L222 and where you include (Herraiz-Borreguero and Naveira Garaboto, 2022): might it be appropriate to also include (van Wijk et al., 2022) here? I appreciate this source was not available at the time of submission, but can perhaps be included in the final revised version?

Thank you for drawing our attention to work, it is very relevant. We've added it into the manuscript introduction and included the reference in our conclusion.

L76-85 - The high basal melt rates close to the grounding line in this region of Antarctica have been linked to a warming of up to 0.5 °C over the last 40 years that occurred in the open ocean off East Antarctica, concurrent with an even more pronounced warming of 0.8–2 °C observed over the continental slope (Herraiz-Borreguero and Naveira Garabato, 2022). This Circumpolar Deep Water (CDW) warming is linked to a poleward shift of the Antarctic Circumpolar Current's southern extent onto the Indian Ocean sector of the East Antarctic continental slope, in which the Shackleton system is located. The continental slope warming appeared strongest near ice shelves that are thinning or have retreating grounding lines such as the Denman Glacier (Herraiz-Borreguero and Naveira Garabato, 2022). In addition, recent profiling float data have revealed that the thickest and warmest modified CDW layers in the region have been observed in a deep trough adjacent to the Denman Glacier tongue (van Wijk et al., 2022).

L226 remove 'in' before 'have been observed'

Removed

L82-4 - Although basal melt is considered the dominant form of melt related mass loss in East Antarctica, the outermost portions of Shackleton Ice Shelf have been observed to experience the most intense surface melt outside of the Antarctic Peninsula (>>200mm w.e. year-1) (Trusel et al., 2013).

L238 remove 'Ice Shelf' here?

Removed

L95-6 – Here we add to the previously reported dynamic changes in the Denman Glacier over the 60-year period of observation and place them into the wider regional context of the Shackleton system.

L241-242 maybe you can explicitely refer to the section numbers where you report on each of these elements of your analysis?

We have added the relevant sections to each of the elements and the sentence now reads

L98-100 - We firstly report on the main structural features (Sections 3.1-3.3) and dynamic changes across the whole system (Sections 3.4-3.6) and then discuss the changes in the system and their possible impact by sub-system region (Sections 4.1-4.4).

L383 'initiate' instead of 'initiates'?

Changed

L199-200 – The rifts initiate approximately 20 km down glacier of the grounding line (as defined by MEaSURES (Rignot et al., 2017)) and widen to ~ 2.5 km as they flow around the Taylor Islands.

L416 should Section 3.3 be titled 'ice thickness' instead of 'ice extent'?

Changed

L208 – 3.3 Ice thickness

Section 2.2 Please add some further details on how you calculated the strain rates. Did you apply filters to suppress the noise, and do you trust results for the extensive area of high strain rates upstream of the Northcliff Glacier grounding line?

We did not apply filtering to supress noise and it is likely that the high strain feature upstream of Northcliff Glacier is noise. Strain was calculated across 2 pixels (of 100m) N-S and E-W of the central pixel. We have included these details and added the following to Section 2.2 and the caption of Figure 8.

L135-7 - The magnitude of the principal strain rate was derived from the mean velocity maps (2017-2020), strain was calculated across 2 pixels (of 100m) North-South and East-West of the central pixel, no filtering was applied to suppress noise.

Figure 8: (a) Mean speed for 2022 with velocity arrows. (b) Magnitude of the principal strain rate of Shackleton system derived from Sentinel-1 derived mean velocity data over the period of observation. N.B. The area of high strain upstream of Northcliff Glacier is likely noise as not filtering was applied to supress noise. The feature down flow of pinning point c on the Denman Tongue is an artefact, we see no evidence of rifting in the remote sensing data in this region (e.g., Fig. 2b, 7a).

Section 2.3 Refer to Figure 7 for the geographical context and spatial coverage of the flightlines.

We have referred to figure 7 in section 2.3, the opening sentence of which now reads

L135-136 - The ice-penetrating radar data presented here were acquired on two survey flights using the Snow Eagle 601 BT-67 aircraft (Cui et al., 2018) flown on 19 and 20 December 2018 (Line locations shown in Fig. 7).

Fig 7 needs labels a), b),…

Added

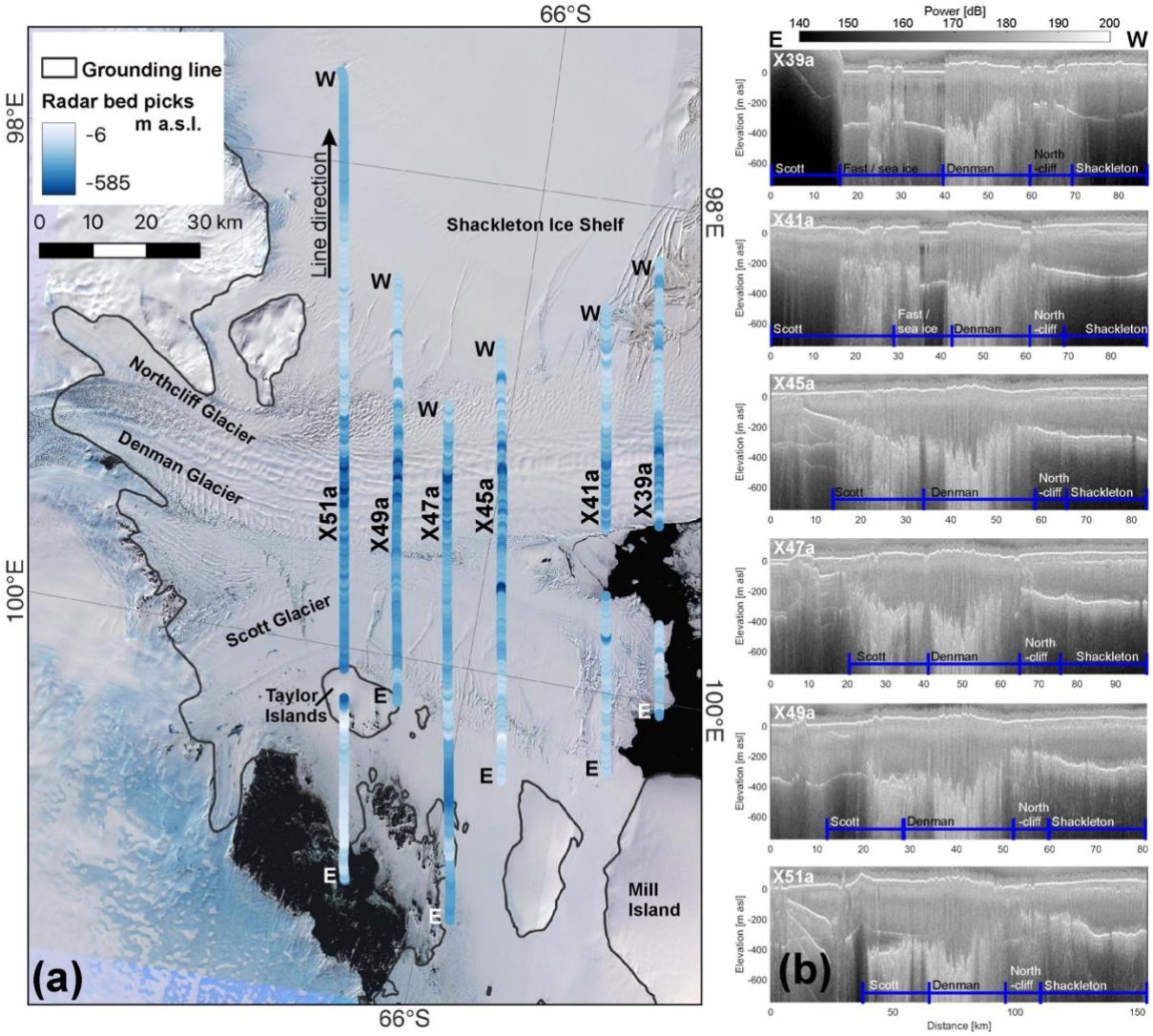

Figure 7: (a) The location and ice base below sea level of 6 ICECAP radar lines acquired in December 2016 (Background Sentinel 2A acquired 23rd February and 1st March 2017). (b) Annotated ICECAP radar lines (position and east-west line direction shown in a).

L434 refer to section 3.2 instead of 3.3

Changed

L226-7 – As described in Section 3.2, a rift along the shear margin was observed to be three times the length and 10 times the width to that observed in 2015 (Fig. 5).

Figs 8, 9 and 10 Can you add the grounding line and ice front for context?

We have added the grounding line to figures 8, 9 and 10 (see below) but have not added the ice front position to the plots as none of them represent a single point in time. They are either based on an annual mean or represent change over several years. We did try picking a single ice front position, but this made the figures confusing as the Denman Glacier particularly has a high annual flow speed and therefore significant rate of annual ice front advance.

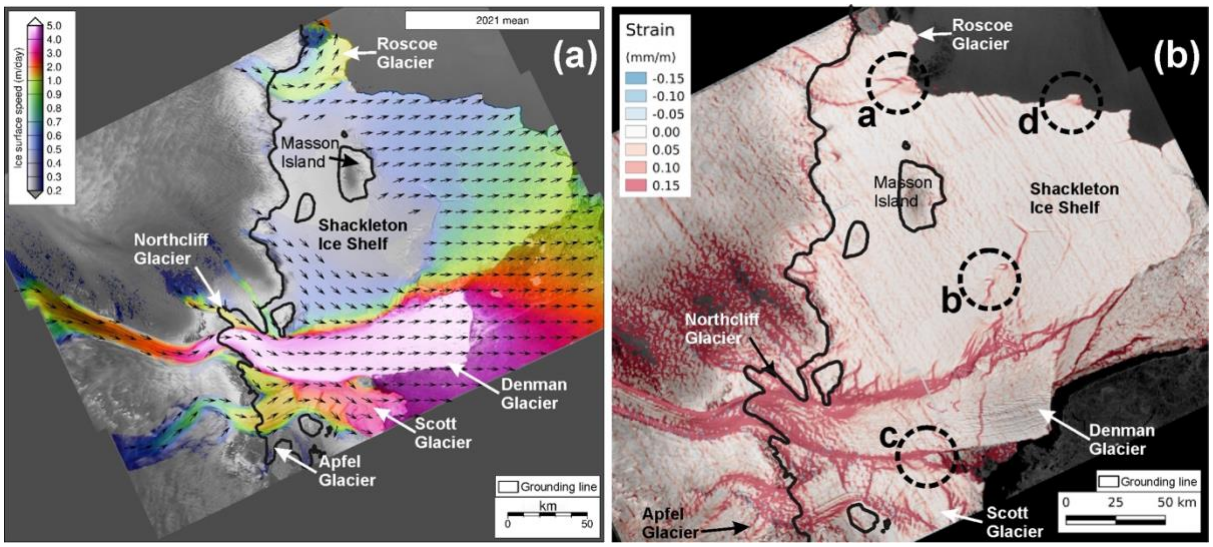

Figure 8: (a) Mean speed for 2022 with velocity arrows. (b) Magnitude of the principal strain rate of Shackleton system derived from Sentinel-1 derived mean velocity data over the period of observation. N.B. The area of high strain upstream of Northcliff Glacier is likely noise as not filtering was applied to supress noise. The feature down flow of pinning point c on the Denman Tongue is an artefact, we see no evidence of rifting in the remote sensing data in this region (e.g., Fig. 2b, 7a).

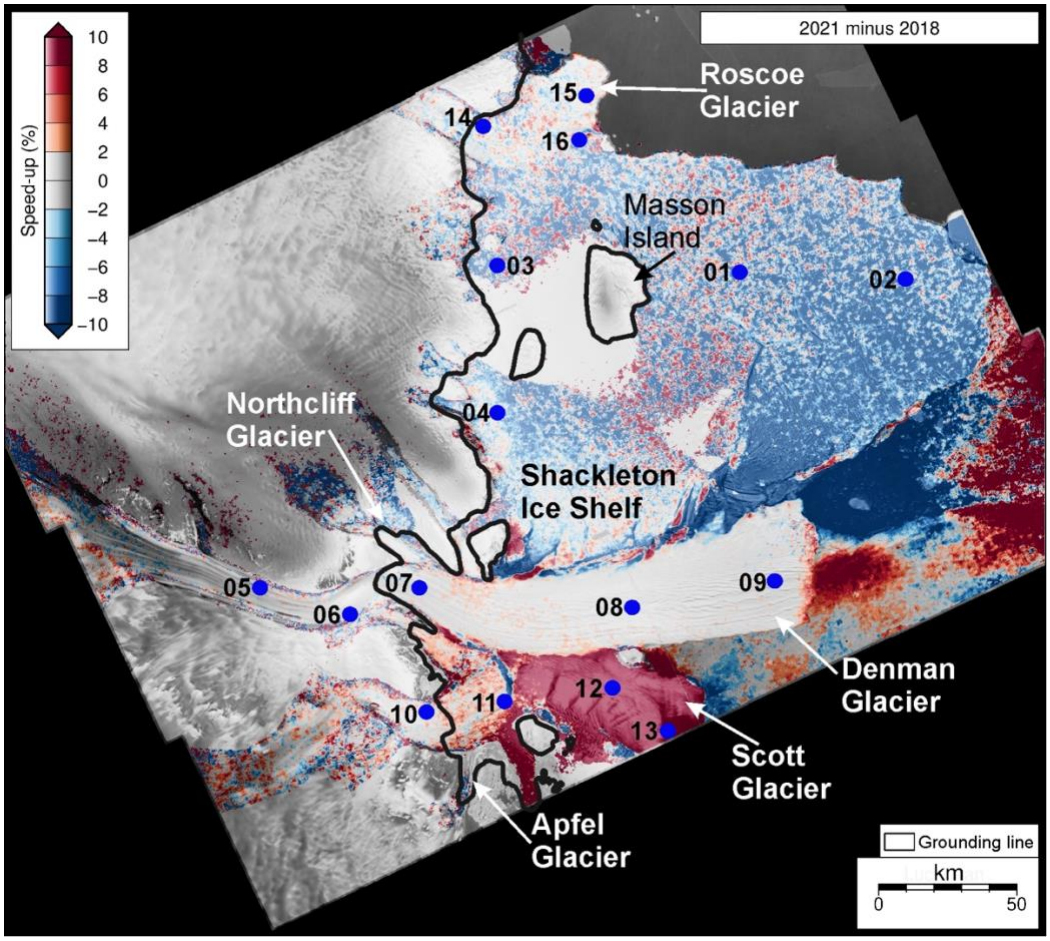

Figure 9: Percentage difference in mean speed between 2021 and 2018, scaled between +/- 10%, with point locations illustrating the ice speed timeseries in Figure 11.

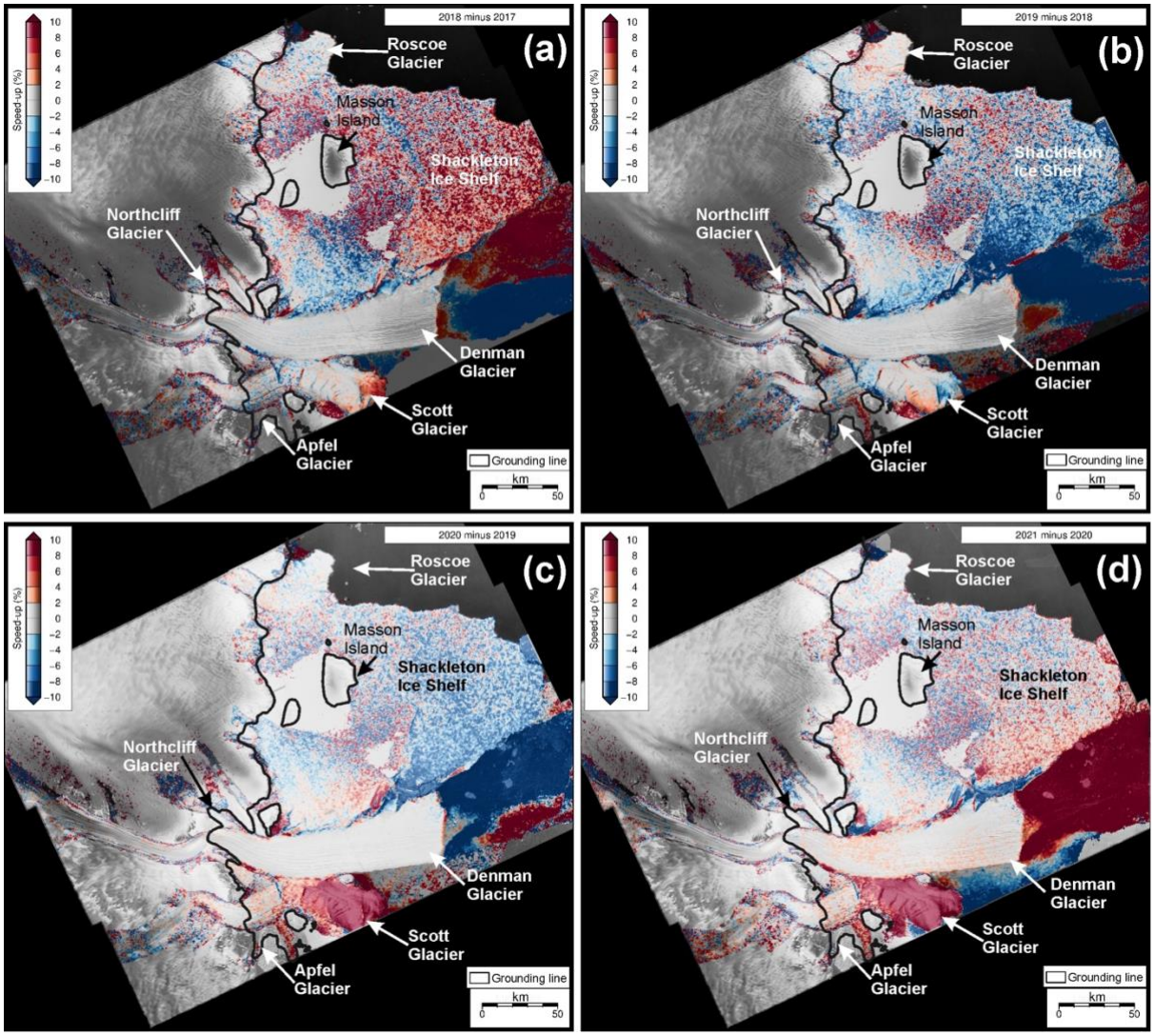

Figure 10: Percentage difference in mean speed between (a) 2018-17, (b) 2019-18, (c) 2020-19 and (d) 2021-20 scaled between +/- 10%.

L573 capitals for Ice Shelf

Changed

L256 - 60 km of the floating tongue of Scott Glacier and the Shackleton Ice Shelf (Fig. 9).

L734 check units: rate of deceleration should be m/yr2/yr

Changed

L308-9 - In 2021 flow speeds in this area of the ice shelf were in the region of 1 m day^{-1} so that the annual rate of deceleration over the 3-year period would only equate to ~ 10 m year^{2}.

L775 remove 'most'?

Removed

L341-2 - Although both suggestions are plausible at this location, current observations are insufficient to conclusively identify the cause of the reflector and therefore the impact of the evolution of the system.

L800 'experienced' instead of 'experience'

Changed

L367-8 - We observe the ice front of Scott Glacier to be in a similar position in 2009, 2002, 1991 and 1962 (Fig. 2a, 3), but the ice front may have experienced retreat inland of this position in the intermediate time periods.

L828 'an' instead of 'in'

Changed

L391-2 - If the muted reflectors identified (Fig. 7b) are in indication of high salt concentration, any changes in atmospheric or ocean forcing could have an enhanced impact on this region of the Shackleton system.

References

van Wijk, E. M., Rintoul, S. R., Wallace, L. O., Ribeiro, N., & Herraiz-Borreguero, L. (2022). Vulnerability of Denman Glacier to ocean heat flux revealed by profiling float observations. Geophysical Research Letters, 49, e2022GL100460. https://doi.org/10.1029/2022GL100460