Atmos. Chem. Phys. Discuss., 7, S4513–S4517, 2007
www.atmos-chem-phys-discuss.net/7/S4513/2007/

Atmospheric
Chemistry
and Physics
Discussions

Interactive comment on “Characterization of Polar Stratospheric Clouds with Space-BorneLidar: CALIPSO and the 2006 Antarctic Season” *by* M. C. Pitts et al.

M. C. Pitts et al.

Received and published: 30 August 2007

Response to Referee#2

The authors would like to thank the anonymous reviewer for his/her careful critique of our manuscript. His/her helpful comments and suggestions have led to an improved paper.

Our response to the specific comments is provided below.

Referee’s specific comments:

1. p.7940, line 4: Data below 20.2 km is averaged to fit the resolution above 20.2 km. In fig. 3b, data above 20.2 km seems to be different than on fig. 3a. Is this feature

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

real? If yes is it linked to the way the averaging is done?

There was an error in Fig. 3 in the original manuscript. This is now fixed and a correct Fig. 3 is included in the revised manuscript. The data above 20.2 km in Fig. 3a and 3b now match as they should. Based on another referee's suggestion, we have also added a third panel (Fig. 3c) that depicts the image in the final 5-km x 540-m resolution.

2. p.7940, line 17-19: How does this processing impact on the profiles? I mean many PSC present structured layers (sometimes less than 1 km thick) that can be smooth with a 540 m vertical resolution. This is not crucial for the present study but it could be when trying to infer conclusions on PSC type and composition.

Given the low SNR of the CALIPSO lidar measurements in the stratosphere, some spatial averaging is desirable to reduce the measurement noise and enhance the detection of the relatively weak stratospheric signal. The horizontal smoothing of the data to 5-km resolution is required to put the data onto a common horizontal grid and is effective at significantly reducing the measurement noise. The decision to smooth the data vertically to 540-m resolution was somewhat arbitrary, however, and may not be as important, especially given that we perform additional horizontal smoothing (25- and 75-km) as part of the processing. We agree that it is desirable to retain as much spatial resolution as possible to minimize mixing cloud features with different compositions and that the vertical smoothing may smear out some finer structure. We will examine the possibility of retaining the finer 180-m resolution in future versions of the algorithm.

3. p. 7941, lines 7-11: I understand the backscatter coefficients used here are uncorrected from the particles extinction. Do you plan to make this correction in the future?

In the data processing, we correct the backscatter coefficient profiles for molecular and ozone attenuation, but not aerosol/cloud (particulate) attenuation. There are plans to include attenuation-corrected backscatter coefficient profiles in a future CALIOP Level 1b data product release. This future version of the lidar data will include corrections for molecular, ozone, and aerosol/cloud attenuation. We will use this attenuation-corrected product once it becomes available.

4. p. 7941, line 12: On fig. 4, the spreading around R=1 seems to increase when temperature decreases. I can understand higher scattering ratios as aerosol dilute with decreasing temperature, but why a symmetric spreading?

The increase in the background noise with decreasing temperature is really an altitude effect that shows up as a temperature effect because temperature is decreasing with altitude for the ensemble of points shown in Fig. 4. It is not of geophysical nature, but caused by normalization of the total backscatter signal by the molecular signal which is decreasing exponentially with altitude.

5. p. 7944, lines 21-23: This sentence “On the other hand Ěvariable with time” is not clear to me. Could you clarify what you mean?

Frequently, the total number of data points in a given ensemble was as small as 1000, especially for the 25- and 75-km smoothing levels. In these cases, the accuracy to which we could determine the 99.85 percentile value of scattering ratio decreased significantly. As a result, the daily values of RT determined with the 99.85 percentile appear noisy and are highly variable over the course of the season. We found that the 99.5 percentile values were much less noisy and more stable over the course of the season. We have rewritten these sentences in the revised manuscript to clarify this point.

6. p. 7949, lines 6-8: The CALIPSO features appearing on fig. 12 are consistent with what is observed with the ground-based lidar at the local scales. It clearly shows the novel contribution of CALIPSO as compared to previous satellite observations.

We would be very interested in seeing these ground-based lidar data records. Is there a reference the reviewer could provide us? In the future we plan to subset the CALIPSO data to the locations of the ground-based lidars and compare the seasonal statistics.

7. p. 7951, lines 3-14: MLS is measuring HNO3 in the gas phase. The MLS observa-

tions do not take into account the weight fraction of condensed HNO3. In this way, while using observed HNO3 remaining in the gas phase, TNAT should be underestimated. On the other hand, PSCs are often not observed although temperature is below TNAT. This should be discussed more in the paper, as it is a point in favour of the contribution of CALIPSO PSC observations.

This is an important point that we neglected to mention in the original manuscript. Our estimates of the TNAT assume that the MLS measurements represent the total abundance of HNO3. However, MLS only measures the fraction of HNO3 in the gas phase and does not account for the HNO3 taken up by PSCs. As a result, the TNAT calculations neglect the fraction of condensed HNO3 taken up by PSCs and, thus, underestimate TNAT. Therefore, the area with T$<$ TNAT would be even larger than shown in Fig. 17. Clearly, there are many instances where the temperature is below TNAT, but CALIPSO does not observe PSCs. We do not emphasize this in the paper, however, because it is possible that we are underestimating the PSC areal extent since there may be a subset of optically-thin PSCs that aren't being detected with this version of the algorithm. Future versions of the algorithm will include enhancements that will aid in the detection of these optically-thin PSC and provide a better understanding of this discrepancy.

8. p. 7952, line 1 to p. 7953, line 7: To understand this section and figures 19 and 20, more details are needed on the criterias used to discriminate the different type of PSC and the way they are combined. As a companion paper is writing on this topic, this should be just mention. Here the authors tell too much or not enough.

Since the companion paper is lagging quite a bit behind this paper, we feel that a brief discussion of the capabilities of CALIPSO for PSC composition discrimination is useful. Table 3 lists the criteria used to discriminate the various compositions. We have added a few sentences to clarify how the criteria are used to infer the composition.

9. Summary and Conclusions: Few sentences should be added to summarize and

synthesize the results concerning the observes seasonal and geographical PSC distributions over this winter.

We have added a few sentences in this section summarizing the seasonal and geographical distributions of PSCs over the winter.

Technical comments:

1. Fig. 11 to 18: The labels inside the plots are difficult to read. A color scale would be helpful.

Color scales have been added to Figs. 11-18.

2. Fig. 12 to 18: Indications of the month on the x-axis would help also to read these figures.

Month names have now been added to the x-axis labels in Figs 12-18.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 7933, 2007.

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper