

Dear Dr Heil

Thank you for the additional review and suggestions. Each point is addressed below (in red) and the changes have been made to the revised manuscript.

Comments:

l198: Change of "Flux (ppb kg m⁻²) = concentration (ppb) x snow accumulation (kg m⁻²)" to be a proper equation (with number).

Added two equations with numbers.

We also added proper equations for the calculation of xs SO₄ (section 2.6).

l463: Please soften the statement "where a clear mechanism was evident." -- This is agnostic to the reservation expressed by reviewer #2. As noted in your text above (l305ff) "the "interpretation team) to establish if the correlations observed can be attributed to a realistic source region and transport mechanism." No verification is provided here, so the statement "where a clear mechanism was evident" is not justified.

I encourage the authors to revisit their approach of an expert interpretation team.

The description of the data interpretation step has now been expanded in section 4.1. We have removed reference to the interpretation team, as this appears to have caused some confusion.

We also include the statement "based on the parameters applied for this first pass filter" to the text and figure caption. The intention is to acknowledge again that this is not an exhaustive approach, but rather an initial assessment to support the data usage.

In the revised text we have provided examples of the characteristics for a positive case, which we now describe as having a "plausible" transport mechanism or source region. The following text has been amended.

"For sites to be identified as having a relationship with either SIC, atmospheric pressure (z500) or winds (u850 or v850), they had to be supported by a plausible transport mechanism or source region. Therefore, each record was individually evaluated. Sites with a plausible connection were marked as "yes", while sites which did not have a plausible mechanism were marked as "no". In the case of the Ferrigno ice core (Fig. 2a), [Na⁺] is significantly correlated with SIC is in the adjacent ocean (Amundsen-Ross Sea), and with low pressure anomalies and winds over in the Ross Sea which transport air-masses in a clockwise direction from the source region to the ice core site. Thus, for Ferrigno a plausible source region and transport mechanism has been identified. Conversely, Na at the DFS10 site is also correlated with SIC in the Ross Sea, despite the ice core being located on the opposite side of the continent (Fig. 2b). However, DSF10 [Na⁺] is not significant correlated with either atmospheric pressure or winds that could transport [Na⁺] from the Ross Sea to the ice core location. Thus, for DFS10 a plausible source region and transport mechanism has not been identified.

Tab3: Need to define "uncertain" and its use there.

Sites where the transport mechanism was not clear were listed as “uncertain”, for example the TA192A ice core (Fig. 2c). Despite the significant correlation between TA192A [Na⁺] and SIC in the adjacent ocean, the correlations with atmospheric pressure and winds suggest transport that [Na⁺] from this source region would be transported away from the ice core site. Therefore, it is not possible to identify a plausible source region and transport mechanism for the TA192A site based on the parameters applied for this first pass filter. “

Minor comments:

l97: Need to be consistent "time scales" vs 3 x "timescales" (l 77, 269 and 492)

all converted to timescales.

l116: Correct "O'brien" to "O'Brien".

corrected

l154: Correct "(i.e." to "(i.e.,".

corrected

l159: Correct spelling of "east Antarctica" to capitalize "East Antarctica".

corrected

l182: Correct "e.g." to "e.g.,".

corrected

l209: Correct "(e.g." to "(e.g.,".

corrected

l217: Correct "O'brien" to "O'Brien".

corrected

l252: Ensure that closing bracket "]" is part of the expression "[SO₄²⁻".

Checked all brackets included

l255: Capitalize "table S1" to read "Table S1".

corrected

l268: Change "in the central East Antarctic plateau" to read "on the central East Antarctic plateau".

corrected

I327ff: The explanation of local vs far-field sea-ice information within the ice-core record needs cleaning up to promote the information held within the CLIVASH2k record. Pls detangle and strengthen your argument.

This argument has been updated in terms of the expected elevation of air-parcels reaching the site, which is different at low and high elevations. The work of Suzuki et al., 2013, demonstrate that air-parcel origin height and residence time is much lower at the coast than the interior.

New text added.

We have not applied a uniform cut-off size for the area of correlation or specified a minimum or maximum distance from the source region, as these features will be site specific. For example, the typical air-parcel origin height and residence time over the ice sheet is related to the site topography. As such, air parcels reaching low elevation coastal sites will originate from low elevation sources (e.g., < 2000 m) and have short residence times over the ice sheet (< 20 hours) (Suzuki et al., 2013). Some coastal sites (e.g., Sherman Island) may also be influenced by local orography (mountains), which block air-mass transport and limit the geographical extent of the [Na⁺] or [SO₄²⁻] source region e.g., Tetzner et al., 2021a. Conversely, air-parcels reaching central Antarctic sites (e.g., South Pole) may originate from elevations in excess of 4000 m, and reside over the ice sheet for more than 120 hours (Suzuki et al., 2013). Thus, higher elevation sites might be influenced by long-range air-mass transport and capture changes in sea ice from relatively distant source regions e.g., Winski et al., 2021.

I329: "Long-range air-masses" are not a thing. Assume you mean "Long-range air-mass transport".

Corrected

I330: Add a comma before "e.g.,".

Corrected

I330: Remove brackets around "(Winski et al., 2021)".

Corrected

I334: Capitalize "figures".

Corrected

I346: Correct "Fifty-Six" to "Fifty six" or change "56".

Corrected

I348: Comment from Reviewer 1 has not been corrected even though ticked off: "Please adjust them according to the values listed in Table 3 (if I understand correctly, it should be 86% compared to 78%)."

--> Pls correct, or explain in the author response.

Corrected – apologies this was missed previously.

I452: Change "the defined criteria." to "the criteria defined here".

Updated

I471: Change "first attempt to compile" to "first compilation of".

Updated

I473: Remove "In this study".

Updated

I475: Change "(if available) " to "(where available)".

Updated

I493: Add "distribution" to read "sea-ice distribution".

Updated