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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Location controls the findings of ground-based PSC observations" *by* Matthias Tesche et al.

Vincent Noel (Referee)

vincent.noel@aero.obs-mip.fr

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In this paper, the authors combine two CALIPSO cloud datasets to evaluate the amount of stratospheric clouds (PSCs) that could be detected by ground-based lidars at various polar locations, taking into account the optical obstruction of the lidar laser beam by tropospheric clouds.

The concept behind this study is simple and smart, relatively straightforward to apply once the datasets are made coincident in time and space, and in this study provide results that will be definitely useful to inform installations of lidar instruments in polar locations. In other words, I think the authors had a very good idea. For the most parts, they executed that idea well: generally the paper is clear and well-written, the figures

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convey the important points well, and the conclusions are useful. The article is short, which I appreciate, but perhaps a bit too short. I have a few questions for which I could not find answers in the paper, and I think some of the paper's results could be made clearer (see below).

Major points

1. My first major point is that while I think I understand how the authors processed profiles with stratospheric clouds and no tropospheric clouds, I'd like a clarification on how the authors decide, when tropospheric clouds are present, whether these clouds are transparent enough for a ground-based lidar to detect the PSC above (L. 105)? I expect the authors apply a threshold criteria on some integrated property of tropospheric clouds within the profile – is it on the geometrical thickness of the tropospheric clouds, on their optical depth, on something else? The value of the threshold might change from one ground-based lidar to the next, since one lidar with higher SNR might be able to penetrate further than another lidar with a smaller SNR. Also, given a semi-transparent tropospheric cloud with a specific optical depth, a given lidar might be able to detect a relatively bright (larger backscatter) PSC beyond, but not detect a thinner one. Could you comment on how these considerations affect your results, or if they do not affect them at all? Maybe discussing the distribution of opacities of tropospheric clouds the ground-based lidars are supposed to go through would help evaluate if this is an important issue or not. These considerations might lead to location-dependent uncertainties of the approach, according to the distribution of opacities of tropospheric clouds and backscatter of stratospheric clouds over a given location.

2. My second point relates to the presentation of the results by location. Once I understood the premise of the study, the first thing I looked for is a figure presenting the amount of PSCs detectable by a ground-based lidar at each location (taking into account obstruction by tropospheric clouds), relative to the amount of PSCs actually present in the profile (and observable from space). That information might be present in Figure 1 (the numbers in each bar?), or Figure 8 (the y-axis?), but I'm not sure.

Regarding Figure 8, I am not sure I understand it correctly. I am under the impression the authors tried to create a single figure that somehow sums up the potential of each location for ground-based lidar observation of PSCs, but this attempt might be at the cost of ease of interpretation. For instance, the meanings of the grey lines is lost on me. Could you make it clearer somehow if that information is present somewhere in the paper, or add it if it's not there? I understand there is value in having a single figure that ranks locations according to their ground-based performance, but maybe the authors could consider spreading the information it contains on several figures to make it easier to discuss and digest?

3. Another information I'd like to see: given a particular location, if we take the spaceborne-retrieved PSC fraction over a given location as the "truth", how off are the fractions retrieved from the incomplete ground-based retrievals at the same location? This would quantify the error or uncertainty in ground-based PSC retrieval from a given location. Depending on the seasonal variability of PSCs over a given location, it might provide a different way to rank the locations. A location with the best sampling might be affected by a larger error than another with a poorer sampling, if the PSCs over that last location do not change much.

Minor comments

1. L.26: "Today, we are confident..." I'm not sure we are that confident. There is definitely a consensus in recent studies that study PSCs to focus on three possible particle types (ICE/STS/NAT), but I'm under the impression this consensus has less to do with actual evidence showing that all PSCs are made of these particle types (meaning in-situ measurements) and more with a standardization around dominant retrieval algorithms and datasets. Please use a less confident statement, or correct my impression with references.

2. L. 77: "only the austral winters of 2012 and 2015 are are included in the analysis of Antarctic PSCs": Why is that? Why not use the same record for both poles? If one

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dataset is 3 years long and the other 12 years long, how does it affect our confidence in the results from both poles? (Also "are" is said twice)

3. L. 93: "Maps of the occurrence..." Which maps are we talking about here? If this refers to the upcoming figures, why not wait until the figures are introduced to discuss the maps?

4. L. 92 "a certain a PSC", "this types was"

5. Like another reviewer, I do not think the title is a clear description of what this article is about. Without reading the article it is unclear what the authors did. I understand the authors wanted the title to be more about PSCs and less about location ranking, but I find the current title to be less interesting than what the paper describes. It sounds almost obvious: "Location controls the findings of observations" is always true. The contents of the paper go beyond that, and the title might do the article a disservice. I'm not sure what a better title would be though.

6. The approach presented by the authors here has, in my opinion, applications beyond the polar regions. It could be used to rank the potential of locations to provide ground-based observations of high clouds in other regions (eg Tropics), or evaluate the best use of mobile observation setups during campaigns, etc. Maybe the authors could include a comment to this effect in the conclusion.

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