Response to comments by reviewer nr 2 on "Hydrography, circulation, and response to atmospheric forcing in the vicinity of the central Getz Ice Shelf, Amundsen Sea, Antarctica" by V. Dundas, E. Darelius, K. Daae, N. Steiger, Y. Nakayama, and T. W. Kim (https://doi.org/10.5194/os-2022-13)

We thank both reviewers for reading the manuscript thoroughly and for comments that have helped us make our main messages clearer. Below we respond to comments from reviewer nr 2. Our responses are in orange, and changes or additions to the manuscript are in italic. Line numbers refer to the new manuscript.

To indicate whether the lines we refer to have been changed since the first version of the manuscript we label the lines we refer to as CC (Changed for Clarity), AC (Added for Clarity), CR (Changed for Readability), or UC (UnChanged).

Response to reviewer nr 2

Major comments

Comment nr 1:

The authors did impressively thorough work, but I think not all of your work should be included in this manuscript. To my understanding, the key findings of this manuscript are the comparison between this ice-shelf front to other ice-shelf fronts nearby in the Amundsen Sea, the reason why they are different (from your manuscript, mainly bathymetry), and the mechanisms driving the temporal variation of the hydrographic properties (from your manuscript, mainly wind stress).

Re: Thank you for the positive and constructive feedback.

However, this manuscript focuses a lot on other minor details, e.g.,

a) "The correlation is predominantly negative, but shorter periods of positive correlation occur, most notably during summer 2017" (line 212), which is not related to any of your key findings

We have considered this and concluded that we want to keep this detail as it makes it clear that the main relations between ocean surface stress and currents/deep temperatures at GC6 cannot be generalized in time. We have, however, followed your advice and removed details concerning this, and the paragraph (line 192-199) now reads (CC):

"*The strongest correlation between the along-trough current at GC6 and zonal τ D18 occurs during winter over a region that roughly overlaps with the Amundsen Sea Polynya (ASP, Fig. 1a) and extends northward to the shelf break (Central-box, Fig. 5a, r= −0.49, lag= 0 days, BP8D-10M). The negative sign indicates that strong westward τ_D18 enhances the along-trough current toward the ice front. Only shorter periods of positive correlation, most notably during summer 2017, interrupt this pattern (Fig. 6b). The occurrence of periods with positive correlation is independent of the parameterization of τ (Appendix B).*

For mCDW-temperature, the maximum correlation with τ_D18 is also found during winter, but in an area further east (East- box: cyan box in Fig. 5b, r= 0.52, lag= 4 days, BP8D-10M). The positive sign

indicates that strong eastward τ correlates with higher mCDW-temperatures at GC6 and holds for most of the mooring period (Fig. 6a)."

In response to your comments, we have also elaborated slightly in the discussion (lines 356-361, CC/AC):

"During summer, the correlation is mostly insignificant but shows signs of anti-correlation (Fig. 6a). We speculate that the insignificance is due to this shift from positive to negative correlation but that the shift happens too gradually for our moving windows to capture periods of significant negative correlation. We further suggest that the shift depends on the position of the zero-contour, as we observe that a northward shifted zero-contour coincides with periods of anti-correlation between the zonal stress and the mCDW-temperature. Dominating westward winds, general depression of the thermocline at the shelf break, and increased summer stratification also likely weaken the relationship between τ and the deep temperatures."

b) The green diamonds in Fig. 4abd for the strong cooling events found in GW6f, which are not significant in your mooring observations and not mentioned afterwards

Re: We have reduced the focus on these events since, as you comment, they do not have a major impact on GC6 in the end. However, since the events' amplitudes decay with distance from the coast, the effect on the hydrography closer to the ice shelf front is likely larger. This makes the events important for the ice shelf front, although they are less important for the mooring location itself.

Line 158-160 now reads (CC): *"There is also a strong variability on shorter time scales, for example, several abrupt cooling events in 2016 that correspond to cold events found at GW6F (Steiger et al. 2021, Fig. 4a,b,d, green diamonds), explained by wind-driven coastal trapped waves."*

Line 362-367 now reads (CC/AC): "*The cooling events at GC6, which are similar to those observed at GW6F during the same period (Steiger et al., 2021), might be triggered by strong winds over a region of low SIC east of Carney Island. The estimated propagation speed of a coastal trapped wave from this region to GC6 (0.4 – 0.7 m s-1) matches the propagation speed of the coastal trapped wave observed at GW6F (Steiger et al., 2021). The effect of the events on the heat content at GC6 is less than at GW6F, possibly explained by the larger distance of GC6 from the ice shelf front. However, this implies that the signal is stronger at the ice shelf front than at GC6. Consequently, the effect of this wind-induced coastal wave is likely substantial at the ice shelf front in the GC6-Trough."*

c) The authors also mentioned the advection time from the shelf break to the ice front several times, which is again, not related to any of your key findings

Re: We agree that this is not one of the main findings, and we have reduced the focus on this aspect. Since advection of heat from the eastern Amundsen Sea and the deep ocean north of GC6 contribute to the long-term variability in heat content at the GC6 mooring site, we still mention the time scale to relate it to these processes.

Comment nr 2:

I think the authors should focus on explaining the temporal variation of data with the physics behind it, instead of describing the variation. For example,

a) In lines 199-213, the authors describe every tiny anomaly in the line figures, without mentioning why the correlations are generally less significant in summer than in winter. Provided that no

significant seasonality in TS was observed in the mooring site, the seasonality of the significance of the correlations can be a fair scientific subject that is within the scope of this study

Re: See response to comment 1a.

b) In the model results section, the authors describe the shape of the lines in Fig. 7 panel by panel, without giving a convincing explanation (you hypothesize some mechanisms but do not explore further – you may also want to leave those hypotheses that lack evidence in future work) of how they are connected to the hydrography at the mooring site

Re: We have simplified this section and removed unnecessary details. Line 219-224 now reads (CC): "*The SIC over the GC6-Trough, the wind field, and the wEK in the SB-box display large year-to-year variability (Fig. 7a-c), with implications for the GC6 region. The wintertime SIC is always high, but highly variable between summers, ranging from ∼80% to ice-free (Fig. 7a). There is no trend in the average wind velocity during 2001-2017, but the mooring period is within a period of relatively weak τ over the shelf break north of GC6 (not shown). Occasionally, the zero-contour does not migrate north (south) as expected during summer (winter) (Fig. 7c). wEK is generally highest at the end of winter, and lowest at the end of summer, but shows strong positive anomalies, including during the mooring period (Fig. 7a,b).*"

The reason for describing these differences comes on lines 237-244 and 368-377, which are unchanged since the first submission.

Technical corrections

Line 106-107, "We note that trough openings are generally deeper in the regional model than in the IBSCO bathymetry." I think the authors mean "deeper in the regional model than in the observations (e.g. multibeam survey)"? - as the model uses IBSCO?

Re: The model's bathymetry is *based* on IBCSO; it does not use it directly. To make this distinction clearer, we have rewritten lines 108-109 to (CC): "*We note that trough openings are generally deeper in the regional model's bathymetry, which is based on IBCSO, than in the IBCSO bathymetry itself*."

Line 221, Fig. 7c, I think you mean Fig. 7d

Re: Corrected as suggested

Line 230, Fig. 7a, I think you mean Fig. 7a,b,c

Re: Corrected as suggested

Fig. 7d, in the legend, "current at V_NE" might be removed?

Re: Changed as suggested

Fig. 7e, (you might do it on purpose?) but the thick black line for the 12-month meaning average is missing

Re: Changed as suggested

Line 251, "Peaks that occur at all three locations tend to first occur at V_NE, then at V_CN, and finally at GC6…" I do not see that in the figure? For me, the most striking peak was in 2007, and the peaks arrived at different locations in the opposite sequence.

Re: We agree that this is not evident from Fig. 7, and as this is not a major point, we removed this sentence.

Line 355, the comma after "Ekman pumping anomaly" is missing

Re: Changed as suggested