

Review of “Compound intense warming and precipitation events in the Patagonian Icefields and the Antarctic Peninsula Ice Sheet - Part 1: Event frequency, atmospheric circulation and impacts on glacier Surface”, by Torres *et al.* (egusphere-2026-3508)

General Comments

The Patagonian and Antarctic Peninsula Ice Sheets are both important components of the Southern Hemisphere cryosphere which both have the potential to make significant contributions to global sea level rise. Both ice sheets lie within a region characterised by high atmospheric circulation variations, on interannual to interdecadal timescales, which can impact their surface mass balance (SMB), either through changes in precipitation (which contributes positively to SMB) or melt (which contributes negatively to SMB). In this paper, the authors focus on identifying atmospheric circulation anomaly patterns which simultaneously generate intense warm events (IWE) over the Patagonian Ice Sheet and intense precipitation events (IPE) over the Antarctic Peninsula, which they refer to as compound events. Previous studies have shown that IWEs over Patagonia are associated with a local high pressure/geopotential height anomaly while IPEs over the Antarctic Peninsula are driven by a dipole anomaly, with high pressure and geopotential anomalies centred on the Falkland Islands. In this paper the authors use reanalysis and regional atmospheric model data to show that compound events are associated with a modified version of the dipole anomaly in which the high pressure extends westward over Patagonia (see Fig. 4). Using model data, they examine the impact of compound events on the surface mass and energy balances of both regions. Over both ice sheets, compound events are associated with enhanced ablation but, in the Antarctic Peninsula, this is outweighed by increased precipitation.

The study uses well-established datasets and analysis tools and applies fairly standard methodologies. Many of the patterns that emerge (e.g. Figs. 4, 6, 7, 8) are similar to those that have been found in previous studies of the impacts of atmospheric rivers and föhn winds in the Antarctic Peninsula, which is not surprising. The novelty of this study is the focus on compound events which, by definition, have a broader geographical impact. However, the authors never properly explain the motivation behind this focus. It is not properly explained in the introduction and I was still unclear about it after reading the whole of the paper. The definition of a compound event as a day on which there is an IPE on the Antarctic Peninsula, and IWE in Patagonia and an atmospheric river impacting the Antarctic Peninsula seems somewhat arbitrary and requires further explanation. It is also unclear from the paper whether, when averaged over time, compound events have a higher impact on the Antarctic Peninsula and Patagonian regions than extreme events that impact only one of the regions do. If compound events have a disproportionately large influence then this would provide some motivation for

studying them. Overall, I think that this study is suitable for publication in *The Cryosphere* once the motivation behind the focus on compound events has been clarified and the specific points that I list below have been attended to.

Specific points

1. Title: Would "...glacier surface mass balance" be clearer?
2. Lines 115-118: I think it would be appropriate to move some of the discussion about the uncertainties in precipitation measurements that is currently in lines 165-171 into this earlier section.
3. Figure 1: I think that the black line on Figure 1(b) indicates the ice-covered area but this is not stated in the caption. It would also be useful to show climatological low-level winds over both study regions but this information might have to go on another figure, possibly in the Supplement?
4. Line 125, Table 1 title: Should be "accumulated precipitation data...", rather than "accumulated rainfall data"?
5. Line 177, section 3.2: The same title is used for section 3.3 a few lines later. Should section 3.3 be titled "AR compositing", or similar?
6. Figure 3: This figure seems incomplete because you don't show the occurrence of IWE on the Peninsula and IPE over Patagonia. Including these missing data might help you to explain and justify your definition of a compound event.
7. Figure 4: Are these anomalies statistically significant? Do the 910 IWE days and 648 IPE days also include the 127 compound event days?
8. Section 4.3: The text gives maximum anomalies seen on each of the panels in figure 6, but these extreme values are not always clear to see on the figures. It would be useful to also give areal average anomaly values, which are a more representative indication of the impact of the events that are being studied.
9. Lines 282-283: Do you have an explanation for the altitudinal dependence of net radiation anomalies? What are the individual gradients for net SW and LW?
10. Lines 291-295: The spatial pattern of surface energy flux anomalies in the Antarctic Peninsula is very similar to that seen in studies of föhn conditions in this region (e.g. King *et al.*, 2017, doi:10.1002/2017JD026809). This is not surprising, as atmospheric rivers approaching the Peninsula from the west or northwest almost always generate föhn winds on the eastern (downwind) side of the Peninsula mountains.
11. Section 5.1: This section seems out of place here and would more logically belong in a section on MAR validation earlier in the paper.
12. Section 6, Conclusions: This section lacks a proper discussion of the overall importance of compound events. Do compound events contribute disproportionately to surface mass balance in Patagonia and the Antarctic Peninsula? If not, what is the motivation for studying them?

