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Atmospheric Chemistry and Physics Discussions

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 # 1 (anonymous)

Comment 1:
Are the criteria (a) as little absorption as possible and (b) wavelengths longer than 400 nm the only criteria for the selection of suitable wavelengths? What is the minimum difference in wavelengths? Have other wavelength pairs been tested? Why not use a visible and an infrared wavelength?

Reply to comment 1:
There is a reason why it is better to use wavelengths outside the visible range - if possible - although the detection of PSCs is certainly also possible with visible (weakly

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absorbed) wavelengths: The longer the wavelength, the lower is the tangent height where the atmosphere between the tangent point and the instrument becomes optically thick with respect to Rayleigh extinction. In other words, the "knees" in the limb radiance profiles appear at lower tangent heights for longer wavelengths. If the atmosphere becomes optically thick along the instrument line of sight, then the sensitivity to PSCs is reduced. At 750 nm, the limb radiances increase (for cloud-free) conditions until the surface is reached, i.e., the atmosphere can still be considered optically thin at this wavelength for the typical altitude range, where PSCs occur. This is essentially the same argument as in (b); the cited 400 nm threshold is only an approximate threshold.

To clarify this aspect we added the following sentence to the text:

"Please note that 400 nm is only an approximate threshold. The longer the wavelength, the larger is the altitude range where the atmosphere between the tangent point and the instrument is optically thin in terms of Rayleigh extinction."

Another reason against visible wavelengths around 600 nm is absorption in the Chappuis-bands of ozone, that also changes the shape of the limb radiance profiles and hence affects the color indices and color index ratios. The color index ratio threshold for PSC detection would then also depend on the ozone profile.

No other wavelengths were tested, since the PSC detection method worked well with the initially chosen wavelengths 750 nm and 1090 nm. We did not investigate what the minimum wavelength difference is that is sufficient to detect PSCs. But note, that, e.g., the spectral signature of noctilucent clouds in a 20 nm window (between 290 nm and 310 nm) is wide enough to retrieve NLC particle sizes with high accuracy [*von Savigny et al.*, Vertical variation of NLC particle sizes retrieved from Odin/OSIRIS limb scattering observations, *Geophys. Res. Lett.*, doi:10.1029/2004GL021982, 2005].

Comment 2:

Why is 1.3 chosen as a PSC detection value? Is it because it is just above 1.2? Have sensitivity studies been conducted?

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Reply to comment 2:
We also performed tests with different values for the detection threshold: 1.15, 1.2, and 1.25, and found that with all of these values we get spurious PSC detections, also at mid and low latitudes. The smaller the detection threshold value, that larger the number of spurious PSC detections. With θ = 1.3, the number of wrong PSC detections is very small: as the histograms in Fig. 7 show, only a small fraction (less than 1.5 %) of the "detected" PSCs occur at temperatures that are slightly too high (200 - 205 K; however, they may still be real PSCs). Therefore, we believe that 1.3 is an appropriate compromise between high sensitivity to PSCs and an increased number of spurious PSC detections. We are aware of the fact, that any decision on a detection threshold is arbitrary to a certain extent. But all other PSC or NLC detection studies share this problem. We added a sentence to the methodology section that mentions that different PSC detection thresholds were tested as well.

Comment 3a:
The description of the color index and the color index ratio is difficult to follow. The authors should keep "color index" when speaking about R_c and "color index ratio" when using "θ (TH)".

Reply to comment 3a:
We agree, that the description is not easy to follow, and replaced "R_c" and "θ" by "color index" and "color index ratio" or added "color index" and "color index ratio", as suggested by the referee.

Comment 3b:
Text on page 7174 line 2 should be "Figure 2 shows color index profiles" instead of "color ratio profiles"

Reply to comment 3b:
The referee is right, that the text should read "color index profiles". This was changed.

Comment 4:

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Page 7172, line 16: "alternatively" instead of "alternatingly"?

Reply to comment 4:
I guess we actually meant "alternately", i.e., one limb measurement, then a nadir measurement, again limb, nadir etc.. We thought "alternatingly" is the correct adverb of "altinernating". Thanks for pointing this out!

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