

A Comparison of South Pacific Antarctic Sea Ice and Atmospheric Reconstructions Since 1900

The study compares different proxy-based and station-based Antarctic sea ice extent reconstructions throughout the 20th century with the aim to investigate the reason behind their discrepancies, with a particular focus on atmospheric circulation. The reconstructions show a good agreement in the Weddell sea, and a weaker agreement in the Ross and Bellinghousen seas possibly due to changes in atmospheric circulation. The sea ice reconstructions are compared with pressure reconstructions spanning the Southern Hemisphere, finding a connection of mid-latitude atmospheric circulation with Antarctic sea ice variability.

The study is very well detailed and definitely worth publication. I particularly appreciated that years of efforts in reconstructing sea ice using paleoclimate archives are being used in a wide spatial and temporal context to investigate underlying climate relationships. There are a few typos here and there but otherwise it is excellently written, with a good flow and level of English. However, while I appreciate the level of detail of the paper, I think it could have been more concise, in order to facilitate the reader to go through the very long text. I suggest to try to simplify the text whenever possible as I had myself to read the paper several times to understand the reasoning of the authors. One possibility could also be to report a discussion of the results in the "Discussion" section that follows the same structure as the "Results" section, to better synthesize the main findings of the article.

Also, as the authors state on page 15, the various sea ice reconstructions represent different aspects of sea ice variability and moreover are based on different methodologies and on a different number of records considered. I suggest to be more clear of these limitations in the text when examining the different sea ice reconstructions and their relationship with atmospheric circulation.

Please find below some technical comments:

Table 1: in the Abram et al. (2010) and Thomas and Abram (2016) rows I would indicate the type of sea ice proxy used. In the Dalaiden et al. (2021) row please modify "isotope-enabled CESM1" with "isotope-enabled CESM1"

Figure 2a: please change the title to Fogt et al. (2022a) for consistency

Line 151: "The CDS algorithm output combines ice concentration". Remove "of".

Line 169: "sediment-derived"

Line 172: "ice core-derived"

Line 174: remove "a" from "used a three ice cores"

Line 176: "Further West" with capital letter

Line 190: "and those variables given by the Earth System Model..." please specify which variables

Line 194: the Dalaiden et al. (2021) reference is repeated twice, please remove one

Line 216: please change with "paleo data, including those from data assimilation -based reconstructions"

Figure 4: please make clearer that the middle and right columns refer to Abram et al. (2010). Why not change the colors from Thomas and Abram (2016)?

Line 306: "Dalaiden et al (2021) are typically highest in JJA". Please remove "in"

Figure 5: I suggest to indicate the sectors in the figure as in figure 1a green line. Again, it is not clear which Fogt et al. (2022) paper is referred to.

Line 344-357: Here the authors compare the Abram et al. (2010) sea ice reconstruction with the other reconstructions in figure 5. However, such reconstructions are based only on three ice core records. I suggest to mention here that this is one of the limitations of that reconstructions with respect to e.g. Dalaiden et al. (2021) which is based on several records.

Line 368: typo in “geopotential height”

Line 391: “opposite to the strong positive trends”. Please add “to”.

Figure 7: as in Figure 2a please change the title to Fogt et al. (2022a) for consistency

Figure 8: Again clarify which Fogt et al. paper

Line 510: “it is not surprising that the relationship”. Remove “then” and “both”

Figure 10: Please rename figure titles

Line 566: please add “to” after “opposite”

Line 573: “This suggests that the Fogt...”. Please add “that”

Line 591, 593 and 594: please check the figure number, it should be figure 11

Line 608: Please refer to the figure

Line 616: I suggest to change “hence why the” with “explaining why the”

Line 617: add parenthesis before “black correlation”

Line 741: Figure 12 instead of 11