EGUsphere, referee comment RC2
https://doi.org/10.5194/egusphere-2022-1163-RC2, 2022

Comment on egusphere-2022-1163

Anonymous Referee #2

Referee comment on "Statistical analysis of observations of polar stratospheric clouds with a lidar in Kiruna, northern Sweden" by Peter Voelger and Peter Dalin, EGUsphere, https://doi.org/10.5194/egusphere-2022-1163-RC2, 2022

Review of 'Statistical analysis of observations of polar stratospheric clouds with a lidar in Kiruna, northern Sweden', by P. Voelger and P. Dalin.

Summary:

Voelger and Dalin use a ground-based lidar located in Kiruna to present a climatology of polar stratospheric cloud characteristics from 11 winters of observation. The authors note that their observing location is in the lee of a major mountain range, resulting in an influence on PSC composition and mean altitude seen above Kiruna. Specifically, the properties of PSCs are different in the presence of mountain waves than in their absence. Voelger and Dalin discuss their climatology in the context of results from other locations.

Overall, the paper is well written, informative, and contains information worthy of publication. The paper is however too succinct, in that more discussion and placing your results into previous studies (ground-based and satellites) is needed. You could either create a separate Discussion section to achieve this, or, add paragraphs at the end of each section discussing the figure. Further, inconsistencies in labelling (i.e Type1a / NAT etc) is noted throughout, and forms a major distraction from the manuscript. However, I suggest that these issues can all be satisfied following 'minor revisions'.

Minor Comments:

Line 76: Readily noting that this is beyond the scope of your work, but I wonder whether the radar which Rao et al (2008) used can be used for a future study to combine mountain wave PSC observations seen with lidar (as per your paper) and vertical wave motion in the UTLS which should be readily observable with the VHF radar? Is it still operating? Such a study might help elucidate the perennial limitation with ground-based lidar observations of PSCs which can only be performed in clear weather, i.e. when do you observe strong mountain wave activity with the radar, but it's too cloudy to observe with the lidar?

Figure 2 caption: Need to be consistent between your caption (Types Ia, Ib, II) and your figure ('ice', 'NAT','STS') and throughout the text (and in other figures, e.g. Figure 8). As most ground-based lidar papers refer to the 'Types', you could if you choose go with that in your text and figures. But I'd still recommend a discussion of how these relate to the satellite-derived PSC classes. On the other hand, Tritscher et al. (2021) note these 'type' classifications are outdated and are not recommended any more (their Section 1.3), and this is what I'd prefer to see (i.e. switch to NAT, STS, etc. throughout).

Figure 2; why not indicate lines for the boundaries rather than these ellipses, which don't seem physically based?

Figure 2 and Figure 7: It might be worth considering plotting these as perpendicular backscatter vs scattering ratio (e.g. Tritscher et al 2021 Figure 2, or Pitts et al 2018 Figure 5b), as used for CALIOP v2 PSC observations? That should make discussions and comparisons easier (see comments above noting the need to have a much-expanded discussion of your results).

Figure 4 and 9 could (should) be normalised.

Line 155: The point could be made that while 'hard' boundaries between PSC types are used, in reality the boundaries are somewhat fuzzy (see discussion in Pitts et al 2018, their Section 3.3). The same point would apply to ground-based observations.

Line 220 and following: Essentially you are discussing here (or accounting for) differences between your climatology and the Arctic-wide satellite distributions. Perhaps an expanded discussion on 'mother-cloud' seeding is warranted here, and may help tie your point-source, ground-based results into the regional scale (i.e. over mountains and downwind of mountains) PSC satellite observations and more regional-scale aircraft observations (and

modelling studies) above and downwind of the Scandinavian mountains (e.g Dörnbrack et al. 2002 JGR) and over polar mountains more generally.

Figure 6: Probably more useful to show these as a fraction of 'conditions favorable for mountain waves' rather than actual number of hours?

Figure 7: As for Figure 6, why not normalize these plots so you can quantify and compare the relative changes. Also, I suggest you add in the PSC type (or better, class) boundaries.

Figure 9: You could also include each PSC class as a function of altitude too.

Figure 9b: Temperature decreases in the cool phase of the wave should induce some PSC formation at lower altitudes. Do you find any examples of these in your time series?

Data availability: check that your 'lidar data is available on request' is consistent with the journal. A permanent doi linking to the data is, I believe, much preferred.