Thank you for reading our paper in detail and providing such valuable comments and suggestions. We have taken all of these into account and made changes to the manuscript accordingly.

The following section lists each comment/question raised with appropriate replies.

Reviewer 1.

a) Altitude dependent thresholds: The recipe for the application is given in the results section when describing how to calculate cloud and aerosol top heights and the cloud top occurrence frequency. In order to make this more succinct, we will add additional sentences to highlight the application procedure. With regard to the latitude bands, the simulations were performed on the latitude bands belonging to the IG2 trace gas climatological database for consistency. We then investigated application of the thresholds to MIPAS spectra on this latitude configuration as well as finer latitude banding. We did this by performing analysis of cloud and aerosol top heights for the complete MIPAS dataset with the IG2 latitude bands as well as the finer latitude bands and found that the finer bands resulted in no obvious discontinuities in the calculated cloud fields (whilst on some occasions, some discontinuities were observed when using the IG2 latitude bands in the mid-latitude to polar regions).

   Finally, the fact that the patterns observed in MIPAS cloud/aerosol fields compare so well with those observed in HIRDLS cloud/aerosol data (and show no discontinuities in the cloud features) hopefully provides some verification of the thresholds performance.

b) P1799L3: Typical values for nadir sounders are given as 3 to 4 km, (Rodger, 2000). We will have changed this paragraph in the manuscript and added that typical values for nadir sounders are given as 3 to 4 km.

c) P1799L5-6: We agree with the reviewers comment here; scattered solar radiation *can* affect radiances at longer wavenumbers, thus point C has been removed.

d) P1799L10- 11: Thank you for pointing this out; HALOE cirrus measurements are of course made in the mid-infrared spectral channel. Thus the paragraph describing limb sounding instruments that measure clouds has been modified to accommodate this information.

e) P1801L3: We have changed this paragraph in the manuscript to highlight that this NESR is valid for MIPAS band A in “Full Resolution” mode and give the NESR information for the “Optimised Resolution” mode.

f) P1801L13: We have modified the latitude coverage to give the exact degree’s covered (89.3° north and south).

g) P1808L17:
    a. The definitions for MW1 and MW2 were missing and are now added to the manuscript.
    b. Thank you for pointing this out to us. We had actually missed out a term in the error calculation printed in the manuscript. The uncertainty calculation should be as follows;

The calculation of the CI uncertainty is based on the fact that the quantity CI, that is a function of MW1 and MW1, has associated standard errors, ΔMW1 and ΔMW2.

Thus, using the standard equations for the calculation of relative errors, the error on CI should be:

σCI/CI = SQRT((ΔMW1/MW1)^2 + (ΔMW2/MW2)^2). Absolute errors are then calculated as ΔCI = CI * (σCI/CI)

The relative error equation is given in the text from which the absolute error is then derived.

h) P1808L22:
   a. We feel that calling this the "total noise" is actually bit misleading as we are referring to a sigma introduced by the instrument noise effect only. This has been changed in the manuscript.
   b. The limiting source of error on the CI is due to the propagation of instrument noise through each of the microwindows. Since each of the MW's would be subjected to the same systematic errors, they should in effect, cancel out and the final error should be a function of the noise uncertainty on each MW. To make this more apparent, we have redefined sigma error (noise error) in the manuscript.
   c. We think the figure will be too difficult to follow if we add the sigma profiles. The dotted lines in figure 3 are in fact sigma profiles (for the polar cases only), thus, sigma profiles are already shown. We can note in the text that typical values of sigma (sigma_total) are close to 0.5 below 15 km. Worst case values are 0.3 at 12 km, ~ 1.0 from 15 km to 20 km and greater than or equal to 3.0 at altitudes above 25 km in polar winter.

i) P1811L2: Since the initial submission, we have revisited this issue in more detail. The effect of ClO is only observed in MW2 where weak ClO features are observed at 832.5 cm^{-1} to 832.8 cm^{-1}, and 833.9 cm^{-1} to 834.1 cm^{-1}, a stronger feature is observed at 833.3 cm^{-1}. We performed some additional tests on the polar index calculations by modifying temperature, O3, ClO and HNO_3 (modifying each separately) and we can deduce that the combined effect of low temperature, low O_3, low HNO_3 (in both microwindows) and enhanced ClO (in MW2) is the dominating factor that determines the resultant index values. This combined effect outweighs the impact from the enhanced ClO alone, therefore, masking the ClO lines would not be of any benefit. Generally, we see that low temperature causes an increase in noise with low O_3 and low HNO_3 causing the index values to decrease. We originally did not include any information on the HNO_3 in the manuscript (although in the calculations shown in section 5.2.2. we do modify it according to Manney et al, 2011) and have now modified the manuscript. We have also clarified in the abstract that it is not high ClO formation but rather, a combined effect from the atmospheric deviations in temperature and the gases above.

j) P1812L14: The reviewer is correct that there is some impact on uncertainty of CATH according to field-of-view. For a cloud filling the tangent layer, one can estimate that the uncertainty is asymmetric and ranges approximately from +0.5 to -1.5 km for reduced resolution mode and +1.0 km to -2.0 km for full resolution mode; Höpfner et al 2009 results indicate the positive bias is 0.5 to 1.0 km. However, Höpfner at al, 2009 also note that the offsets depend on the horizontal extent of the clouds. Therefore we prefer to conservatively assign an error of ±1.5 km across all CATH. We note later that a bias of 0.75 km in reduced resolution mode for UT clouds can explain some of our results and is broadly consistent with expectations from Höpfner et al 2009 simulations for filled tangent layers.

k) P1813L11: The mean CATH has been calculated only from points for each instrument which are found to be cloudy; non cloudy points do not contribute since we have no information. Thus, the mean CATH is calculated only in the altitude range where both MIPAS *and* HIRDLS data exist. HIRDLS data actually reaches much lower than 12 km but these data are excluded from the analysis to keep consistency in the mean CATH calculations.

l) P1814L8: The figure explanation refers to the "North American Monsoon region" and this will be made clearer in the text. The region referred to is located over Mexico and south-west region of the United States.

m) P1814L11-13: Yes, this argument does only apply in the N-S direction where the HIRDLS profiles sampling of ~ 100 km and the E-W is more comparable to that of MIPAS. The other factor that is likely to contribute is the vertical resolution which for limb sounders controls also the horizontal extent in the tangent layer. Most likely both effects contribute. This will be clarified in the manuscript.

n) P1814L14: Day and night CALIOP measurements are used for consistency with the MIPAS-HIRDLS observations which are also day and night.

o) P1814L14 and Fig. 5: The primary focus of this comparison is MIPAS and HIRDLS only as they are both thermal limb sounding instruments with a comparable vertical sampling of clouds. We prefer to concentrate on these comparisons and to use the histograms with CALIOP added simply as a final verification of the CATH range observed.

p) P1814L22: The histograms are made from the mean CATH within the specified altitude range; i.e. All datasets, MIPAS, HIRDLS and CALIOP) are first filtered between 12 and 20 km and then the mean CATH calculated. Hence the lower altitudes sounded of the lidar are not relevant. These points are now made clearer in the manuscript.

q) P1815L1-2: In fact a "best agreement" is obtained by shifting the MIPAS data in altitude by 0.75 km. The overall bias of MIPAS is consistent with the theoretical bias shown in Höpfner et al 2009 if one assumes that the cloud layers predominately fill the lowermost tangent layers (horizontal extent). An additional comment has been added to the manuscript to this effect.

r) P1816L23: This averaging (where CALIOP data were gridded onto a 4° by 4° latitude grid) was used to approximately *"match"* the MIPAS horizontal resolution. However, we have decided to instead include the non-averaged CALIOP data in this figure for the 7th to 16th February (night data only). This allows us to avoid any biases that may be introduced by the averaging and to better illustrate how well the position of the plume and the range CATH has been captured.

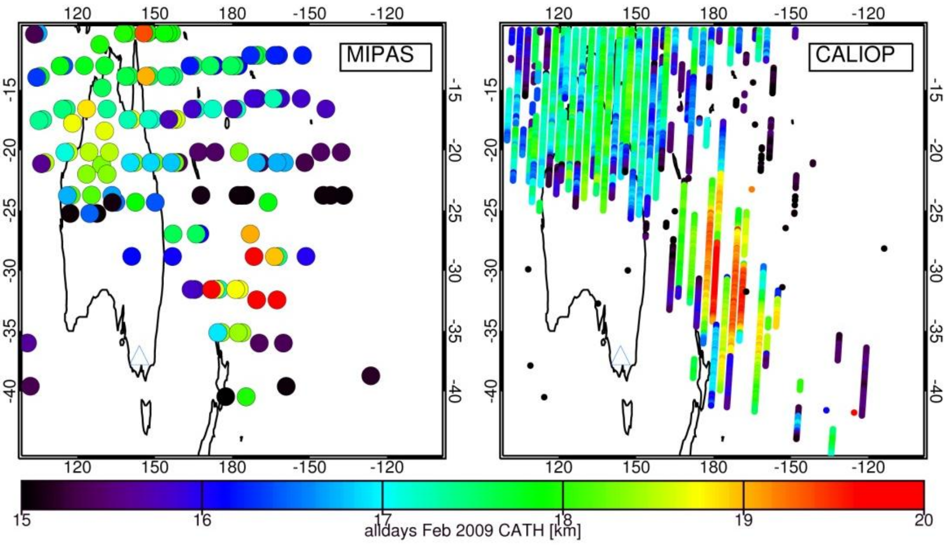

Figure 1. MIPAS and CALIOP CATH (night only) with un-averaged CALIOP data for the 7th to 16th February.

Technical corrections:

P1797L9: ‘at 12 μm’ has been changed to *‘at a wavelength of 12 μm’*
P1800L24: ‘685 to 2400 cm^{-1} spectral range’ has been changed to *‘685 to 2410 cm^{-1} spectral range’*
P1807L18-19: ‘from the saturation vapour pressure (Voemel, 2011), with respect to water vapour and ice’ is changed to *‘with respect to liquid water and ice’* to be consistent with the definition from Voemel, 2011.
P1811L11: ‘respectively For’. A *‘.’* has been added to complete this.
P1814L7: ’over localised over’. We have deleted one *’over’*.
P1821L15: ‘radiaitve’. We have corrected this to *’radiative’*
Fig. 4 and 5: Could you print in the title of each plot the instrument and season it belongs to?
We have now added these to the figures as suggested.