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Atmospheric Measurement Techniques Discussions

Interactive comment on "MIPAS detection of cloud and aerosol particle occurrence in the UTLS with comparison to HIRDLS and CALIOP" *by* H. Sembhi et al.

Anonymous Referee #1

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The manuscript by Sembhi et al. presents a new method to improve standard cloud detection schemes applied to MIPAS/Envisat limb-sounding measurements. The method is based on determination of new cloud-index threshold values through simulation of cloud-free background situations. Validation has been performed by comparison to independent space-borne limb-sounding and Lidar measurements of cloud-top heights. Two special case studies, the Australian bush fire of Feb 2009 and the eruption of Mount Kasatochi in August 2008 are additionally presented.

This well structured paper describes a valuable improvement of a frequently used cloud detection scheme for MIPAS. The presentation is clear and coherent - spanning from

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the description of the new scheme via validation by independent measurements to interesting case studies.

One point I would like to raise at the beginning concerns the altitude-dependent threshold cloud detection values. These are given for various latitude bands and polar vortex conditions. However, I miss a recipe (together with an example/justification of its application) how to apply these limits globally without the danger of introducing discontinuities at the band-edges. Further comments are listed in detail below.

P1799L3: 'compared to that of passive nadir sounders'

- could you give a reference and typical values here?

P1799L5-6: 'hence uncomplicated by surface emissions/reflections'

- not entirely true: as mentioned later in the paper, also IR limb observations are affected by scattered radiation e.g. originating from the Earth's surface

P1799L10-11: '(Hervig and McHugh, 1999)'

- HALOE is given as an example for the UV-SWIR range; however, in Hervig and McHugh, 1999, the mid-IR 5.25 μm channel is used for cirrus detection

P1801L3: 'has a nominal NESR of 30 nW/(cm2 sr cm$-$1)'

- please specify that this is valid for the measurements in high spectral resolution. Could you give the values also for the OR-mode which is mainly discussed below?

P1801L13: 'up to 90 deg north and south'

- 90 deg is not reached, could you give more exact numbers or change to 'up to nearly 90 deg. . .'

P1808L17: Equation (2)

- how are MW1 and MW2 in the denominator defined here? Is it the mean radiance in each window?

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- can you explain the approximations made to derive this formula? I might be wrong, but since the CIs are quotients, i.e. MW1/MW2, if MWx denote the mean radiance in window x, the correct Gaussian error propagation should be: Sigma_total = sqrt((sigma1/MW2)^2 + (sigma2*MW1/MW2^2)^2)

P1808L22: 'is the total instrument error on the index'

- do you mean here the instrumental noise error as calculated in EQ (2) or a real total instrumental error including further more systematic error terms like gain calibration, offset calibration, spectral shift, etc. If only the noise error is meant (as I assume) could you explain why these other errors are neglected?

- could you show some typical values of sigma_total (e.g. in combination with the discussion of Fig. 2)?

P1811L2:

- Could you distinguish the contribution of low ozone and high ClO on the CI limit? Also it would be good to see which window is affected by which gas. - A further possibility to circumvent the high ClO-problem would be to exclude spectral lines of ClO from the affected microwindow which should be possible given the high spectral resolution of MIPAS. This should also be mentioned here together with an example how this could improve the performance of PSC detection.

P1812L14: 'an uncertainty of $\pm$1.5 km can be associated with each CATH measurement'

I don't really agree with this number. One has e.g. also to consider the oversampling wrt the field-of-view width in case of MIPAS measurements since 2005. In Fig. 6 of Höpfner et al. 2009 altitude dependent cloud-top detection errors (bias and standard deviation) are shown based on Monte-Carlo simulations and MIPAS viewing geometry.

P1813L11:

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It should be explained how the mean CATHs are calculated. For MIPAS the lowest tangent altitude is latitude-dependent (e.g. at the equator the lowest tangent altitude is at 12 km). What values have been used if no cloud has been detected down to the lowest tangent altitude? Has this been done consistently for MIPAS and HIRDLS?

P1814L8: 'the north American'

I cannot see such high values over 'north America'. Could you explain?

P1814L11-13: 'HIRDLS demonstrating a more compact distribution. This is in line with the fact that the HIRDLS instrument measured profiles on a denser network approximately 110km spacing as opposed to MIPAS which is closer to 440 km spacing.'

- does this argument not only apply to the N-S along-track direction? Has HIRDLS in E-W direction really a closer spacing than MIPAS?

P1814L14:

-can you specify if for the Lidar only night-time data have been used?

P1814L14 and Fig. 5:

It should also be worth to show here the similar maps for CALIOP. This would especially be interesting for the discussion of Fig. 6.

P1814L22: 'Figure 6 shows normalised distributions of gridded mean CATH for . . .'

-are these the distributions of the mean CATHs or of all single CATHs? For mean CATHs one has to consider the different lowest tangent altitudes of MIPAS and HIRDLS compared to the lidar which covers the whole range.

P1815L1-2: 'consistent feature in both seasons is that MIPAS cloud altitudes appear to be approximately 0.5 km higher than both HIRDLS and CALIOP'

- this would be consistent with the 0.5-1km bias determined theoretically in Fig. 6 of Höpfner et al. 2009. Could you comment on this?

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P1816L23: ‘The CALIOP data are averaged onto a 4×4 deg latitude/longitude grid’

- Can you describe how this averaging has been performed? I would expect a low bias of CALIOP due to the viewing geometry and small footprint such that very low cloud top heights and measurements down to the Earth’s surface also count.

Technical:

P1797L9: ‘at 12 μm’

- ‘at a wavelength of 12 μm’

P1800L24: ‘685 to 2400cm$-$1 spectral range’

- should read ‘685 to 2410cm$-$1 spectral range’ to be consistent with the band D limits given below

P1807L18-19: ‘from the saturation vapour pressure (Voemel, 2011), with respect to water vapour and ice’

- is here really meant ‘with respect to water vapour and ice’ and not ‘with respect to liquid water and ice’?

P1811L11: ‘respectively For’

Full stop missing

P1814L7: ’over localised over’

Delete one ’over’

P1821L15: ‘radiaitve’

- ’radiative’

Fig. 4 and 5:

Could you print in the title of each plot the instrument and season it belongs to?

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Interactive comment on Atmos. Meas. Tech. Discuss., 5, 1795, 2012.