Dear Dr. Li,

Thanks for your assessment of the latest version of the manuscript and for managing our submission again. We are glad to read that you appreciate our study and we have followed your recommendations to further improve it. We have thus reconsidered some of the comments from the reviewers and would like to propose an updated version of the manuscript.

1. We have added a more extended discussion on the impact of ENSO on Antarctic sea ice, including two new figures in the Supplementary Material: a regression map of SIC anomalies on the Niño3.4-index in spring and summer (Fig. S17) and a comparison of the time series of the observed total SIE (as in Fig. 1a) with the Niño3.4-index (Fig. S18). As you mentioned, a linear regression may not fully capture all the processes involved, but we find this figure helpful to illustrate the main regions potentially affected by El Niño/La Niña and the related impacts. We have thus mentioned a possible role of ENSO in the SIE summer minima, though our limited sample does not allow for further insights.

   L422: *Several studies have suggested an impact of ENSO on the atmospheric circulation at southern high latitudes, mostly related to the poleward propagation of an anomalous Rossby wave train at upper levels (e.g. Turner et al. 2004, Li et al. 2021). A prominent feature of this teleconnection is a weakened (strengthened) ASL during El Niño (La Niña) events, which could in turn affect sea ice in the adjacent regions. However, the atmospheric response is highly variable between ENSO events and likely modulated by the phase of the SAM (e.g. Hobbs et al. 2016). Hence, the impact of ENSO on Antarctic sea ice is even harder to establish (Simpkins et al. 2012). Simple linear regressions of SIC anomalies on the Niño3.4-index suggest that anomalous sea ice loss is associated with El Niño in the Ross sector and with La Niña in the Weddell sector, in spring and more weakly in summer (Fig. S17). The summer SIE minima examined here could thus encompass a contribution from ENSO variability, but a clear role is difficult to identify as no preferred ENSO phase emerges in our sample (Fig. S18): the five years considered as total minima follow different ENSO phases (El Niño in 2019, neutral conditions in 1997 and 2019, La Niña in 2006 and 2022).*

   Simpkins et al. 2012: Seasonal Relationships between Large-Scale Climate Variability and Antarctic Sea Ice Concentration. J. Climate, 25, 5451–5469, https://doi.org/10.1175/JCLI-D-11-00367.1.
   Li, X. et al. 2021: Tropical teleconnection impacts on Antarctic climate changes. Nat Rev Earth Environ 2, 680–698. https://doi.org/10.1038/s43017-021-00204-5

2. We have changed the title to "The role of atmospheric conditions in the Antarctic sea ice extent summer minima". We hope you will find this suitable.

Thanks and best regards,

Bianca Mezzina, on behalf of all co-authors

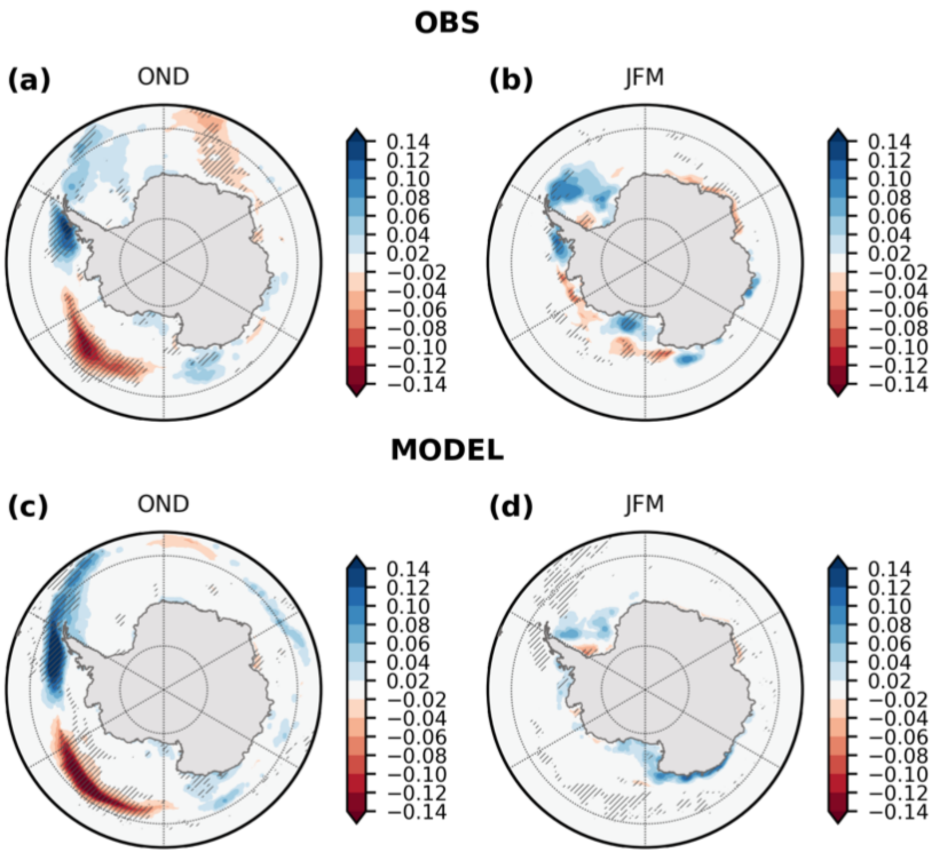

Figure S17: Linear regression of SIC anomalies on the DFJ Niño3.4 index in spring (left) and summer (right), representing the linear response to the warm ENSO phase (El Niño). Top: observations. Bottom: model. The Niño3.4-index is computed as the standardized area-averaged SST anomalies from HadISST over the Niño3.4 region (5°S–5°N, 170°–120°W). Hatches indicate statistical significance.

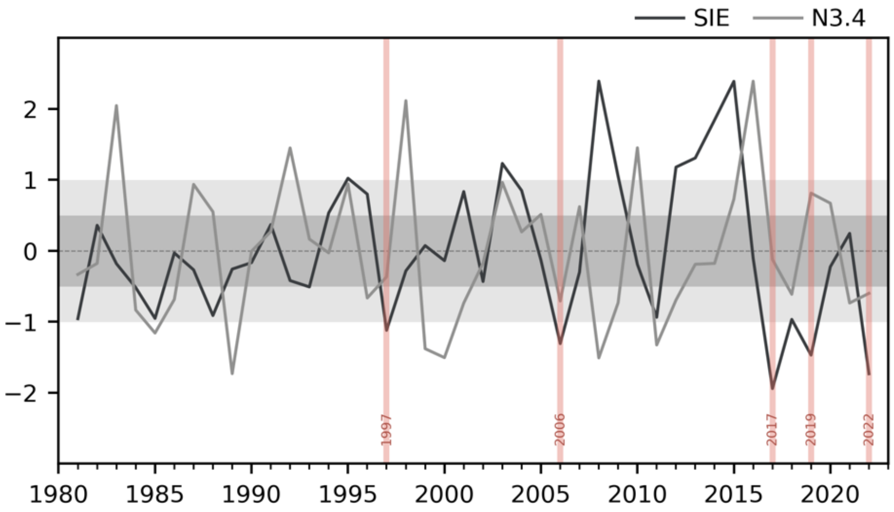

Figure S18: Black line: standardized SIE anomalies in JFM computed over the total SO domain in the observations. Grey line: DJF Niño3.4-index. Dark and light grey shadings indicate the ±0.5 and ±1σ, respectively. Years with a minimum SIE are marked in red.