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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 #2

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MIPAS detection of cloud and aerosol particle occurrence in the UTLS with comparison to HIRDLS and CALIOP

Sembhi et al.

Summary

The paper describes the use of the standard MIPAS cloud index as a simple cloud/aerosol detection test, with the associated tangent altitude of the spectra used to locate the cloud/aerosol top height. To increase its sensitivity to optically thin aerosols, latitudinally and seasonally varying CI threshold values are established, representing the extreme values expected from cloud-free atmospheres. The cloud top height and

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occurrence frequencies are compared with HIRDLS results for two 3 month periods, and two stratospheric aerosol injection events are compared with CALIOP observations.

General comments ———————————————————

1) It should be noted that this is still a qualitative, rather than quantitative measure of extinction: it can record the presence or absence of cloud/aerosol, and therefore some estimate of its altitude, but not much else (unlike, for example, the HIRDLS and CALIOP data which also quantify extinction). Clearly there is some relationship between the CI value and the aerosol extinction but this is not discussed. (As an aside, it is unfortunate that the CI was defined, unintuitively, as 'large cloud index = no cloud', which also leads to unstable values of 1/infinity for low signal/noise, and not the other way around; however, here the authors are just following the convention.)

2) The argument that using a higher CI threshold for detecting aerosols in the stratosphere is convincing, but any advantage in the upper troposphere, in the presence of water vapour and conventional cloud, is not evident. It's not apparent that a variable CI threshold is particularly useful either, apart from the polar vortex cases (see later comment). Also, from the cloud statistics comparisons against HIRDLS, it is also unclear whether the variable CI is providing any better results than, say, the standard fixed value of 1.8.

3) It seems that the positive altitude offset relative to the other data can be easily explained as due to the use of vertically over-sampled MIPAS spectra. If spectra are obtained centred at 6, 7.5, 9km with a 3km FOV, any cloud top between 6-7.5 km will be detectable in both the 6 and 7.5km nominal spectra but presumably assigned to the higher spectrum, ie 7.5km. Similarly any cloud top between 7.5 and 9km will be assigned to 9km. So, on average, the assigned cloud top altitude will be about 750m above the real cloud top.

4) The Kleinert 2007 paper only discusses the full resolution mode measurements

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made up to 2004. So what is the origin of the 30nW figure assumed here for the noise in the optimised resolution measurements?

5) Much is made of the problem with ClO contamination of the CI microwindows in polar conditions, so I would have liked to have seen a plot of the spectral features of concern (is it in MW1 or MW2?). Why can't the ClO spectral features simply be removed from the calculation of average radiance. And given the problems of low signal/noise, couldn't the MWs be made wider?

6) According to the text (P1805, L7) CI histograms show a bimodal structure. Section 5 of this paper concerns the modelling of the 'cloud-free' peak in this histogram, and the demarcation between the cloud-free and cloud/aerosol-contaminated spectra. Before moving on to the results, I would like to have seen some comparison between the modelled and measured CI distributions which would validate the calculations.

Minor/Specific corrections and suggestions ——————————

P1799 L25 'focussed' is misleading. Suggest 'wideband'.

p1799 ACE-FTS, being solar occultation, is mentioned as being different from the other instruments discussed. But SAGE and HALOE are also solar occultation. OSIRIS and SCIAMACHY should also be distinguished since these measure scattered sunlight rather than thermal emission. Basically there are three distinct types of instrument here, and four if you want to distinguish between infrared and microwave limb emission. And the ODIN SMR microwave instrument has also been used to retrieve cloud ice content.

P1800 Given Envisat's probable recent demise, MIPAS measurements should be now be referred to in the past tense.

P1800 L25: 'channels' is sometimes used to indicate individual points on the spectral axis, so I suggest using 'bands' or something else here.

P1800 L26: I don't see how a spectral calibration can be obtained from deep space or

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on-board black body measurements.

P1801 L5: '3km FOV': more specifically, the FOV is a trapezium of 4km base, 2.8km top. So in principle a cloud top could be detected up to 2km below the nominal central tangent height, not 1.5km as suggested by its description as a '3km FOV'.

P1802 L14: Given the extreme azimuth viewing of HIRDLS, what is the LST of the observations?

P1803 L6: 'between 0 and 100%' - are there really precision values less than or equal to 0%?

P1804 L7: 'radiance offset' implies that the whole spectrum is shifted by some constant amount. 'baseline offset' is a more accurate description.

P1804 L8-10: presumably these regions with the largest cloud effects just correspond to the well-known infrared atmospheric windows?

P1804 L17: the explanation of how the microwindow pairs are selected is misleading. The 'trace gas' in the control region is not arbitrary - it has to be a well mixed gas (CO2 preferably) - nor is it weak, otherwise the cloud effects would be just the same as in the other microwindow.

P1804 L21: Given the entire focus on this paper is on the MIPAS CI-A (A band cloud index) it would be better not to confuse things by mentioning CI-B and CI-D. In which case, 'CI' is sufficient throughout the paper and Table 1 is largely redundant.

P1805 L9: 'Closer to 6 ... trace gas signatures'. I think what is meant is that vales closer to 6 are what is expected from cloud-free spectra. It's not really just 'influenced' by trace gas signatures.

P1805 L11: 'clear sky' is misleading. The sky may be completely cloudy from the ground-observer's point of view (which is the usual perspective when discussing 'sky'). I suggest 'cloud-free'.

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P1805 L19: 'propagation' implies a more complicated process than it really is. 'effect' or 'influence' would be more appropriate.

P1806 L6-7: 'Furthermore ... spectral data'. It is unclear whether this sentence is to emphasise the fact that this method is independent of real data, or whether it is to emphasise that this method also allows real data to be used to provide an independent determination of these thresholds.

P1808 L15-25: This is a bit confusing. It seems as if the maximum (ie saturated) water vapour profiles were calculated using the maximum temperature profiles. However, comparing these with ECMWF profiles, they were found to be too large so removed. So did that just leave the saturated profiles calculated from the 'mean' temperatures (which would presumably be lower than the max values in the ECMWF data)? And why not just use the ECMWF max values anyway (which is what is implied in Table 2 but not here)? There should also be at least some comment on the fact that the concern is for cloud-free, high water vapour profiles being mistaken for clouds, but what is the likelihood that high water vapour profiles are actually cloud-free anyway? (could the cloud information in ECMWF data be useful here?).

P1808 Eq2. The terms 'MW1' and 'MW2' in Eq 2 are not defined. If they are meant to represent the mean radiances in MW1 and MW2 then this is the expression for the fractional error in CI, not the absolute error which is how sigma_total is used in Eq 3. Also, if it is assumed that the NESR amplitude is the same (30nW?) for both microwindows a simpler expression can be obtained if Eq 1 is substituted into Eq 2 directly without having to define sigma_mwi.

P1811 Section 5.2.3 This would be better presented as a table or diagram. Eg you already have Fig 2 showing the CI threshold profiles, why not a matching figure side-by-side showing the corresponding extinction detection limits?

P1813 L4: on P1801 L11 it was stated that MIPAS only reached 100% duty cycle in Dec 2007: JJA 2007 is before this.

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P1813 L26: I find the definition of Cloud Occurrence Frequency confusing. Is this simply the percentage of the time that a cloud top is detected within the 12-20km altitude range? If so, I don't see how the 1km altitude bins come into this. If, instead, it's also supposed to include the fraction of the 12-20km altitude range covered by cloud, why not just weight the count by the cloud top height rather than use altitude bins (I'm assuming that if a cloud is detected in one altitude bin it will also be detected in all lower altitude bins). And given HIRDLS narrower FOV size (10km width cf MIPAS 30km width) wouldn't you expect MIPAS to find clouds more often in any case?

P1816 Fig 7: isn't this simply the same plot reproduced in the left panel of Fig 9?

P1816 It is mentioned that MIPAS and CALIOP sample at 3h difference in time, but what about longitude differences? Can we safely assume that the points plotted in similar lat/lon locations in Fig 9 were actually taken on approximately the same day in the 9 day span?

P1819 L13: '15 to 18 km layer' - 'layer' here is confusing. What the plot shows is not the aerosol layering but the distribution of aerosol top height. The 'layer' may well extend all the way down to the tropopause.

P1828 Table 1: the microwindow boundaries are not multiples of the 0.0625cm-1 spectral grid

P1829 Table 2: mention which H2O continuum model is used.

P1830 Fig 1: it would be better to expand this plot to show just the region of interest for the CI microwindows, and use MIPAS OR rather than FR data since that is what is used in this paper. Also mark the locations of the two CI microwindows used. Expand 'LOS' in caption.

Technical corrections ————————-

P1796 L11 - expand 'UTLS' on first use (here rather than in L24).

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P1796 L11 - 'The newly established thresholds improve confidence ... as well as better characterised cloud distributions.' Some extra words are required to make this sentence grammatically correct.

P1796 L21 'thresholds of 5 apply ... decrease rapidly...'. If the cloud index value is 5, then this is one (singular) 'threshold'.

P1796 L26-27 'Comparisons ... establishes' confusion with singular/plural.

P1796 L28 'cloudS and aerosol top heights' should be 'cloud and aerosol top heights' (reads better and consistent with definition of CATH in section 6)

P1797 L6 'into the UTLS, and into the stratosphere'. The 'LS' part of 'UTLS' *is* the stratosphere.

P1797 L27 'manifest' should be 'manifests' if 'combination' is the subject of the verb.

P1798 L3 'ejected' - is this different from 'injected' used in the previous sentence?

P1796 L25-29: 'The [CALIOP] ... offers ... making the most ...' grammatically inconsistent.

P1801 L14: 'This combined with ... allow ...' should be '... allows ...'.

P1801 L16: 'upper stratosphere' is well-sampled in all three of the main MIPAS operating modes. 'thermosphere' would be a better example in this context.

P1802 L18: 'assigned as;' should be a colon rather than a semi-colon.

P1803 L3: 'Gille et al ... recommends' should be 'recommend'

P1803 L6: '215 and 20 hPa' should be '215 to 20 hPa'.

P1803 L9: insert comma after 'lidar' (to match comma after HIRDLS)

P1803 L15: 'the CALIOP' - just 'CALIOP' for consistency with usage elsewhere in the text.

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P1806 L12: 'As no cloud ... are included'. This could be better phrased, eg 'neither cloud nor enhanced aerosol is included' or 'both cloud and enhanced aerosol are excluded'.

P1812 L20 'CATHs'? elsewhere 'CATH' is used for both singular and plural.

P1817 L19: 'partial columns of UTLS'? Presumably 'partial columns of SO2 in the UTLS' is meant.

P1820 L28 'statistical based' ? statistically based.

P1829 Table 2: replace 'MIPAS-E' with 'MIPAS'

P1831 Fig 2. Outward pointing tickmarks would be easier to see. Also, replace semicolon after 'ClO;' with comma. Suggest overplotting the CI=1.8 line.

P1836 Fig 7 caption: 'Februay' should be 'February'. Legend within the figure is redundant.

P1837 Fig 8. Legend within the figure is redundant.

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