EGUsphere, referee comment RC1
https://doi.org/10.5194/egusphere-2022-1163-RC1, 2022

Comment on egusphere-2022-1163

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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-RC1, 2022

Voelger and Dalin analyse 11 years of lidar measurements that were performed in Kiruna to derive the general characteristics of polar stratospheric clouds (PSCs) and to examine the influence of lee waves on the properties of the polar stratospheric clouds in this area. They find clear differences between PSC formed at wave conditions and PSC formed solely by synoptic cooling. This is a nice and interesting study and I have only suggestions for minor revisions before publication in ACP.

Specific comments:

P2, L32: Here, I am not sure if you generally refer to clouds or if you mean PSCs. You should rephrase the sentence to be more clear. In case you mean clouds in general you should provide more details. If you mean PSCs when you should replace “clouds” by “PSC”.

P2, L34: I would suggest to rephrase the sentence. As suggestion is as follows: “The statistic based on the CALIPSO data has resulted in a global PSC climatology.” You could also mention how long their data sets were that have been taken into account to derive the climatologies.

P2, L44: There is a recent study by Tence et al. (ACP discussions) analysing the Durmont d’Urville data which would be worth to be mentioned here additionally to Santacesaria et al. (2001).

P2, L54ff: You should provide a short explanation or measure for the different scale of these waves.

P3, L66: Also here it is not clear if you mean cloud in general or PSCs. Please clarify and rephrase accordingly.

P3, L68: Add here how they affect ozone depletion (thus by the reactions on the surface of the PSC particles).

P3, L78: Here some more recent publications from the e.g. RECONCILE (Dörnbrack et al. (2012), see https://acp.copernicus.org/articles/special_issue228.html) or POLSTRACC (https://acp.copernicus.org/articles/special_issue913.html) campaigns should be added.

P4, L95ff. It would be nice if you could add here more details on how many measurement days and how many hours of measurements you derived in the considered 11-year period.

P5, Sect. 3: It would be nice if you could give examples for cold and warm winters, respectively, and how these winters are reflected in your statistic shown in Figure 1.

P5, L135: Yes, this is indeed the peak season for PSCs in Kiruna. Indeed, most PSCs appeared in January since the vortex is then usually quite stable and it becomes sufficiently cold. Are these climatological features documented somewhere? It would be nice if you could add a reference.

P6, L149: You shouldn't write it that simple with just one short sentence. As you write it it can easily be misunderstood and it does not reflect what Achert and Tesche (2014) actually concluded. You should add more details when which scheme performs best (or write it specific to your data) since Achtert and Tesche (2014) provided clear statement for which data which schemes is most suitable.

P6, L164: This statement is not correct. STS forms at much higher temperatures, namely already at 192-193 K (see Tritscher et al., they write at Tice+4 K, which with Tice at 188 K corresponds to 192 K). Thus, this does not explain really why you observe mostly NAT particles over Kiruna.

P7, Figure 2 caption: In the figure you use the abbreviations "NAT", "STS" and "ice", but in the caption you write "Type1a", "Type 1b" and Type2". You should be consistent and use only one way of writing (or add STS, NAT and ice in parentheses).

P8, Figure 4: Would it be possible to also plot the height distribution separated by PSC type? This would be quite interesting to see.

P9, Figure 5: Add here also in the legend STS, NAT, and ice (respectively).

P9, 198: Here you should add a sentence about the quality of the ER5 winds. How reliable are these?

P11, L226: The height difference between non wave clouds and wave clouds is a quite interesting result. However, do you have an explanation why the wave clouds are found at higher altitudes? I would rather have expected the opposite result.

P11, 229: Also here you should add some more recent references than just Fleming et al. (2011).

P11, L231: The relationship between PSCs and water vapour trends was investigated by e.g. Khosrawi et al. (2016) and Thölix et al. (2016). Both did not find any significant trend in H2O so far. Their results should be discussed as well.

P12, Figure 9: Also here it would be really nice if you could add this figure separated by PSC type.

Technical corrections:

P1, L14: "HNO3" should be written in an upright font.

P1, L13-15: I would suggest to more clearly write:"…...by the formation of nitric acid containing PSC particles and……..…"

P2, L27: multiyear □ multi-year (?)

P2, L29: I would suggest to also already here to provide the references of Pitts et al. (2018) and Spang et al. (2018).

P2, L32: Better to write “PSC” instead of just “clouds”. See also my specific comment.

P2, L34: add “as e.g. MIPAS” after “techniques”.

P3, L62: “several years or more”. I would suggest to rewrite this to “at least several years, but rather a decade or more”.

P3, L73: groundbased ☐ ground-based

P3, L85: I would suggest to rather name this section “Data and Method” than “Tools”.

P7, L181: Not the PSC has the temperature, it’s the air that has a certain temperature. Thus, the sentence should be rewritten. You could e.g write “…...PSCs at higher altitudes more likely encounter low temperatures”.

P14, L269: fomration ☐ formation

P15, L309: poole ☐ Poole

P16, L330: HNO3/H2O should be written in an upright font.

P16, L330: ER 2 ☐ ER-2

P16, L332: typo in “role“

References:

Dörnbrack, A., Pitts, M. C., Poole, L. R., Orsolini, Y. J., Nishii, K., and Nakamura, H.: The 2009–2010 Arctic stratospheric winter – general evolution, mountain waves and predictability of an operational weather forecast model, Atmos. Chem. Phys., 12, 3659–3675, https://doi.org/10.5194/acp-12-3659-2012, 2012.

Tencé, F., Jumelet, J., Bouillon, M., Cugnet, D., Bekki, S., Safieddine, S., Keckhut, P., and Sarkissian, A.: 14 years of lidar measurements of Polar Stratospheric Clouds at the French Antarctic Station Dumont d'Urville, Atmos. Chem. Phys. Discuss. [preprint], https://doi.org/10.5194/acp-2022-401, in review, 2022.

Thölix, L., Backman, L., Kivi, R., and Karpechko, A. Yu.: Variability of water vapour in the Arctic stratosphere, Atmos. Chem. Phys., 16, 4307–4321, https://doi.org/10.5194/acp-16-4307-2016, 2016.

Khosrawi, F., Urban, J., Lossow, S., Stiller, G., Weigel, K., Braesicke, P., Pitts, M. C., Rozanov, A., Burrows, J. P., and Murtagh, D.: Sensitivity of polar stratospheric cloud formation to changes in water vapour and temperature, Atmos. Chem. Phys., 16, 101–121, https://doi.org/10.5194/acp-16-101-2016, 2016.