Quentin Dalaiden

The study led by Paul Holland is very interesting and presents a heavy load of work on historical and future changes in surface winds in the Amundsen Sea area. The authors provide a clear quantification of the internal and external contributions to wind changes in this region where very large ice losses have been observed over the past decades. They also provide a narrative on the ice loss from the WAIS starting in the 1940s. This study is thus highly suitable for publication in The Cryosphere. I really enjoyed reading the paper, which I find very well written. Here are some comments:

Lines 54-55: Could you give more detail on the ice-ocean feedbacks that could maintain the initiated ice loss?

We will expand this point.

Lines 84-88: Some studies suggest that the ASL deepening is also driven by anthropogenic forcing, in particular the stratospheric ozone depletion (e.g., England et al., 2016) – albeit it is seasonally dependent. I think it would be worth mentioning.

We will add this point (see also below).

Lines 256-257: It is worth mentioning that the impact of stratospheric ozone depletion is mainly visible during austral summer, which could explain why the response to ozone is weaker than the response to GHGs (in addition to the fact that over the analyzed period, some decades are not impacted by ozone as mentioned by the authors).

We will add this point (see also response to reviewer comments).

Lines 260-261: Have you looked at the variance in the reconstruction and model simulations before computing the difference between the two for inferring the internally-generated variability? My feeling is that if the reconstructed variance is different from model simulations, the inferred internally-generated variance could be wrongly estimated (over and underestimated). This could directly impact the contribution of the internal and forced variabilities on the total change.

We agree that is crucial that the variability in the CESM1 simulations be consistent with that in the reconstruction if we are to derive the internally-generated trends using our technique. The pertinent question in the lines referred to here is whether the reconstructed centennial trends sit comfortably within the CESM1 ensemble of historical centennial trends. (The CESM1 ensemble spread in trends is caused by the modelled internal variability.) We show in Figure 3 that this is the case for LENS (see paragraph starting on line 337), and we also find this to be true for PACE (not shown, line 438). In particular, Figure 3 shows that the 'internal part' of the trends in the reconstruction matches that realised by the model. This model--reconstruction consistency is aided by the fact that we use CESM PACE simulations as the 'prior' in the reconstruction, but it is still a very positive result. We will add a note to line 260 referring the reader to this consistency test later in the paper.

Lines 265-266: I don't fully agree with the authors on the fact that the ASL deepening is internally generated. Figure 1b indicates an intensification of SAM (decreasing sea-level pressure around the Antarctic continent), driven by the forced variability. Yet, SAM strongly modulates the ASL. Therefore, to me, the ASL deepening is also driven by external forcings and not only by internal variability. In contrast with the forced response, the internal response is less spatially homogeneous. Figure 1c clearly shows a major role of tropical variability with the propagation of Rossby waves. Would it be possible to quantify the contribution of both the external and internal variabilities? To come back to my previous comment, I think it is important to pay attention to the variance of the reconstruction and climate model simulations when assessing those contributions.

This important point relates to the definition of the ASL. If the ASL is defined in terms of its absolute central pressure, then it is certainly true that external forcing plays an important role in ASL trends, since external forcing drives a strong deepening of pressures over Antarctica (Figure 1b). However, if the ASL is defined in terms of local pressure anomalies, e.g. as an anomaly relative to the zonal mean pressure, then the influence of external forcing on ASL trends is much weaker, since external forcing drives trends that are primarily annular over Antarctica (Figure 1b). We prefer this 'local' definition of the ASL, since it relates more closely to the winds of interest, and separates the behaviour of the ASL from wider hemispheric signals such as the SAM. However this is a very important distinction and so the paragraph will be re-written to make this clear.

Lines 453-454: As mentioned in your previous paragraph, you should specify that the tropical Pacific cannot explain the entire variability of winds.

The tropical Pacific variability cannot explain the wind variability on centennial timescales, as detailed in the previous paragraph, and this paragraph is intended to consider interannual and interdecadal timescales. We will clarify this point.

Lines 616-617: As already mentioned above, I don't fully agree with the unique contribution of the internal variability to the ASL deepening. In the same paragraph, I think it is worth mentioning that the Tropical Pacific cannot explain all the internal variability (since it is in contradiction with the results of Holland et al. [2019]).

As detailed above, the role of internal variability depends upon the definition of the ASL, while the tropical Pacific cannot explain variability primarily on centennial timescales. We will clarify this paragraph.