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Comment

Interactive comment on “Maximum likelihood representation of MIPAS profiles” by T. von Clarmann et al.

T. von Clarmann et al.

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The authors thank the reviewers for their helpful comments and the positive reception of the manuscript. In the reply below the original comments of the reviewers have been inserted in *italic* face. Our replies and changes to the manuscript are printed in normal face.

Review #1:

Comment: *Review of "Maximum likelihood representation of MIPAS profiles" by T. von Clarmann et al.*

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The manuscript presents “Maximum likelihood representation of MIPAS profiles” by T. von Clarmann et al. (amt-2015-50) that can provide a user-friendly and virtually unconstrained representation of remotely sensed vertical profiles of atmospheric constituents. The methods appear appropriate and the paper is well written. Therefore, the study is of interest to the reader community of AMT, and I recommend publication after considering the following two comments.

General comments

This study proposes a very useful alternative to OE products. In order to show the accuracy of the unconstrained retrieval, it might be good to provide the comparison with ground-based observations highly accurate. You might want to add a new figure of the comparison in the manuscript.

Reply: The comparison of MIPAS data with ozonesondes has already been published (A. Laeng et al. 2015 “The ozone climate change initiative: Comparison of four Level-2 processors for the Michelson Interferometer for Passive Atmospheric Sounding (MIPAS)”, *Remote Sensing of Environment*, Vol.162, Pages 316–343). Figures 1 and 2 of our paper show that the mixing ratios do not change substantially between the original and the new representation. The combined errors of the MIPAS and the comparison profile are typically much larger than the differences between the different MIPAS representations, and the latter are fully explained by the resampling. Thus we think that the validation paper mentioned applies also to the new data.

Action: We have added a reference to the relevant MIPAS ozone validation papers. Since the main text is generic (i.e. not gas specific) while the validation refers to ozone

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only, we have made the reference in the Figure caption.

AMTD

8, C1219–C1224, 2015

Comment: *As authors pointed out in the manuscript, the content of a priori information in OE products can lead to unsolved problems in analyses of trend estimates and annual cycles. It would be great to show the difference of the trend estimates or annual cycles derived from the regular and unconstrained retrievals in order to demonstrate how much significant the problems could be, if possible.*

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Reply: Unfortunately we do not have the complete data set available yet. Currently we have processed only a couple of test orbits. This is by far not sufficient to demonstrate the effect of the new scheme on time series.

Action: Instead of demonstrating the effects ourselves, we have added a further reference on problems with time-dependent averaging kernels.

Review #2

This paper describes a specific representation of trace gas profile retrievals from MIPAS, a thermal-IR limb sounder. The maximum likelihood representation described here provides a useful alternative to existing MIPAS retrieval products and will address the needs of a subset of data users. The paper is clear and well-written. The subject matter is appropriate for AMT and the paper should be useful to users of MIPAS and other limb-sounding datasets. I recommend publication. I have a few relatively minor comments/suggestions. It would be helpful to provide the explanation of the term “maximum likelihood” in the Introduction rather than waiting until Section 2 to define

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this term.

AMTD

Reply: Agreed.

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Action: Short explanation inserted after the first mention of this term in the Introduction.

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Comment: *I think it would also be helpful to refer to the Bayesian framework in the introduction.*

Reply: Agreed.

Action: We now refer to the Bayesian framework in the beginning of the introduction.

Comment: *Page 2504, lines 23-25: In the section above, you state that the “maximum likely” estimate refers to a solution without consideration of prior information, but then in this section you go on to discuss the role of prior information/assumptions in the context of a maximum likelihood retrieval. This is a little confusing. Could you add some language to make this easier for the reader to follow?*

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Reply: Agreed.

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Action: We now take care in the text above that we never say “free of prior information” but “free of formal prior information”. Further, the text about the role of prior information/assumptions has been rewritten.

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Comment: Page 2510, lines 1-5: You state that for some species the ML-representation is inadequate. Could you list the species for which the ML MIPAS data products will be made available?

Would it be possible to provide a table showing the global grid for each of these species? It would be very interesting to see how the grids for each species compare to the resolution of the master vertical grid. This might be a useful reference for other groups who might want to try this for other limb-sounding datasets and see how their vertical resolution compare.

Reply: Of course we could make statements on what we intend to do in future. We could also list the specific grids we consider adequate for a number of species. Since we have no opportunity to do related thorough tests in due time, we think that this kind of speculative statements would add some vagueness and uncertainty to the paper. Thus we prefer not to follow the reviewer here, to restrict the work on the demonstration study which is based on thorough tests, and to postpone issues related to other species to papers dealing with the respective data products.

Action: None by now. If, however, inclusion of this information related to other species is considered essential, we are of course willing to include it in another iteration of the paper.

Comment: Typos/grammar: ...

Reply: Thanks for spotting.

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Action: Corrected.

AMTD

Further changes:

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The following change has not been requested by any of the reviewers but appears adequate to us: Figures 1 and 2 have been replotted such that only those layers are shown where the averaging kernel diagonal actually is approximately unity. Due to boundary effects this is not always the case.

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Interactive comment on Atmos. Meas. Tech. Discuss., 8, 2501, 2015.

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