Atmospheric Measurement Techniques Discussions

Interactive comment on "The effect of horizontal gradients and spatial measurement resolution on the retrieval of global vertical NO$_2$ distributions from SCIAMACHY measurements in limb only mode" *by* J. Puķīte et al.

J. Puķīte et al.

janis.pukite@mpic.de

Received and published: 2 August 2010

Response to Referee #2

General comments: This paper is well-written, and contains a well-constructed study concerning the effect of horizontal gradients on retrieval of NO$_2$ profiles. The results are useful, and should apply readily for numerous other species (not limited to NO$_2$). My questions relate to details that would help me understand the paper better.

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We thank Referee #2 a lot for reviewing the manuscript and very positive response and helpful hints. Please find our reply point by point below.

Specific comments: Sect. 2, 1st paragraph: It would be helpful to specify who "our group" is.

We specify "...our group (the remote sensing group of the Max Planck institute for Chemistry in Mainz and also two members of the atmospheric physics group from the Institute of Environmental Physics in Heidelberg)"

Sect. 2, 2nd paragraph: Since Deutschmann (2009) is not readily available to most readers, could you briefly describe the difference between the McArtim model and the Tracy-II model, and how these differences affect (or fail to affect) the results of this study?

The main difference is that in "McArtim" the separation between trajectory generation and weighting is not performed, i.e. the absorption is included in the trajectory generation. This increases the calculation speed especially for cases with large optical depths. All other features relevant for this study, like the full sphericity option, and the 3D box AMF concept are kept and do not affect the results. We add to the description in this paragraph: "The main difference is that in "McArtim" the separation between trajectory generation and weighting is not performed, i.e. the absorption is included in the trajectory generation. This increases calculation speed especially for cases with large optical depths. All features relevant for this study like full sphericity option, 3-D box AMF concept are kept and do not affect the results."

Sect. 2.3, 2nd paragraph: Interpolation is mentioned in several places, but the nature of the interpolation attempted is not specified. Is it linear interpolation? Of what quantity? (Number density, mixing ratio, etc.)

We explain the interpolation used now at the end of Sect. 2.3: "In our study linear interpolation of number density is applied, although, in general, different kinds of interpolation may be defined by the matrix **X**."

Sect. 3.1, 5th paragraph: It's a little unsettling that such a large fraction of the regions shown in Figs. 4-5 are cross-hatched (retrieval error > gradient effect). However, I suppose the (presumably) random

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nature of the retrieval error allows useful information to emerge from the picture even in the cross-hatched regions.

As the referee correctly realizes, we do not want to speculate about the usefulness of such information for the shaded regions, since it is not clear whether it comes from a real gradient or is caused by the retrieval error. Therefore we indicated that the error is larger than the gradient effect. However, the figure also shows that the 2D tomography provides important and also significant improvements already on a per orbit basis for a wide altitude range. On the other side, by averaging the result for different orbits, systematic gradient structures become more visible which is also an effect of a decreasing random component of the retrieval error.

Technical comments: Sect. 4.2.2, 4th paragraph: I think this should read: "In analogy to Figs. 8 and 10, Fig. 17 shows..."

Thanks for this point, we corrected it as suggested and thank again the referee for the comments

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 2055, 2010.