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Atmospheric Measurement Techniques Discussions

Interactive comment on "Methane and nitrous oxide retrievals from MIPAS-ENVISAT" *by* J. Plieninger et al.

Anonymous Referee #1

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General Comments

In this paper the authors present revised methane and nitrous oxide retrievals for Envisat MIPAS. In particular, the impacts of updated spectroscopic data, radiometric offsets, regularization, microwindow selection, and joint fits with HNO3 and H2O are discussed. It is demonstrated that known high biases of the existing MIPAS CH4 and N2O data are reduced by the revised retrieval scheme. Retrieval characteristics, i.e., systematic error budgets and estimates of vertical resolution, for reduced and full spectral resolution mode measurements from Envisat MIPAS are presented.

At first reading, I was not convinced that this paper provides extremely new and interesting results. However, reading it again, I realized that the high bias of earlier MIPAS

CH4 and N2O retrievals must have been large, indeed, and that the revisions of the retrieval scheme presented here are substantial. The paper will be of interest for a broader community of users of the IMK/IAA MIPAS data and other retrieval scientists. I found that the paper is well written and that the presentation is mostly clearly. Some points may require a more detailed discussion, please see specific comments below. I concluded that the paper fits in the scope of AMT and would recommend it for publication once the following comments are properly addressed.

Specific Comments

p7806, l2-15: The abstract is missing details, I think. What is the time period covered by the new MIPAS data sets? What is the quality of the new data sets in terms of error estimates and resolution? It might be worthwhile to mention here how large the high bias of the old data products was to indicate that the new products provide significant improvements.

p7807, l4: Which apodization was used?

p7807, l19-p7808,l2: In order to help the reader judge if these high biases are important, I would suggest to add relative numbers. For example, 0.7 ppm for CH4 and 80 ppb for N2O in the lower part of the profiles correspond to ∼40% and ∼25% relative difference, right? After reading the introduction for the first time, I was wondering if these new MIPAS data are really needed, but these numbers point to large errors in the earlier data products, indeed.

p7810, l23-25: How did the CH4 and N2O spectroscopic data change in the HITRAN2008 update? The update seems to change the retrievals significantly, so it might be worthwhile to discuss this a bit.

p7811, l19-22: The reference to Bardeen et al. (2008) points to a study on numerical simulations of meteoric dust in the mesosphere and upper stratosphere. Do you expect such particles to cause significant influences on the MIPAS radiances and do these

events occur frequently so that a large number of MIPAS profiles would be affected?

p7812, l5: Do you mean "radiometric offset" instead of "spectral offset"?

p7812, l6-7: It is pointed out here that with the revised retrieval scheme 10403 instead of 10378 profiles converge. Is this improvement of 0.2% statistically significant?

p7812, l7-8: Your assumption that the retrieved background radiation is probably related to aerosols needs further analysis, I think. Maybe the background signals are just due to calibration errors of the instrument?

p7814, l4-7: Perhaps be a bit more specific and provide numbers here? How much did the RMS and DFS actually change?

p7815, l3-11: Can you provide an explanation for the reduced vertical resolution in the UT/LS? Figure 9 indicates that the vertical resolution decreases to ∼7 km for CH4 and ∼10 km for N2O in the UT/LS, which is much coarser than the vertical sampling and field-of-view of the instrument. This reduced vertical resolution might be a drawback for scientific studies, I think. Why is the vertical resolution at mid latitudes better than at tropical or polar latitudes?

p7815, l24-28: I am not sure if the additional plots of the columns of the averaging kernel matrix provide much extra value. The integral value of the averaging kernels (rows) would be more interesting to add, providing a measure of measurement information versus a priori information in the results.

p7816, l8-11: Are there references discussing these instrument errors?

p7816, l25-p7817,l11: This paragraph is presenting the retrieval errors for a mid-latitude profile. Are the results for other latitudes/seasons similar?

p7817, l15-18: I am surprised that the vertical resolution estimates for the full resolution retrievals (Fig. 13) vary so largely. In the UT/LS they alternate between 6-7 km and 12 km for adjacent altitudes (on a 1 km grid)? Is this related to the method that was

used to estimate the resolution? Are these FWHMs of the averaging kernels or are the estimates based on concept of information density (Purser and Huang, 1993)?

p7818, l7-11: Strictly speaking, if the new data products are really "improved" can only be demonstrated by validation with other/external instruments. However, it certainly looks like a step forward.

Technical Corrections

p7812, l28: "remains" -> "remain"

Figs. 1-3: Replace "On the upper panel..." by "Upper panel..." (like in the caption of Fig. 9)?

Figs. 4-5: "but difference _of_ retrieval..." ?

References

R. J. Purser and H.-L. Huang, 1993: Estimating Effective Data Density in a Satellite Retrieval or an Objective Analysis. J. Appl. Meteor., 32, 1092–1107.

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 7805, 2015.