

Comment on essd-2021-412

Anonymous Referee #2

Referee comment on "Water vapor in cold and clean atmosphere: a 3-year data set in the boundary layer of Dome C, East Antarctic Plateau" by Christophe Genthon et al., Earth Syst. Sci. Data Discuss., <https://doi.org/10.5194/essd-2021-412-RC2>, 2022

Review of "Water vapor in cold and clean atmosphere: a 3-year data set in the boundary layer of Dome C, East Antarctic Plateau" by Genthon et al.

This manuscript describes humidity data generated from a tower over Antarctica. This is an important data set in a unique environment. The authors do a good job of describing the relevance of the data. The manuscript is generally well written. It spends most of its time doing basic analysis of the data, with some interesting results. It is quite curious that there is no supersaturation with respect to liquid seen, even if the authors imply it from qualitative observations of possible droplets. I have a few major concerns, and minor comments.

My major concerns are:

1. It seems odd to me that the manuscript pays more attention to analysis than to description of the sensors, calibration and errors. That seems appropriate for ESSD, while the scientific analysis perhaps belongs somewhere else. Section 2 should be expanded with more detail on the error characterization.
2. In particular, I think the paper should use the best available conversions for water vapor saturation pressure (e.g. Murphy and Koop 2005), or show several different ones. Particularly for Relative Humidity over Liquid.
3. In general the plot quality for line plots is not that great. As noted, some of the plots are redundant (Figure 7, Figure 10).

4. Some of the plots could be improved. The PDF histograms at different heights (Figure 5, 13) would be easier to interpret with overlaid transparent filled colors for the bars.

5. There should be more discussion of possible errors in section 2 or in section 4. This seems strange given the discussion of potential supercooled liquid water, but no evidence of RH liquid > 100%.

6. Links: not sure why the DOI refers to 3 more DOIs, one at each level. But I guess that is the Authors' choice.

Specific comments:

Page 5, L106: what is this reference to Genthon et al 2022: it's not in the references. Is it supposed to be the data itself?

Page 6, L144: Does the Humicap calibration assume a saturation vapor pressure relationship? Seems like it must in the empirical calibration somewhere. Please elaborate and specify what is used or why it is not used.

Page 7, L163: Is the modified sensor in 3b the heated inlet on the right side of figure 1? Please clarify.

Page 8, L167: does "adapted" mean "heated"?

Page 9, L181-8: Most of the discussion of mechanisms here is speculative. Do you have data that can bear on this? Figure 3b supports this figure, but not the mechanisms. Maybe show low winds with low temperatures? Or other measures of subsidence? Subsidence would lead to drying, but also warming, so pushing air out of those temperature ranges. Air aloft is going to have a higher potential temperature than surface Air, so without large radiative cooling it would be warmer.

Page 11, L240: Figure 7 doesn't really add new information. Couldn't you add standard deviations as colored shading to figure 6? Then you could do it for RHi and PPW too...

Page 15, L320: Figure 10. What does this figure show that is different from figure 9? I don't think this figure adds value to the paper and could be removed.

Page 18, L410: might want to note that since $RhL < RHi$ then if $RhL > 100\%$ then $RHi > 100\%$. That's the logic here right? If not, then how do you get supercooled liquid if $RhL < 100\%$?

Page 19, L445: Was the observed haze liquid or ice? That would seem to be an important distinction. Was there ever evidence of supercooled liquid at Dome C?

Page 19, L447: if you used a different saturation vapor pressure like Murphy and Koop would you get a different answer? That should reduce conversion inaccuracies.

Page 19, L449: But earlier you argued that Dome C was pretty homogeneous? How does that match with the heterogeneity you imply here.

Page 22, L508: This is the same repository and doi as Genthon et al 2021? Just checking that is supposed to be the case. What is the reference to Genthon et al 2022 noted above?