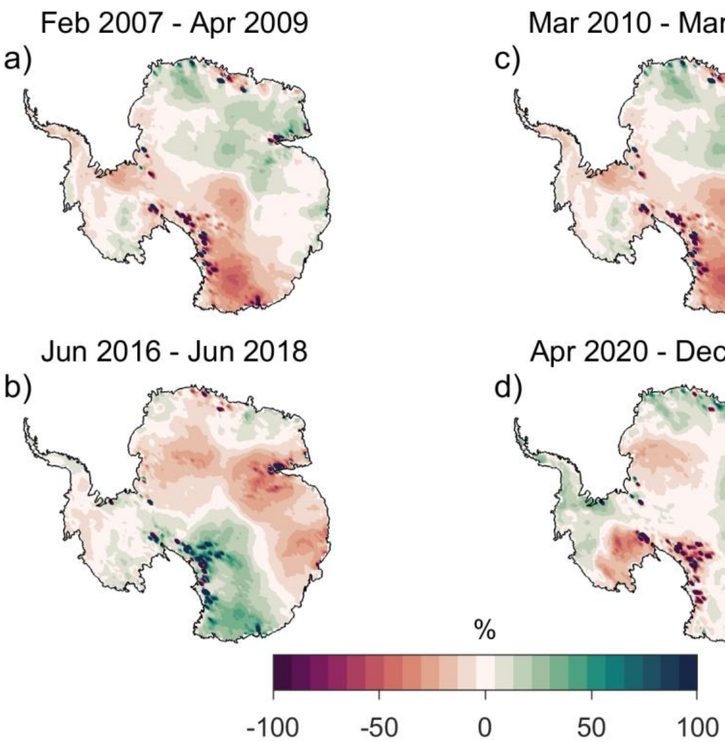

Figure S4. Map of RACMO2.4p1 SMB changes, expressed as a percentage relative to 2002–2022 during La Niña-dominated periods. Panels: (a) Feb 2007–Apr 2009, (b) Jun 2016–Jun 2018, (c) Mar 2010–Mar 2014, and (d) Apr 2020–Dec 2022.

Section S5

The impact of the March 2022 extreme event is assessed by comparing scenarios that include and exclude the event and evaluating the difference between the two.

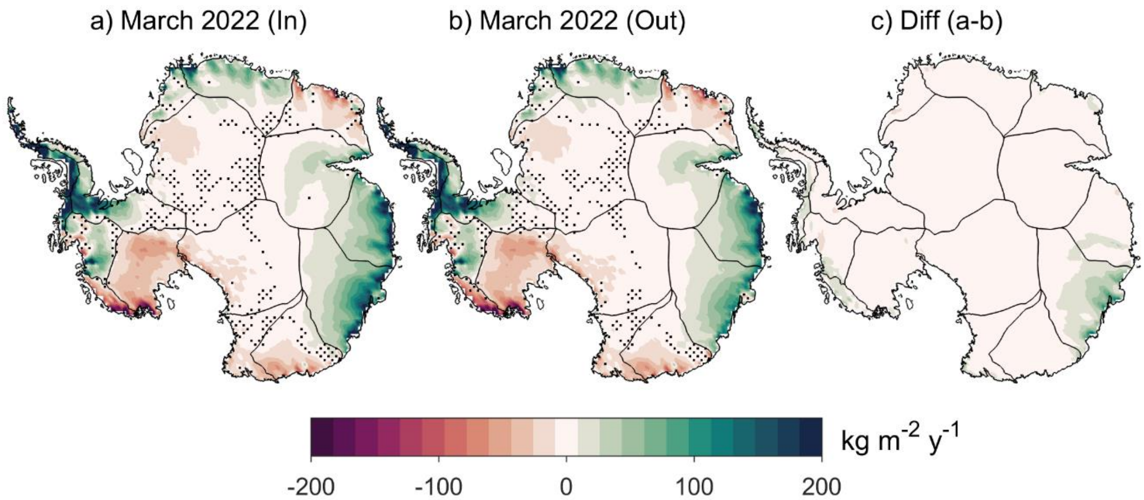

Figure S5. Map showing the rate of change of SMB anomalies during the 2020–2022 La Niña-dominated

period: (a) with the inclusion of the March 2022 extreme event, (b) with the March 2022 event excluded, and (c) the difference between (a) and (b). Non-significant areas are stippled at p-value>0.05.