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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Polar stratospheric cloud observations by MIPAS on ENVISAT: detection method, validation and analysis of the northern hemisphere winter 2002/2003" *by* R. Spang et al.

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General comments

The paper describes observation of PSCs with MIPAS on Envisat in the Arctic wintertime stratosphere 2002/2003. Applied methods for cloud detection/cloud top height determination and the PSC type separation are presented. Results are validated by comparison with co-located lidar and solar-occultation satellite measurements. The development and distribution of PSCs during the winter is presented and correlated with stratospheric temperature. To my knowledge this is the first publication on MIPAS PSC measurements in winter 2002/2003. Thus, it presents an important new dataset which overcomes the limitations of latitude

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coverage of space-borne occultation experiments and, thus, allows to follow the development of PSCs over the complete region of the polar vortex on a daily basis. Cloud detection is based on a colour-ratio index which has previously been applied for CRISTA data analysis and which is used to detect clouds in the MIPAS real-time data analysis. Further, Type 1a PSCs are identified by means of a specific spectral signature at 820 cm^{-1} which was also observed in CRISTA spectra and a new method for the detection of this band is presented. The applied methods do not make use of the full content of MIPAS measurements, which would allow to derive information on cloud particle radii and volume density. However, they are very well suited for a fast processing of the large amount of data. For validation, probably all available sources of PSC observations have been taken into consideration properly. However, results of the intercomparison of some parameters are missing, like the PSC height of lidar and PSC type of lidar and POAM vs. MIPAS. Further, it might have been worthwhile to try to tune cloud-index limits in order to enhance the potential of the applied methods. The PSC evolution in the northern winter 2002/2003 is clearly described and very well correlated with temperature evolution and I would regard this also as kind of validation of the derived PSC data. Perhaps the term 'analysis' in the title of the paper is a bit ambitious since there are no comparisons with PSC models included. In summary, due to the presentation of new data and methods with respect to MIPAS PSC observations I think that after some minor revisions this paper is well suited for publication in ACP.

Specific comments

P6287L1-4: It is not obvious to me why this information is given here at all. Later in the paper it is not used in the argumentation. Also the wording is misleading. It should read: 'Validation studies indicate that the variation of the instrument offset along one orbit is less than 6 nW/(cm^2 sr cm^{-1}) (A. Kleinert,...) and tests show that the offset error in the calibrated spectra induced by this variation is

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less than 2-3 nW/(cm^2 sr cm^{-1}).' This means that the study dealt with the calibration errors due to time offset between calibration measurements and scene measurement. Other possible sources of offset calibration errors, like non-linearity, have not been investigated here. (source: Anne Kleinert, Institut für Meteorologie und Klimaforschung, Forschungzentrum Karlsruhe.)

P6287L12: 'continuum emission' should be changed to 'continuum radiation', since, as discussed below in the paper, a significant part of the radiance from PSCs can be caused by scattering, even in the mid-IR.

P6287L20-21: 'cloud emission' -> 'cloud radiation' (see above)

P6288L7: '... radii > 1 μm' change to '... radii > 1 μm in channel A of MIPAS.' Because for higher wavenumbers (e.g. channels C,D) scattering is also significant for particles with radii 0.5-0.2 μm.

P6288L13: What means 'under conditions with no PSCs'? It should read: 'Profiles for which a CI of 4 does not indicate PSCs.' But it is not evident that these are really free of PSCs. Perhaps examples of definitely PSC-free regions, like mid-latitudes should also be shown in Figure 2.

P6288L26: 'threshold value to 4': How has this value been derived? Could it be tuned for even better sensitivity?

P6289L7-15: Too much discussion of winter 2002/03 here in the section where the cloud detection method is described. Perhaps better move to section 5.

P6289L15-22: There is a small error in the given MIPAS pointing corrections: It should read: '0.2 km higher altitudes in November 2002 ... Until end of March .... to 1.5 km lower...'

P6289L15-22: In this discussion of the error estimate of the cloud height detection, I miss the effect of the field-of-view (fov), which adds to the uncertainty of the miss-pointing about +-1.5 km (fov/2). (For thick clouds). For thinner clouds,

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which need some coverage of the fov to be detected the error becomes asymmetrically around the tangent altitude and MIPAS shows systematically lower cloud top heights.

P6290L9: How has the threshold of 10% been determined? 'Significant' should mean that some statistical considerations have gone into the determination of this threshold. What are the exact ranges of the used three microwindows? Assuming, that these are 1 cm $^{-1}$ broad (and an unapodised MIPAS noise of typically 25 nW/(cm^2 sr cm^{-1}) in that region) each radiance value can be determined with a random error of 4 nW/(cm^2 sr cm^{-1}). And, thus, the difference with 5.6 nW/(cm^2 sr cm^{-1}). Thus, I would assume a threshold of about 12 nW/(cm^2 sr cm^{-1}) to be significant beyond the 2σ limit. Thus, I also don't quite understand why the enhancement is defined in relative units.

Section 4.1: I miss some statistics about comparison of MIPAS and lidar cloud-top heights.

Section 4.2.1: To estimate the cloud-top height intercomparison it would be nice to have the absolute accuracy of the POAM measurements.

P6293L1: I have problems with the given length of the measurement volume of MIPAS and POAM along the line-of-sight. In case there is a non-homogeneous cloud, the accuracy of the location of this cloud is rather determined by the vertical stepping distance of the limb-sounder than by the vertical field-of-view.

P6293L15: Can you give also the standard deviation of the mean differences?

P6293L24: Would it be possible to try to correlate the not-detected PSCs by MIPAS with differences in the T-field at the MIPAS and POAM tangent points?

P6295L11: Perhaps check T-fields also here.

P6295L23: Any idea why POAM PSC top heights fit much better to MIPAS than SAGE? Just statistics? POAM less sensitive than SAGE? Latitude dependence?

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P6296L11: Can the CI-values be adjusted to match more of the SAGE/POAM PSC-observations?

Chapter 4.3: I miss comparisons between MIPAS and lidar/POAM PSC-types.

Somewhere it should be pointed out that the Type detection of SAGE/POAM is based on different size distributions between Type 1a and Type 1b PSCs, while the one of MIPAS is a real spectroscopic identification of composition (very probably NAT as stated by the authors).

P6298L28: Perhaps you can mention here that there is one PSC identified with CI about 3.8 on Jan. 3rd, south of Spitzbergen. Otherwise it is not clear why a CI<3 is mentioned here. (Fig. 7 indicates even two events on that day.)

P6299L5: Fig. 7 indicates no PSC events at all in February.

P6300L13-22: Can you identify such an effect in the MIPAS PSC data? From Fig. 8 (d) I think there is no clear signal that (meanCTT - Tnat) is decreasing. This should be mentioned.

P6302L21: It could be misleading to compare formation processes here, since the statistics for MIPAS is rather small and since CRISTA data have been measured in August and not during the initial period of PSC formation over Antarctica.

P6303L5: New calculations showed that 1.3<CI<1.5 can also be STS (or large, but also dense NAT), however, more probably it is ice. CI<1.3 is very probably ice.

P6304L9: In contrast to what is said here, Fig. 7 shows no PSCs during mid-February.

Figure 2: Mean profile of log(CI) and standard deviation of log(CI): what are these necessary for? Are these used somewhere?

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Technical corrections

P6284L15: 'to 90N' -> 'to 89.4N'

P6285L8: 'typicall' -> 'typically'

P6285L22-23: What is meant with 'the most recent instruments'? Is this related to the papers mentioned in the previous list?

P6285L25: Missing in the list: 'broadband spectral measurements'

P6285L28: 'up to 90' -> 'nearly 90N' or '89.4N - 87.3S'

P6286L25: '235 km' instead of '250 km'

P6287L21: '680' -> '685'

P6289L28: 'shown' -> 'show'

P6291L16: '65' but in the table there are only 55 ?

P6303L2: 'Figure 10' -> 'Figure 9'

P6303L2: 'significantly' should only be used in connection with statistical analysis

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Interactive comment on Atmos. Chem. Phys. Discuss., 4, 6283, 2004.