Reviewer Comment 3

This study uses paleoclimate reconstructions to assess the drivers and rarity of the 1940s events that led to large ice shelf melting and glacier retreat in the ASE. These events were rare due to their large magnitude and duration. Local forcings in combination with a major ENSO led to the 1940s events, which are rare on centennial timescales but uncommon on millennial timescales. The paper is written in an elegant way, with clear messages and figures. The subject is of interest to glaciologists and oceanographers studying West Antarctica, and I recommend publication in The Cryosphere. Below are some comments and suggestions that might help to improve the manuscript.

We thank the reviewer for their positive review and helpful comments.

Major:

1) The authors say they evaluated the rarity of the event in the Holocene, but their simulation goes back to ~2000 yr (lines 192-194). Although this is part of the Holocene period, it does not cover the full Holocene or the Holocene conditions. I need a better explanation of why they claim the analysis covers the Holocene. Or, the authors could change Holocene to a simple "10kyr period"?

Following our response to the other reviews, we will revise the text to note the uncertainty associated with repeating the LENS simulations as an analogy for the Holocene.

2) Section 3.2: When I read "Drivers" (also in the title), I thought the authors would track down the origin of the rare 1940s event. But I have the feeling that they don't. Instead, their assumption is that other events in combination with ENSO could trigger and amplify the 1940s event. My questions remained: How this event was generated? What (local conditions) triggered this event? Saying that the 1940s event was due to local drivers and not totally ENSO-related does not properly address the "Drivers" of the 1940s event, in my opinion. I'd like to see more analysis on this to properly address what led to the 1940s event. I think this is a key question that could benefit this paper to be a greater contribution to the glaciological/ocean/atmospheric community. If the authors decided to not track down the causes of the 1940s event, which I understand can be a lot of work, I'd recommend avoiding using "Drivers". However, I think understanding the local conditions could be a great addition to the paper.

Following reviewer #1's similar comment, we will add some new analyses, figures, and text to investigate the potential additional drivers of the 1940s event. This will include analyses from the Atlantic and Indian ocean pacemaker simulations. Please refer to our explanation of this analysis in our response to reviewer #1.

We note that this does not address the drivers of local variability in the Amundsen Sea, which have been investigated in previous studies (e.g., Raphael et al., 2016; Goyal et al., 2021). We will remove the use of the word "Drivers" in our manuscript title and revise our use of the word "drivers" throughout the text.

Minor:

- Line 294: Figure 5 instead of Figure 4?

Yes, that is a typo. We will change the reference to Figure 5 in the revised manuscript. We thank the reviewer for catching this.

- Line 348: Figure 6e?

Yes, that is also a typo. We will change the text in the revised manuscript.

- Why the authors use 10kyr most of the time, but sometimes 10ka?

We will change all cases of “10ka” to “10kyr”.

- In the authors' opinion, what is most relevant for the ice shelf melting that occurred in the ASE: duration or magnitude of the 1940s event?

We suggest that it’s the combination of the two (i.e., the time-integral of the anomaly) that caused a significant perturbation to the ice shelves. Modern observations and the reconstructions show that similar magnitude events have occurred several times before in only the last several decades, and similarly persistent events have occurred several times before—but never one that is both large in magnitude and duration. However, ocean simulations that investigate the sensitivity of CDW transport and ice shelf melt to wind events with different characteristics are needed to answer this.

New References

Goyal, R., Jucker, M., Gupta, A. S., England, M. H.: Generation of the Amundsen Sea Low by Antarctic orography, Geophys. Res. Lett., 48, e2020GL091487, 10.1029/2020GL091487, 2021.

Raphael., M. R., Marshall. G. J., Turner, J., Fogt, R. L., Schneider, D., Dixon, D. A., Hosking, J. S., Jones, J. M., Hobbs, W. R.: The Amundsen Sea Low: variability, change, and impact on Antarctic climate, Am. Met. Soc., 97(1), 111-121, 10.1175/BAMS-D-14-00018.1, 2016.