Response to EC1: MS No.: egusphere-2026-1250

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Authors response to EC1:

According to the comments from the two reviewers and my own assessment, the manuscript should be further improved by addressing some questions and suggestions, especially from reviewer 1. I suggest minor revision before this manuscript can be considered for publication.

We thank the reviewers for their comments and appreciate your assessment of the revised manuscript. We have further addressed each of the remaining points raised by the reviewer including additional discussion, softened attributional wording, and a comparison of NSIDC and NNR1 daily sea ice extent. Our specific point by point response to Reviewer 1 are given below.

Authors response to RC1:

We thank the reviewer for their careful examination of the manuscript.

The revised manuscript has been substantially improved, especially in the methodological description and in the addition of pattern-correlation diagnostics. However, I still have several major concerns that should be addressed before publication.

First, the physical interpretation remains insufficient. The newly added pattern correlations help identify whether the extracted events resemble known modes such as SAM, PSA, ASL or ZW3, but they do not fully explain the processes through which these atmospheric states affect sea-ice growth or retreat. A clear discussion of the relevant thermodynamic and dynamic mechanisms is still needed.

We have added further motivation in the introduction and discussion of the broader thermodynamic and dynamical processes on how the major climate modes affect sea ice in the Antarctic region. The paragraph in the discussion on these process can be found starting line 348 of the revised manuscript.

Second, some causal or attributional wording remains too strong. Although the authors state that they do not claim causality, the manuscript still uses terms such as "drivers", "responsible for", "dominated by". These should be further softened to more accurately reflect the analysis, which mainly demonstrates covariation and physically plausible associations.

We agree with the reviewer on this point and have removed all language which implies causation throughout the paper. We note that some instances of "driver" remain when discussing the literature outside of the analysis, such as ocean-based drivers, to remain consistent with the language used in those publications.

Third, the robustness of the sea-ice and reanalysis data remains insufficiently addressed. Since the study focuses on synoptic-to-subseasonal events, the comparison between NNR1 and NSIDC

at monthly scale is not fully adequate. The authors should either provide event-scale or daily-scale validation for key sea-ice events, or more explicitly acknowledge this as a limitation. Similarly, the possible sensitivity to the choice of atmospheric reanalysis should be discussed more clearly.

We have expanded Figure 1 to include comparison of the anomalous daily sea ice extent for the two reanalyses spanning January 2016 through October 2024 (using a common climatology as previously used for the monthly sea ice concentration anomalies) incorporating updated accompanying text on the calculation and findings (starting line 103 of the revised manuscript). The possible sensitivity of the findings to the choice of reanalysis and attribution of cause to potential differences requires a detailed comparison of biases in selected reanalysis products, including their underpinning dynamical models. While this lies outside the scope of the present study, we mention this as a consideration for a future study starting line 385 of the updated manuscript.

Overall, the manuscript is improved, but further revision is still required before it can be considered for publication.