

Dear Prof. Karen Heywood,

Thank you so much for your comments and suggestions – we have updated the manuscript accordingly, and our answers are found below in italic.

Best regards, Elin Darelus & co-authors

Reviewer 1:

I enjoyed reading this paper. It is well written, clearly presented and interesting, with some ingenious analyses. The figures are very good. A particular strength is the analysis of an excellent long-term climatology that has been carefully assembled of ship, seal and float profiles in a region where there have been relatively few studies. It also presents unusually long time series from moorings near the Filchner Ronne Ice Shelf and on the continental shelf and slope. The paper discusses temporal variability, and in particular, possible causes and implications of an occurrence of surprisingly warm WDW in 2021. I found the estimates of the possible impact on AABW very interesting.

I am happy to recommend acceptance of the paper subject to consideration of some minor suggestions that I list below.

The abstract is nice, but it doesn't really do justice to the conclusions you came to about the importance of the observed warming, for example for eventual AABW properties. It would be good to include these implications in the abstract.

We now mention the potential implications for AABW properties in the abstract.

L17 I wouldn't say that the Amundsen Sea has a narrow continental shelf – it is hundreds of km from the shelf break to the vulnerable glaciers such as Pine Island and Thwaites.

No, the shelf is definitely not narrow there. The error is corrected and the text now reads: "where the continental shelf and the ice shelf cavities are flooded by warm Circumpolar Deep Water (CDW)".

L23 include a reference to moderate melt rates for FRIS?

We have included a reference to (Rignot et al., 2013)

L27 typo – you mean tenths not tens of a degree, I think.

Corrected

L41 I had to read the bit after the Nicholls reference several times, as it's difficult to make out with the commas and references breaking it up. Try to rephrase to make it easier for readers?

We have moved the references to the end of the sentence to improve readability.

L54 I was curious what the source was of the remaining profiles out of the >1000 that are not ship or seals! Later on it's clear that these are profiling floats – I would state that here.

We now state that the remainder of the floats were collected by profiling Argo-floats.

Also I recommend giving a reference to MEOP to give due credit to those assembling MEOP data – information about how to cite the data is here <https://www.meop.net/database/how-to-cite.html>.

We have included a reference to one of the articles suggested on the meop website.

Probably there is a similar reference to duly acknowledge the efforts of those assembling the Argo float data set? Both these data sources should be cited in the text as well as included in the data section at the end.

We now acknowledge the ARGO-project, and list the data bases from which Argo-data were downloaded.

L64 what is OTE? Expand?

OTE is short for Ocean Test Equipment, the company that produces the bottles, but we decided this information was unnecessary and removed the sentence.

Caption to Figure 2. I get that the mentions of 1515 m depth and the 1300-1700m depth range are referring to the sea bed depth, but maybe that needs to be spelt out more clearly?

We now refer to isobaths rather than depth in the caption.

L106 and L108 Are these references to the same paper? In review? 2023? Reference list says in prep?

No, these are two different papers. The first one is now published and the reference is updated accordingly. The second one is about to be submitted.

L116 The in review reference should be updated when available?

The paper is now published, and the reference is updated

L118 reference figure 6 here? It takes a while before the reader realises which figure they are meant to be looking at to support this paragraph. It would be helpful to add references to the relevant figure panel throughout this paragraph to help your readers. E.g. the final sentence, L129,

We now refer to Fig. 6 in the first sentence of this paragraph and include references to individual panels of Fig. 6 throughout the paragraph.

Figure 3. This is a great figure! Very ingenious. There's a lot of information in these. I found the order of the 4 panels confusing – would it be easier to follow if the 4 panels progressed W-E or E-W?

We have re-arranged the order of the panels in Fig 3-5 and corrected the labels (there was apparently some confusion on our side too).

I wondered whether you had plotted the depth of the Tmax in the same way? (not necessarily asking for it to be included in the paper, just curious what it might show – it's not quite the same thing as figure 5).

Here you go – it is basically the same figure, just shifted a bit deeper.

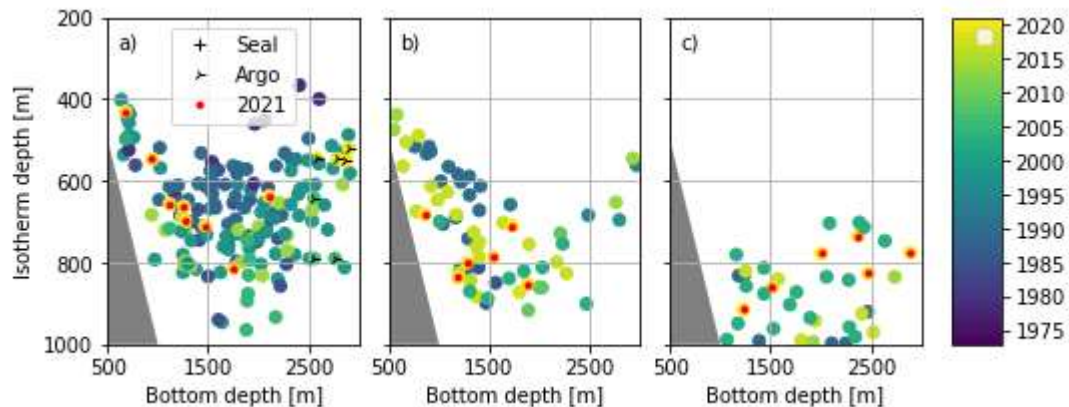


Figure 1: Depth of the Θ -maximum obtained from CTD-profiles a) northwest of FT (35-45W) b) north of the FT (31-35W) c) northeast of the FT (25-31W) as a function of bottom depth. The color indicates the year that the profile was collected.

L125 I'm being picky, but I prefer "decreases" to "drops", here and elsewhere (e.g. l108)

Corrected

Caption to Figure 5. Typo here? The color code is surely the year?

Corrected

L136 I think it would be helpful to add some further explanation of why you consider the green line, 24hr, to be tidal EKE.

This part of the sentence now reads "and ii) the (smaller) wintertime peak in EKE associated with the diurnal tide (B24) is enhanced in 2020 (Fig. 6f, green line) when the mean2w temperature is above the seasonal average"

L141 I think you should reference the figure showing this result, not the figure showing the locations.

Corrected

L141 I would not use the word "now". We don't know what happened since February 2021, correct? It might be cold again? And it's ambiguous when "now" is.

We agree and we now write that the "temperatures were..."

Figure 6. What is the red/pink solid line in panels c and d?

The red line is the seasonal cycle estimated based on the five years of observations. The caption now includes the sentence: "The average maximum temperature (grey dashed line), 0.8°C (red dashed line), and the mean seasonal cycle based on the five year-long records (red line) are indicated".

Figure 6. Caption says 12 hours to 2 days but figure legend says 14 hours to 2 days?
12 hours was a typo. The sentence now reads : “. F) Time series of normalized vertical mid-range EKE (250-500 m depth) at mooring M750 in four frequency bands: 14 hours to 2 days (blue), B12 (orange), B24 (green), and B35 (red).”

Figure 6. I think you need more explanation in caption, and also in the text, of the band pass filters you chose. The caption refers to B12, B24 and B35 but these are not defined?
We have added a sentence describing the filters in section 2.1.1 of the methods: “We estimate the EKE in four frequency bands: around 12h (semi-diurnal tides, B12), around 24h (diurnal tides, B24), around 35h \citep[continental shelf waves, B35,][]{Jensen13}, and 2 days to 14 hours following \cite{Jensen13}. The frequency bands are marked in Fig. \ref{FIG_M3_mooring_records}e.”
In the caption of Fig 6 the description of the frequency spectra (panel e) reads: “The shading marks the B35 (red), B24 (green), B12 (orange), and 2 days to 14 hours (blue) frequency bands, color-coded by the legend in panel f)”

Figure 7. Is this correct? These temperatures seem excessively cold, especially for WDW? They are well below freezing? Check y axis labelling?
Welcome to the cold Weddell Sea, Karen! The y-axis is correct and the water is indeed potentially supercooled. During winter, the continental shelf east of the Filchner Trough is “flooded” by Ice Shelf Water emerging from the Filchner Ronne cavity, see e.g. (Ryan et al., 2017)

L161 We usually say “back of the envelope”.
Corrected

L161 suggest (plural estimates)
Corrected

L162 Clarify, needed for what?
We now write “...needed to maintain the HSSW production”

L168 I think you mean Weddell Sea Deep Water?
Corrected

L173 The Foldvik reference needs brackets, also l209 and l217
Corrected

L186 the references to the figures need Figure.
Corrected

L238 Brackets need moving.
Corrected

The paper ends quite abruptly, and I think it would benefit from a bit more discussion of the importance of the results, why they matter (for whom?), and what unanswered questions the work raises?

We have now extended the conclusion addressing the questions raised by the reviewer.

The Data availability section doesn't mention float profiles?

We acknowledge the International Argo Program in the data availability section and state that the Argo-profiles used were obtained from the World Ocean data base and the Coriolis project (without doi).

References

- Hattermann, T., Nicholls, K. W., Hellmer, H. H., Davis, P. E. D., Janout, M. A., Østerhus, S., Schlosser, E., Rohardt, G., & Kanzow, T. (2021). Observed interannual changes beneath Filchner- Ronne Ice Shelf linked to large-scale atmospheric circulation. *Nature Communications*, 2021, 1–11. <https://doi.org/10.1038/s41467-021-23131-x>
- Purich, A., England, M. H., Cai, W., Sullivan, A., & Durack, P. J. (2018). Impacts of broad-scale surface freshening of the Southern Ocean in a coupled climate model. *Journal of Climate*, 31(7), 2613–2632. <https://doi.org/10.1175/JCLI-D-17-0092.1>
- Rignot, E., Jacobs, S. S., Mouginot, J., & Scheuchl, B. (2013). Ice-shelf melting around Antarctica. *Science (New York, N.Y.)*, 341(6143), 266–270. <https://doi.org/10.1126/science.1235798>
- Ryan, S., Hattermann, T., Darelius, E., & Schröder, M. (2017). Seasonal Cycle of Hydrography on the Eastern Shelf of the Filchner Trough, Weddell Sea, Antarctica. *Journal Geophysical Research - Oceans*, 122. <https://doi.org/10.1002/2017JC012916>