

Interactive comment on “Impact of temperature field inhomogeneities on the retrieval of atmospheric species from MIPAS IR limb emission spectra” by M. Kiefer et al.

Anonymous Referee #1

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Kiefer et al. study the impact temperature inhomogeneities in 1-D and 2-D trace gas retrievals for the Envisat MIPAS instrument. For various trace species and several retrieval schemes they show that the assumption of a homogeneously stratified atmosphere causes systematic retrieval errors (on the order of 20%, or more). This is obviously a very important problem that scientific users of limb sounding data should be aware of. The paper is mostly well written, interesting to read, and within the scope of AMT. It should be published after the following comments are properly addressed by the authors.

General Comments

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1) In the paper 1-D retrievals for H₂O, CH₄, N₂O, CFC-11, and CFC-12 are analyzed. However, the presentation of the results is a bit unsystematic, I think. Fig. 1-7 show the impact of neglected temperature gradients for individual latitude bands, individual altitudes, or individual retrieval schemes. This is fine to illustrate that the effect is important in many situations. However, a scientific user of IMK, ESA, or Oxford MIPAS L2 data will likely also need to know the individual retrieval errors for other latitude bands and altitudes? If the authors have carried out a more comprehensive survey than presented in the paper, I suggest they consider publishing the results, e.g. as an electronic supplement to this paper?

2) Given its general importance in atmospheric chemistry and physics, and being a major data product of Envisat MIPAS, the impact on ozone retrievals should be analyzed and presented.

3) The explanation of the impacts of neglected temperature gradients on the trace gas retrievals is appellative (although I find it convincing). A more detailed physical explanation on how temperature gradients affect the radiative transfer and how the retrieval feedbacks due to the assumption of a homogeneously stratified atmosphere work would be interesting.

4) To explain or illustrate the retrieval feedbacks a retrieval experiment based on synthetic measurements and idealized atmospheric conditions (constant background profile plus constant T-gradients) would be helpful. The results of the retrieval experiment based on real MIPAS measurements presented in section 4 (Fig. 10-12) might be obscured to some extent by measurement errors and atmospheric variability?

5) The authors suggest to include prescribed temperature gradients in the radiative transfer to improve 1-D retrieval quality. However, as presented here this recommendation is based on the analysis of four MIPAS orbits. I think a more comprehensive survey is necessary to identify potential pitfalls with this approach. Running the retrieval tests for more orbits may improve the statistical comparison of old and new

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retrievals presented in Fig. 13.

Specific Comments

title: Suggest to replace 'temperature field inhomogeneities' by 'horizontal temperature gradients' to be more specific.

p1708, l2: Suggest to write '... (MIPAS) on board Envisat' or similar, to name specific MIPAS instrument in the abstract.

p1708, l8: Fig. 5 shows differences for H₂O up to 50% rather than 20% mentioned here?

p1715, l10-15: How large is the statistical basis for this analysis, i.e. what fraction of MIPAS measurements was processed with the different retrieval schemes and what fraction of L2 data is used for the analysis presented here?

p1715, l20-22: Are there any difference in the mean latitudes of the analyzed MIPAS profiles for the ascending and descending orbit parts within the bins? Such differences would cause systematic asc/desc temperature differences if an atmospheric temperature gradient is present.

p1716, l6-8: This is most likely due to the presence of the polar vortex boundary?

p1716, l25-26: There are situation in which CFC-11 gradients may be positive with latitude (horizontal transport) or even altitude (in the vicinity of deep convection events). Just write 'which are generally negative'.

p1717, l9-11: I am surprised that the regularization can cause such severe differences between IMK and Oxford retrievals. Is the smoothness constraint rather different in this two schemes?

p1721, l1-19: I would have preferred to see Fig. 8 and 9 already at the begin of section 3, i.e. before the presentation of the results for the trace gas retrievals.

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p1722, l10: Is 400km extent kind of an optimum value? The individual temperature kernel functions along the line of sight are broader than this.

p1725, l9-12: Might be worth to point out that standard deviations estimated from both ascending and descending orbit parts will be severely affected by the retrieval errors described in this paper. It seems variance computed from either ascending or descending data alone might be more representative?

Fig. 1: The mean CFC-11 data from IMK and Oxford shows significant differences. Are these due to the different retrieval schemes? Are the analysis based on the same subset of retrieved profiles? In the caption write '(asc-desc) differences' or '(desc-asc) differences', to assist the reader.

Fig. 5: There seem to be outliers in ESA data around 20 hPa in summer 2003 and 2004? If these outliers can be easily identified they should not be included in the analysis presented here.

Fig. 8: Suggest to include arrows/symbols in the plot to indicate the north/south orientation of the line of sights to assist the reader.

Fig. 10: Suggest to include arrows in the plots to indicate satellite track and/or orientation of line of sight to assist the reader.

Technical Corrections

p1709, l2: Fourier_ _transform

p1712, l7: with the global fit

p1714, l6: spell out GMTR acronym

p1714, l10: make use of 'MIPAS2-D' and 'MIPAS2D' consistent

p1715, l8: write 'trace species' rather than 'molecules'

p1721, l28: write 'tangent altitude' rather than 'LOS'

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p1722, l5: write 'prescribed' rather than 'adequate'

p1722, l24: write 'differences' rather than 'values of differences'

p1723, l4: write 'including the prescribed gradients' rather than 'and LOS data'

p1723, l9: but ___ approximately

Fig. 4: There is a label '15' in one of the plots.

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 1707, 2010.