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Atmospheric Measurement Techniques Discussions

Interactive comment on "MIPAS reduced spectral resolution UTLS-1 mode measurements of temperature, O_3, HNO_3, N_2O, H_2O and relative humidity over ice: retrievals and comparison to MLS" *by* S. Chauhan et al.

S. Chauhan et al.

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We would like to thank the referee for the useful comments and suggestions which contribute significantly to the improvement of the paper.

1. *Comparisons should be made between the standard deviation of (MIPAS - MLS/Aura) and the predicted errors for both instruments. characterization of both the bias and errors is a necessary step prior to combining results from MIPAS and MLS as mentioned in the conclusion.*

   As suggested by the referee, combined random errors of MLS and MIPAS,

combined systematic errors and standard deviations of the mean differences between MIPAS and MLS have been included and compared to the global altitude dependent bias in the revised manuscript. For updated figures please see answer to referee 2 comment no. 12.

Specific Comments Abstract

2. *Abstract: It would be useful to give the validated pressure ranges for atmospheric temperature, ozone, HNO_3, and N_2O in the abstract*

   The suggestion has been taken in to account

3. *Abstract: Line 11 states that MIPAS and MLS temperatures agree within $\pm$4 K. This is presumably the bias between MIPAS and MLS? If so, this should be specified as the bias difference, e.g. MIPAS and MLS temperatures are biased within $\pm$4 K over the whole pressure range of 316-0.68 hPa.*

   The sentence has been modified as suggested.

4. *Line 18: MIPAS and MLS stratospheric volume mixing ratios (vmr) of H2O agree within +-1 ppmv. State what this is also as a %. Again, is this the mean difference (bias)?*

   $\pm$**10%. Yes it is the bias and the text has been changed accordingly.**

5. *Line 15 : ...present similarly in MIPAS and MLS. Recommend changing wording to...present in both MIPAS and MLS.*

   Modified accordingly.

6. *In introduction: ...independence of sunlight, and, in consequence, the coverage of the whole earth within one day. Recommend changing wording to: ...independence of sunlight, allowing the coverage of the whole earth within one day.*

   Changed as suggested.

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7. *In introduction: ...HIRDLS, MLS, SMR and MIPAS are operating continuously. Recommend changing wording to: HIRDLS, MLS, SMR and MIPAS are operating exclusively in limb mode. This is because the instruments may have data gaps for various reasons.*

   Done.

8. *Section 2: As will be shown below, this leads to an improved vertical resolution from 2 to 4 km in the UTLS region of the resulting trace gas profiles compared to the full resolution (FR) nominal mode observations. It is confusing as to which resolution goes with which mode. Is this supposed to read: As will be shown below, this leads to an improved vertical resolution of 2 km in the UTLS region of the resulting trace gas profiles compared to the full resolution (FR) nominal mode vertical resolution of 4 km.*

   The text has been modified. "As will be shown below, this leads to an improved vertical resolution from 2 to 4 km in the UTLS region of the resulting trace gas profiles of RR UTLS-1 mode, compared to the full resolution (FR) nominal mode observations"

9. *Section 2: If the vertical resolution has improved, has there been any downside to the reduced resolution?*

   Regarding the reduction of the spectral resolution, we have not observed any downsides so far.

10. *Section 2.1. It would be useful to have a few statements describing the fit procedure. Are different tangent point data retrieved together or each independently? What is the sequence of retrieval?*

    A section describing in more detail the applied retrieval approach has been added in the text. Shortly, the IMK/IAA data processor uses a constraint retrieval approach where all tangent point observations of one elevation

scan are used simultaneously. In the retrieval sequence, first, the spectral shift of the measurement is determined. Second, temperature and line-of-sight elevation are jointly fitted. Thereafter, H_2O, O_3, HNO_3 and CH_4 jointly with N_2O are retrieved in sequence (CLARMANN et al., 2009).

11. *Section 2.1. Why are zero a priori profiles chosen rather than a more realistic value? It would seem to defeat the purpose of having a priori information included in the retrieval. Additionally, if retrieving in log(VMR) for water as the paper states, a zero value is not possible.*

    The baseline of the applied retrieval approach is to avoid for trace gas retrievals any possible mixing of a priori information with the results. For further discussion please refer to our answer given with respect to referee 3 comment no. 4.

12. *Section 2.1.1, last paragraph: In the case of temperature the total error is dominated by the parameter error. Parameter error is not listed in the list of errors earlier in this paragraph. Parameter error needs to be defined.*

    Within the new section on the retrieval technique error terms are explained. It has been corrected in section 2.1.1.

13. *Section 4: A coincidence criterion of +-12 h in time and +-300 km in space was used to find closely matched profiles. Comment: Since you have defined the criteria, I would remove the term "closely"; which is subjective.*

    Changed as suggested.

14. *Section 4: In case of MLS it has been tried to minimize... Recommend changing wording to In the case of MLS, the choice has been to minimize...reduced resolution?*

    Done.

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Interactive Comment

15. *Section 4: The standard deviation of the difference between MIPAS and MLS needs to be compared to the predicted errors to see if they are consistent within the reported errors, as discussed previously.*

    This has been done (see above).

16. *Section 4, ... the agreement between MIPAS and MLS is between +-3 K. Comment:Specify if this is the bias or the standard deviation difference.*

    It is a bias and has been corrected in the text.

17. *Section 4.5 ... agreement between MIPAS and MLS is within 0.5-1 ppbv. Comment:Also give the % difference. Specify this as the bias difference.*

    The relative differences are now reported in the text.

18. *Conclusion. ... The agreement between MIPAS and MLS is good with the exceptions of... Comment: The term good is a value judgment; good needs to be defined. Additionally the term agreement is not defined and should be specified as what is being compared for MIPAS and MLS. A more precise statement would be, e.g. The bias between MIPAS and MLS is less than 10% for VMR values and less than 3K for atmospheric temperatures, with exception of ...Where I have put in the 10% and 3K thresholds which may or may not be the thresholds you use to define "good".*

    The suggestion has been taken in to account and the conclusion text will be revised accordingly.

19. *Conclusion: Due to the similar altitude resolution and well characterized biases, the combination of MIPAS and MLS datasets seems possible. Comment: To combine results, both the bias and the standard deviation differences for matched profiles should be characterized. Ideally, since there will be differences in IR and microwave sensitivity, e.g. in the presence of clouds; both instruments should also correctly report their sensitivities for an optimal average.*

In the revised manuscript standard deviations of the matched profiles,combined estimated random noise errors and combined estimated systematic errors are included in the altitude-dependent bias plots. A discussion of the comparisons between estimated quantities and observed ones and the drawn conclusions have been implemented in the revised manuscript.

20. *Table 3. These tables give the total error estimates. How do the actual error, rms of (MIPAS-MLS), compare to this predicted error and MLS predicted error?*

    Figures of mean global differences have been extended accordingly. See the detailed explanation given above.

21. *Figure 1-5. These figures have numbers at the top of each plot obscuring the title.*

    Changed.

Reference:

T. von Clarmann el al., Retrieval of temperature, H_2O, O_3, HNO_3,

CH_4, N_2O, $ClONO_2$ and ClO from MIPAS reduced resolution nominal mode limb emission measurements", Atmos. Meas. Techn., 2, 159-175, 2009.

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