**Review of NCOMMS-26-009040**

**Title**: "Model Assessment of Winter Extratropical Cyclone Short-Term Impacts on the Antarctic Marginal Ice Zone"

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Summary and General Comments

This study uses a sea ice-wave model to assess cyclone impacts on the Antarctic marginal ice zone (MIZ). The authors find that enhanced wave activity modulates the inner boundary of the MIZ whereas ice drift and thermodynamic effects impact the extent of the ice edge. They also found that expansion events are more likely earlier in the season, with compaction events dominating later. The two-part study covering both cyclone case studies and statistical analysis of nearly 400 cyclones clearly demonstrates these results.

The title and abstract describe the contents of the paper well. The introduction provides full, clear context for the contribution of this work and is well-cited. The choices made in the methods seem appropriate, however additional clarification on the methods is needed in spots, as listed below.

Overall, the paper is well written, and the figures are clear and easy to understand. The results are novel and an interesting way to assess storm impacts, with the integration of a wave model leading to unique results on the evolution of MIZ width and extent. These results are important to consider in future cyclone-sea ice studies. I have a few, hopefully minor, suggestions listed below.

Specific Comments

119-129/Fig. 1: It might be helpful to include a short description of the cyclone dataset here, just to ensure that the month-to-month differences described later in the paper cannot be attributed to differences in cyclone characteristics like pressure or size.

132: How was this arc length selected and does the analysis change significantly if using a different subdomain? Please provide some justification to this choice. An extra figure demonstrating the size of the sector relative to a cyclone case might be useful here (or add to Figs. 2-4, since the cyclone case studies are different sizes). I also assume the values described in each of the following cases are averaged over the MIZ across this width, however, I don't believe this is explicitly stated in the methodology.

170-171: Perhaps reference Figs. C1e,i here since ice age and concentration are not shown in the figure in the main text.

182: Please be clear about what regions are being averaged over, whether it's just the MIZ or the domain shown in Figure 3.

Figure 3 caption: Only the meridional speeds appear to be shown in panel h.

224: I think a little more detail is needed here, whether this is specifically at the cyclone crossing location or averaged across a region.

Figs 5+6: I found these time series to be very effective!

247-251: It should be made clear here whether the values if $v_{wind}$ and $T_{ice}$ are averages across the MIZ or just at the point of cycle crossing.

259: Is $N_i$ the sector width of 21 grid cells? If so, it should state that this value is the same for all cyclone events.

273: Please clarify the duration the MIZ changes are calculated over. Does it depend on the cyclone lifecycle or is it +/-96 hours as in Figs. 5+6?

Fig. 8c: What does the spread for melting/freezing events look like?

Fig. 8: I'm curious to know if July and August have a greater fraction of (or perhaps longer) off-ice events than later in the season. I also recognize that this is new analysis, but I wonder if it is possible to add this information to this figure or within the discussion.

305: Could this figure be moved to an appendix within the main text?

308: Should the beginning of this sentence refer to "early" winter for clarity?

Fig. C1 caption: The labels here appear to be a bit out of order and the label for ice thickness is missing.

<u>Technical Corrections:</u>

176: missing verb ("edge from")

230: extra parenthesis around figure reference