

Interactive comment on “Detection and mapping of polar stratospheric clouds using limb scattering observations” by C. von Savigny et al.

C. von Savigny et al.

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Reply to comments by referee # 2 (anonymous):

Comment 1:

Are the different aerosol models implemented in LIMBTRAN or are external data from a model or experiments used? If the latter is the case, can you specify the data that you used?

Reply to comment 1:

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The text actually mentions what aerosol extinction profiles and phase functions were used. We used the standard MODTRAN aerosol extinction profiles for the specified conditions together with a Henyey-Greenstein phase function with an asymmetry parameter of $g = 0.7$, appropriate for stratospheric sulphate aerosol.

Comment 2:

Why do the PSCs not simply disappear in a relatively short time, if the sedimentation speeds of PSC particles are on the order of 1 km / h. Perhaps you can include some additional short explanation, this would make things more clear.

Reply to comment 2:

Thanks for asking this question. We realized, that the quoted sedimentation speed for PSC type II particles is far too high. We meant to write: 1 km / day, instead of 1 km / hour. The smaller type I PSCs have much lower sedimentation velocities and may be as small as 10 m / day. This sedimentation speed corresponds to about 300 m / month and is smaller than the PSC descent rates observed here. Therefore, the situation is more complicated and than suggested in the paper. Some of the PSC particles may have sedimentation velocities that would yield an apparent PSC descent rate of 1.5 - 3 km / month. The text has been corrected and a brief discussion of the highly variable particle sedimentation velocities depending on PSC type has been added.

Comment 3:

The PSC altitude coincides with the center of a temperature minimum zone that decreases with time. This is a little bit strange. If we assume that PSCs can exist below 195 K, we would expect the cloud top curve to be located a few kilometers higher. One possible explanation can be found on Fig. 2. By simple visual inspection

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of the left panel, we would find a cloud top altitude of about 26.5 or 27 km. On the right panel however, the color index ratio exceeds the threshold (1.3) at 23.5 to 24 km, one data point lower in comparison with the left panel. The problem would be solved if the color index ratio would be defined as: $\Theta(\text{TH} + \delta\text{TH}) = R_c(\text{TH})/R_c(\text{TH} + \delta\text{TH})$. In this way, all cloud top curves would experience an upward shift of a few kilometers (the tangent altitude grid spacing). I do not want to say, that the paper has to be changed, this is only a remark. The definition of the used color index ratio is clear from the paper. Only the association with “PSC top altitude” is a bit misleading.

Reply to comment 3:

Yes, the referee is right. It appears a little strange that the “PSC altitude” is nearly identical with the altitude of the lower stratospheric temperature minimum, and not slightly higher. The referee’s explanation is also correct in our opinion. We now realize that we did not clearly enough describe the limitations of the current approach to infer what we call “PSC altitude” in section 4.2 (Temporal evolution of PSC altitude). By “... the PSC altitude is a measure for the PSC top altitude and not for the mean PSC altitude” we did not mean to imply, that what we call PSC altitude is identical to the PSC top altitude, but just “a measure” with the limitation that there still is an offset between our PSC altitude and the true PSC top altitude. This should have been explained more clearly. We have now done this. In the future we are planning to also retrieve information on the vertical structure of the PSCs, which is certainly contained in the limb measurements. In terms of the example (Fig. 2) given by the referee, we think that the true PSC top altitude is somewhere between the 2 tangent height steps, perhaps around 25 km instead of the suggested 26.5 to 27 km. At 26.5 km there is basically no effect of a PSC to be seen in the color index profiles. Then the actual PSC top altitude would be rather half a TH step above our “PSC altitude”, and not a full TH step.

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Comment 4:

On Fig. 7 we observe histograms of temperatures at the derived PSC locations. An immediate interpretation leads to strange conclusions. At higher temperatures (above about 200 K), no PSCs are identified (except for a few outliers). We conclude that no PSCs form at higher temperatures, a conclusion that is correct. Below about 184 K, the histogram is zero again, leading to the conclusion that no PSCs form at extremely low temperatures. This conclusion is false. The reason that the histogram goes to zero at low temperatures is most likely that the geographical regions where these low temperatures occur, are small, and therefore undersampled by SCIAMACHY. Maybe you can add a sentence to explain this. Perhaps it would have been better to present the histogram of number of PSC occurrences, normalized with the total number of measurements at the associated temperature (percentage of PSC occurrences at a given temperature, a probability density distribution). Most likely, the histogram will be almost 100 percent below 185 K.

Reply to comment 4:

The referee is of course right, that the reason for the fact that we did not observe any PSCs at temperatures lower than 184 K is not because PSCs do not exist at these temperatures. One reason is that SCIAMACHY's spatial sampling and also its spatial resolution is not good enough to resolve small areas with temperatures lower than 184 K. Another reason is that the SCIAMACHY limb scattering observations are limited to the sunlit part of the atmosphere, implying that there are not many observations at very high southern latitudes, where we would expect the lowest temperatures. If we inspect Figures 5 and 6, we can see that the averaged UKMO temperature profiles at the PSC locations never assume values of less than 185 K.

We have added a small paragraph to section 4.3 (distribution of temperature at PSC altitude) explaining the reasons for the low PSC occurrence numbers for temperatures

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below 185 K. Thanks for pointing this out.

Technical corrections:

- 1) Section 2: change “1 March 2002” to “March 1, 2002”

Done

- 2) Figure 4: the titles, labels and color bars are very difficult to read on a printout. It is probably better to increase the size of the figure.

Yes, on the print version of the paper on the ACPD website the details of Fig. 4 are really difficult to read. But if it is formatted in the final manuscript layout, Fig. 4 will almost cover an entire page, and the titles etc. are well legible.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 7169, 2005.

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