

## ***Interactive comment on “The horizontal resolution of MIPAS” by T. von Clarmann et al.***

**T. von Clarmann et al.**

Received and published: 11 February 2009

### **Replies to the review and the editor’s comment:**

The original review is included in *italic face*; our reply is printed in normal face.

#### **Review:**

##### *Opening Remarks*

*In this paper the authors have calculated the horizontal averaging kernels associated with the retrieval of trace gases with MIPAS radiance data. These averaging kernels have been analyzed for a selection of the MIPAS retrievals. This work contains some interesting results worthy of publication in a journal dedicated to Atmospheric Measurement Techniques. The presented results are specific to the MIPAS observations*

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper



*but as the authors point out the technique is easily adapted to any limb observations where a two-dimensional model of the observed signal is readily calculable. I would suggest this work be published with very few modifications.*

#### *General Comment*

*I feel that it is not necessary to make the authors jump through significant hoops before their paper is published. The nature of this paper dictates how it should be treated. The results are very straight forward observations that arise from a simple analysis applied to the specific MIPAS viewing geometry and radiative transfer problem. The conclusions are not earth shattering and there is way, way more work that could be done along the same lines and the subsequent results could be presented in a long drawn out paper. However, I don't feel more work is necessary. I believe the authors have done the proper due diligence to ensure their results are valid so the only question is should this type of analysis be published. I found the paper well written, interesting and useful. Therefore, I vote yes. It is worthy of publication.*

The authors would like to thank the reviewer for his/her appreciation of their work.

#### *Specific Comments*

*In the abstract many trace gases are mentioned (line 10) but averaging kernels are not presented for many of these gases and I don't believe HNO<sub>3</sub> is mentioned at all.*

In the paper we present and discuss only those results which either are typical and representative for the other results, or those which stand out by a particular feature which deserves dedicated discussion. The averaging kernels of the other gases mentioned in the paper have also been calculated, and they are included in the supplemental material. The option to include material in a supplemental file, accessible to all readers who need complete quantitative information, e.g. to construct operation operators for data assimilation, gives us the chance to keep the paper itself

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper



short and concise.

*On line 25-26 in the abstract it is not clear what is meant by “propagation of the horizontal smoothing ..”. However, it does become clear after the paper was read.*

Since it is very hard to communicate this result in any short and exact while still understandable way, and since this particular result is not spectacular, we have decided to remove this sentence from the abstract.

*I am a little confused about the discussion surround equations (4) and (5). I assumed that equation (4) was for a two-dimensional atmosphere where the optical properties were allowed to vary with both height and angle along the satellite track. This assumption is supported by the statement on line 4-5 on page 109 but contradicted by the statement on line 10-11 on page 108.*

Equation (4) in its general form indeed is for a two-dimensional retrieval; the reviewer has correctly understood this. The statement on line 10-11 on page 108 (“Since no horizontal variation of the atmospheric state has been allowed...”) refers to Eq (4) after tuning the scalar parameter  $\gamma$  large enough to remove all horizontal variation. The idea behind this approach is to emulate a 1D retrieval in a 2D formalism. We have modified the text to make this clearer.

*I found the sentence starting on line 2 page 111, “Only for H<sub>2</sub>O ...” very confusing. I should note that this is uncommon for this paper that I found exceptionally clear way more often than not.*

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper



This sentence has been rewritten.

*If the authors really want to do more work they could perform the analysis in section 4.4 while varying more than just the temperature with angle along the satellite track. They could look at typical gradients found in the trace gases as derived from either climatologies or models and estimate the impact of doing a one dimensional retrieval. I would find that interesting but I wouldn't require the analysis before publication.*

We think this would overload the paper.

*Closing Remarks The authors have done a good job of explaining a technique and some of its results. I have found the paper both interesting and useful and I recommend it be published with only minor revisions.*

The authors are thankful for the appreciation of their work.

## Editor's comments:

### General comments

*This is a very well written paper presenting the relevant and new concept of horizontal resolution of limb sounding satellite instruments. With a few exceptions the paper is really easy to follow. I agree with referee #2, that this manuscript should be published with minor revisions and ask the authors to consider the specific comments made by referee #2*

See above

## AMTD

1, S151–S158, 2009

Interactive  
Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper



as well as the mainly minor comments listed below.

### *Specific comments*

1) Page 110, lines 6/7: “The ESA online processor retrieves profiles at the tangent-points of each limb scan” Does this mean that the retrieved trace gas abundances (or temperature) at different altitudes are assigned different horizontal coordinates depending on the spatial movement of the tangent point during the limb scan?

No, it doesn't! The wording was unprecise. Under the assumption of spherical homogeneity the question where the profiles are retrieved is quite meaningless. The correct answer would be that profiles are retrieved at all geolocations covered by the horizontal averaging kernels. The statement has been corrected for the revised version.

2) Page 111, line 11: “In some cases, however, the majority of information of MIPAS profile retrievals originates from the atmosphere slightly beyond the tangent point, e.g. for daytime tropical NO<sub>2</sub> (Figure 4).” I'm not sure I understand this sentence. Does “tangent poin” here refer to the tangent point at 30 km tangent height, or to the black solid line in Fig. 4?

To the latter, i.e. the actual tangent points, not the nominal ones. This has been clarified for the revised version.

Fig. 4 shows, that the centroid distances are at most altitudes slightly shifted towards the satellite (with 2 exceptions at 42 km and about 50 km) relative to the location of the tangent points, which appears to contradict the above statement (if I understand it correctly). Or does the sentence simply express the fact, that (because altitudes below

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)

*25 km are not retrieved) the centroid distances are negative for most altitudes?*

The sentence refers exactly to the exceptions at 42 and 50 km altitude. This has been clarified in the revised version.

*3) Caption Fig. 4: "Some minor information displacement towards beyond the tangent point is visible for uppermost and lowermost altitudes" Perhaps I'm not getting the point, but the Fig. shows, that for the lowermost (around 25 km) and uppermost (around 70 km) altitudes there is a minor displacement towards the satellite.*

Thanks for pointing out! The figure caption was incorrect. It should read "at 42 and 50 km" instead "for uppermost and lowermost tangent altitudes". This has been corrected.

*4) Page 111, lines 20 - 25: "Moreover, the interaction ... " I read these sentences many times, but find it very difficult to understand, why the combination of vertical scanning and satellite movement leads to a denser sampling beyond the tangent point. I really don't want to be picky, as this is a very nice manuscript. I just don't understand what is meant here. Perhaps you can clarify this point further.*

We have inserted: "Through the satellite motion, the points where the raypaths of a limb scan intersect a certain altitude level move together beyond the tangent point, while they diverge on the satellite side of the tangent point."

*5) Page 112, lines 1 - 3: "Most information on temperature originates from a point displaced from the actual tangent point towards the satellite by about 50 to 100 km (Fig. 5)." I suggest adding a brief qualitative explanation why this displacement by 50*

to 100 km towards the satellite occurs?

While in general different behaviour of temperature and mixing ratio Jacobians (and thus information) is not unexpected, we have no fully conclusive explanation to offer. Since we do not like to include speculative explanations in the paper, we prefer to leave this issue open.

6) Page 115, line 13:“... the methods to calculate the horizontal averaging kernels can be applied to each limb sounding instrument with lines of sight approximately in the orbit plane .. ” This statement is probably not correct if limb-scatter observations are considered as well. In the case of observations of emissions all the information arises from within the FOV. However, for limb-scatter observation absorption also takes place along the path to the line of sight, where the photons are scattered into the instrument’s FOV. Therefore, one would have to consider the horizontal resolution across viewing direction, too.

Well, this depends on what one understands is the line of sight. My understanding is that in such limb scattering cases the line of sight (the scattered one; more exactly: all the scattered lines of sight) are no longer in the orbit plane. However, we agree that a less generalized statement is clearer and have restricted this statement to emission and occultation experiments.

7) You mentioned that no additional vertical constraint was applied (apart from using the tangent height grid as the retrieval altitude grid). I suggest adding a brief discussion how a vertical constraint will affect the horizontal resolution.

We discuss this issue in another paper (AMTD-2008-0031), which will be referred to in

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper



the conclusion of the revised paper.

*Typos etc.*

*Page 106, line 2: “altitde” → “altitude”*

*Page 106, line 8: “trace species abundances profiles” → “trace species abundance profiles”*

Corrected, thanks!

---

Interactive comment on Atmos. Meas. Tech. Discuss., 1, 103, 2008.

## AMTD

1, S151–S158, 2009

---

Interactive  
Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

