

In the response document, reviewer comments I have responded to are shown in blue text
In the response document, responses are shown in black text

Line numbers refer to the track changes revised manuscript

RC1

The authors have made substantial changes to the manuscript, addressing most of my initial comments. I only have a few minor observations to note.

*All line references pertain to the non-track changes version of the manuscript.

General minor comment:

The manuscript presents the ERA5 zonal and meridional winds at 800 hPa. One of the primary uses of this wind dataset is to correlate wind anomalies with sea ice concentration, as mentioned in lines 233-237:

“These relationships can be understood physically: the correlations are consistent with the mean–state northerly winds transporting sea ice towards the coast and therefore, a weakening in these winds implies less transport towards the coast and thus increased SIC in the outer pack. The strengthening of the mean–state westerly winds will enhance northward Ekman transport of sea ice (increasing SIC), as Ekman transport theory dictates that sea ice will drift 45° to the left of the wind direction (UCAR, 2008; Purich et al., 2016), also increasing SIC in the outer ice pack.”

Additionally, it is used to connect the wind vector with the transport of sea salts to the MBS site, as referenced in lines 244-246:

“This indicates that, for both high and low sea salt deposition conditions, on the days of highest precipitation the winds blow over the northeast coast box sea ice anomaly area, and then blow towards MBS, depositing sea salt aerosol at the site that has been scavenged by precipitation (i.e. wet deposition).”

The application of wind data is further summarized in section 3.3, lines 293-296:

“Firstly, strengthened westerly winds increase sea salt aerosol lofting from open ocean sea spray. Secondly, in response to the strengthened westerly winds, there will be enhanced northward Ekman transport of sea ice. This ice transport mechanism will increase the SIC on the outer (equatorward) side of the ice pack and increase sea ice formation closer to the coast, with sea ice providing a source of sea salt, either by blowing snow over sea ice or frost flowers (Frey et al., 2020).”

As presented above, the ERA5 800 hPa data is utilized to interpret “surface” processes. However, the 800 hPa winds does not necessarily reflect surface wind variability accurately. An assessment of how 800 hPa winds relate to surface winds would help clarify whether the variability observed at 800 hPa is representative of surface wind conditions. This analysis could be included in the supplementary materials.

We thank the reviewer for their second review of our manuscript, and their thoughtful consideration of the difference between 800 hPa and surface winds. However, for the sake of the analysis in this manuscript, we feel the 800 hPa winds are appropriate to represent near-surface processes around the Antarctic margins.

The initial study examining the ENSO link to MBS was made using 10 metre surface winds (Crockart et al., 2021), as they were interested in the source regions of the sea salt, which is of course the surface ocean. In contrast, in this study we are looking at mechanisms relating to the larger scale (regional) circulation, including the circulation that is incident at the ice core site (~2000 metres asl). Using surface winds may give an incorrect result for the high-altitude continent (and ice core site), so we would prefer to stick with a level above the surface, as is commonly used in other studies to represent 'near' surface processes. Further, we are not looking at blowing snow transport (a surface process), but rather aerosol transport (near surface). Taken together, we consider that using surface winds would not reflect the full transport pathways well. Thus, we think it more reasonable to use 800 hPa data at these high latitudes and in this study.

Specific minor comments:

Line 24: I suggest adding a line introducing ice cores to smoothly transition from the importance of paleoclimate reconstructions to the importance of a well-dispersed network of ice cores.

Inserted sentence to link these two points. **Lines 24-25.**

Line 31: I suggest including the temporal timeframe used to obtain that correlation
Added

Line 44: remove the full stop before the citation
Removed

Line 81: It is mentioned that four cores were drilled at MBS, but only three are used for the "site average". Could you include a short explanation of why there is a fourth core that was not used?

Added explanation that the fourth ice core was retained for persistent organic pollutant studies. **Lines 83-84.**

Line 118: add a space after "1979-2016"
Added

Line 131: I believe the reference should say "Bureau of Meteorology"
Fixed

Figure 2 caption: change (B) and (D) for lower-case
Fixed

Table 1 Caption: correct "Nino" for "Niño"

Corrected

Line 289: correct “La Nina” for “La Niña”

Corrected

Line 318: remove the double full-stop

Removed

Line 346: As the text mentions the influence of ENSO in Law Dome, it would be useful to have a reference of where Law Dome is located. Maybe in Figure 6 and/or Figure 8.

Thanks for this suggestion. We have added a marker for the location of Law Dome to Fig. 6.

RC3

Attempts to identify the mechanism linking sea salt concentration to ENSO at MBS, building on Crockery et al. and Udy et al., both 2021. There is an El Niño but not a La Niña relationship, which is not particularly surprising given that the atmospheric response to El Niño has a relatively well understood mechanistic connection to Antarctic atmosphere-ocean anomalies. The opposite Pacific SST conditions don't force the same response, leaving other mechanisms to potentially dictate variability in Antarctic Ocean and sea ice conditions in those years.

The same uncertainty in precise mechanistic link between tropical Pacific variability remains in the manuscript, but is acknowledged more explicitly.

We thank the reviewer for their second review of our manuscript, which we appreciate. We feel that the mechanistic link remains limited but agree that our manuscript acknowledges limitations clearly.

Line 44 remove period before parenthetical containing references.

Removed

Line 58 careful to remember that climate indices like Antarctic Dipole are merely statistical descriptions of variability in climate/environmental parameters.

We have added the phrase a 'simplified statistical description of' to the description of the Antarctic Dipole to make this clear. **Line 61**.

Line 62 clarify that the Rossby wave is an atmospheric wave (just to not confuse reader between ocean or atmospheric “wave”)

Clarified

Line 120 there “are” known biases in ERA5... Good references for ERA5 anomalies also come from Bromwich et al. as recently as 2024 (GRL)

Changed is to are and added reference.

Line 127 read for consistent use of data in plural

Fixed for more consistent use of data in plural in the Data section.