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The Cryosphere Discussions

Interactive comment on "2020 Larsen C Ice Shelf surface melt is a 40-year record high" *by* Suzanne Bevan et al.

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Response to Reviewer 1.

Dear Dr King, Many thanks for your careful reading and comments on the manuscript. The suggestions have all been very helpful and we hope we have addressed them satisfactorily.

Specific comments 1. In their study of atmospheric drivers, the authors focus on teleconnections with the IOD and their interaction with the SAM. It is well-known that teleconnections associated with ENSO in the tropical Pacific also affect the Antarctic Peninsula region through the Pacific-South American (PSA) teleconnection pattern. In early 2020 ENSO was in a rather weak warm phase which is generally associated

with high pressure to the west of the Antarctic Peninsula. However, there is no clear indication of a PSA wavetrain in figure A2 and it looks as if the IOD is dominating on this occasion, which justifies the authors' focus. It would, however, be helpful to discuss the (lack of an) ENSO response on this occasion to relate your findings to other work on southern hemisphere teleconnections.

Reply

This is a good point and we will include the following paragraph in the Methods and Data section:

'The El Nino Southern Oscillation (ENSO), or its atmospheric component the Southern Oscillation Index (SOI), is often considered as an indicator of how tropical weather patterns are affecting the high southern latitudes and Antarctic melt (Tedesco and Monaghan, 2009; Trusel et al. ,2012; Barrand et al., 2013). ENSO has generally been found to be inversely correlated with Antarctic surface temperature and with melt, but regionally, and particularly on the AP, the impact can depend on the combined phases of ENSO and (Nicholas and Bromwich, 2014; Clem et al., 2016).' We will also include the following phrase in the last paragraph of the Results section: 'while there was only a weak positive El Niño (https://origin.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ONI_v5.php) toward the end of 2019 and into 2020,'

And add the following paragraph to the Discussion:

It is unlikely that the weak warm El Niño of the 2019/2020 summer was a trigger for the melt event because the Pacific South American (PSA) wave train signature of stationary Rossby waves excited by a warm El Niño (Karoly, 1989) would normally manifest as anomalously high pressure over the Amundsen Sea to the west of the AP (Mo and Higgins, 1998). This anomaly is not apparent in Figs. A2b and c and the wave-path latitude in Figs. A2a–c is shifted south by about 10 âŮę in the Pacific sector compared with that associated with a PSA wave train.

2. Southern Hemisphere teleconnection patterns are generally weaker and less robust in summer than in winter. The averaging periods for the geopotential height anomalies shown in figure A2 a-c appear to have been chosen "...to maximise signals...". How sensitive are the patterns to the exact choice of the averaging period? Are the anomalies statistically significant? It is standard practice to indicate areas of statistical significance on plots like these.

Reply

The averaging period can be justified because of the abrupt downward expression of the SSW on about 17 Oct, causing SAM to go negative. So, it is based on what actually happened and in that way helps to maximize the signal. We will add a note on this point to the caption of Fig. A2.

Regarding the comment on significance we will shade on Fig. A2 (and A3) the areas where the anomalies and the regressions are statistically significant.

3. Please also note the supplement to this comment:https://www.the-cryosphere-discuss.net/tc-2020-130/tc-2020-130-RC1-supplement.pdf

We have addressed and replied to all the notes on the supplement as attached. In summary, we have accepted all the suggestions and will edit the manuscript accordingly.

Additional references

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Impact of a Changing Southern Hemisphere Annular Mode on Antarctic Peninsula Summer Temperatures, J. Climate, 19, 5388–5404, https://doi.org/10.1175/jcli3844.1, 2006. Mo, K. C. and Higgins, R. W.: The Pacific–South American Modes and Tropical Convection during the Southern Hemisphere Winter, Monthly Weather Review, 126, 1581–1596, https://doi.org/10.1175/1520-0493(1998)126<1581:TPSAMA>2.0.CO;2, publisher: American Meteorological Society, 1998. Nicolas, J. P. and Bromwich, D. H.: New Reconstruction of Antarctic Near-Surface Temperatures: Multidecadal Trends and Reliability of Global Reanalyses, Journal of Climate, 27, 8070–8093, https://doi.org/10.1175/JCLI-D-13-00733.1, publisher: American Meteorological Society, 2014. Tedesco, M. and Monaghan, A. J.: An updated Antarctic melt record through 2009 and its linkages to high-latitude and tropical climate variability, Geophys. Res. Lett., 36, L18502+, https://doi.org/10.1029/2009gl039186, 2009. Trusel, L. D., Frey, K. E., and Das, S. B.: Antarctic surface melting dynamics: Enhanced perspectives from radar scatterometer data, J. Geophys. Res., 117, F02023+, https://doi.org/10.1029/2011jf002126, 2012.

Please also note the supplement to this comment:
https://tc.copernicus.org/preprints/tc-2020-130/tc-2020-130-AC1-supplement.pdf

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