We appreciate the reviewers for investing their time and providing constructive comments on our manuscript. Overall, we revised the manuscript in accordance with their suggestions. Below, we explain the changes we have made and present our reasoning for the suggestions we didn't follow. We hope these revisions are satisfactory and that the revised manuscript meets the journal's criteria. Our responses are tabbed and blue, following individual comments. The line numbers we refer to are those of the marked manuscript.

RC2: 'Comment on egusphere-2025-5820', Anonymous Referee #2, 20 Mar 2026

1. General

In this paper, the authors analyze ice core proxies for the opening of a large polynya near Maud Rise. Polynyas are important for a host of reasons, e.g., they are biological hotspots, they affect the regional weather, and are a location of deep ocean water formation. We don't know why the Maud Rise Polynya forms in some years and not in others. It makes sense that this variability is advected onto Antarctica where it is preserved in ice cores. The goal of the present work is to infer the link using numerous proxies within the ice core, e.g, sodium, δ18O, snow accumulation. I think the paper is straightforward and worthy of publication after some minor revisions. I outline some comments below.

We are glad that the reviewer enjoyed reading our manuscript and found it worthy of publication. As described below, we revised the manuscript in accordance with the reviewer's suggestions.

2. Specific comments

1. line 19: I think that 'before the satellite era' would make more sense that 'beyond the satellite era' in this context.

We have updated this to read 'before the satellite era'.

2. line 37: can you be more specific than 'global climate processes'?

We have now modified the sentence to read as follows (Line no. 36 – 39):

> *The significance of polynyas extends beyond their immediate vicinity, influencing deep-water formation, marine ecosystem dynamics, and the intensification of sea-to-air heat and moisture fluxes during the winter months*

3. line 74: where is the Goosse ice core from? Is it the same location?

> The cores used in Goosse et al. 2021 are also from Dronning Maud Land, but from different locations, which are shown in Figure 5 with green dots

4. lines 120-249: I think that a bunch of this information can go into the appendix. It currently breaks the flow of reading the paper.

> Thank you for the suggestion, however we believe that the ice core information, chronology development and satellite-based polynya metrics calculation set the premise for the work and therefore, we would prefer this to be included in the main text. However, we leave this decision to the Editor.

5. line 252: 'imagery is'?

> Changed as suggested

6. line 361: I would say that these are potential polynya years since we have no way to verify that there was a polynya there at that time, right?

> We agree with the reviewer's observation and have rephrased this in the main text as follows (Line no. 411 – 412):
>
> > 'We identified twenty-five potential polynya years from 1774 to 2016 (likelihood >0.6; Fig. 7b);'

7. line 369: the 1833–1884 window is very long! I think this is a typo?

> Thank you for identifying this mistake. This was indeed a typo. We have however recalculated the polynya index as per Reviewer 1's feedback and the results have been rewritten accordingly.

8. Figure 7: I think it is worth labeling the grey bars as polynyas. Why are they multiple shades of grey?

> The dark gray bars show the polynya years, while the light gray bars mark the years with halos., which are transient and unstable non-polynya open waters in some years. However, we understand the confusion that this can lead to for readers. We have now revised the figure to only mark the known polynya events of 1964 and 1974 – 76.

9. Figure 8: It would be valuable to have the grey bars on again to show the recent polynyas. Also is the accumulation difference helpful? I think a single plot that compare directly compares the Goosse data (e.g., Stat) to the new index would be helpful.

> Thank you for the suggestion. We have now labelled the polynya events of 1964 and 1974 – 76 in Figure 8. As for the reviewer's suggestion to only show one index from each study, we

> would like to highlight how different proxies and calculation techniques affect the polynya indices and therefore would like to keep all the indices in the figure.