Weather Clim. Dynam. Discuss., referee comment RC2
https://doi.org/10.5194/wcd-2021-22-RC2, 2021
© Author(s) 2021. This work is distributed under
the Creative Commons Attribution 4.0 License.

Comment on wcd-2021-22

Anonymous Referee #2

Referee comment on "A 25-year climatology of low-tropospheric temperature and humidity inversions for contrasting synoptic regimes at Neumayer Station, Antarctica" by Tiago Silva et al., Weather Clim. Dynam. Discuss., https://doi.org/10.5194/wcd-2021-22-RC2, 2021

Review of “A 25-year climatology of low-tropospheric temperature and humidity inversions for contrasting synoptic regimes at Neumayer Station, Antarctica” by Silva and Schlosser

This is a very well written paper that presents a 25 year climatology of temperature and humidity inversions at Neumayer station. Temperature inversions are important for their role in limiting vertical mixing while humidity inversions are important in cloud processes as well as being associated with atmospheric rivers. This comprehensive study of the climatology of these features will be of interest to the Antarctic and polar meteorology communities and can serve as a model for similar studies at other locations. I do have some larger (major) comments that I believe will improve this manuscript as well as a few minor comments. I find that this manuscript will be suitable for publication in Weather and Climate Dynamics after some revisions.

Major comments

I am not convinced that using the terms cyclonic and non-cyclonic is truly accurate given the way that the synoptic weather observations are used to define these two weather types. While the conditions used to identify the cyclonic type most likely occur during periods of low pressure that may not always be the case. Similarly, the non-cyclonic conditions could occur when the station is under the influence of an area of low pressure. I suggest renaming these two synoptic classifications - maybe precipitating and non-precipitation would be more accurate (although this is problematic due to the inclusion of diamond dust in the current non-cyclonic category, which I think is appropriate). But, I do think this better reflects the distinction between the two synoptic categories being used for this work.

I have some concern about the use of a fixed humidity threshold to define humidity inversions. Given the strong dependence of absolute humidity on temperature it will be much harder to meet the humidity threshold for a humidity inversion in colder conditions (aloft or in winter). It might be better to define a humidity inversion threshold as a percentage of the humidity at the inversion base or top instead.

The inversion composite figures are interesting but it may be better to create these composites using a varying height scale rather than one fixed relative to sea level. Specifically, it might make sense to create composites with the 0 height taken as the inversion base. In this way varying heights of inversion will not "smear" the inversions in the composite and a more robust signal of the inversions and their relationship to wind is likely to be seen. I would also suggest using the temperature (or humidity) at the inversion base as the 0 value so that variability in the value of temperature or humidity can be removed from the composites. Taken together these two changes should produce much more robust composites.

Minor comments

Line 5: What "both" refers to in this sentence is unclear. I assume it is cyclonic and non-cyclonic conditions, but please clarify this text or explain what two synoptic classifications are being presented in this work before this sentence.

Figure 1: It would be useful to also indicate what percent of all possible days in each month during the study period the total radiosonde count for each month represents. This could be listed below the monthly radiosonde count at the top line of this figure.

Section 2.5: It would be good to indicate the typical vertical resolution of the sounding data either here or when the radiosonde data is first introduced. This impacts what depth inversions can be reasonably identified. It might also be worthwhile to discuss why the BSRN radiosonde data is used rather than IGRA data here rather than in the discussion section.

Line 172: It would be useful to more explicitly state how the 5 point moving average profile is used. The text states that this moving average profile is used to detect the inversion base and top positions. Is this done for both absolute humidity and temperature profiles? Also, are the top and bottom inversion values of humidity and temperature taken from the unsmoothed profile data or do these values also come from the moving average profile?

Figure 4 and all similar figures: Please indicate what the boxes, whiskers and open circle symbols indicate in the figure caption. The figure caption should fully explain what is plotted in each figure without the reader needing to refer to the main text for this information.

Paragraph starting at line 299: The change in humidity gradient across the three height ranges and seasonally is driven by changes in the magnitude of absolute humidity as a function of temperature. It is not surprising that gradients are smaller at upper levels or in winter where colder, and thus drier, in an absolute sense, conditions, occur. This point should be made when discussing Figure 10.