

## ***Interactive comment on “Stratospheric methane profiles from SCIAMACHY solar occultation measurements derived with onion peeling DOAS” by S. Noël et al.***

**S. Noël et al.**

stefan.noel@iup.physik.uni-bremen.de

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### **Reply to referee 1**

We thank the referee very much for the overall positive judgement and will consider the comments in the revised version of the paper.

### **Answers to general comments:**

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- *At first I expected a section on the advantages and disadvantages of this method with respect to other strategies such as optimal estimation, but soon realized this was already discussed in the Noël et al. (2010) paper on water vapour profile retrievals. However I would suggest adding a paragraph or, when referring to this paper on p4804, line 9, stating that therein such a discussion can be found.*

We will add a sentence referring to the discussion in Noël et al. (2010).

- *When dealing with long time series such as described in this paper, it is often useful to have some information on the long term stability of the data. Did your comparisons with ACE-FTS reveal any such information?*

A quantitative assessment on the long term stability would require a comparison of validation results for different years. This has not been done (yet) and would probably be limited by reduced statistics. However, looking at the SCIAMACHY time series (Figs. 4 & 5) there is no indication for a degradation of the SCIAMACHY data product, as long as the same dead/bad pixel mask is used for the complete data set (which we did).

### **Answers to specific comments:**

1. *page 4809, l 6: Is there a significant dependence of the residuals on altitude?*

Between 20 and 40 km the residuals are very similar; they increase a bit towards lower altitudes but are still of similar magnitude. We will add a corresponding sentence in the paper.

2. *page 4809, l 24: How is this error defined, is it based on the fit residuals (mentioned later)? If so you might want to refer to the later section or mention it earlier.*

This is the same error (based on fit residuals), we will clarify this in the paper.

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3. *page 4810, l 15: Is water vapour fitted as well?*

No. We checked this but the impact of water vapour is very low, probably because of the low concentrations in the stratosphere.

4. *page 4812, l 1: Did you test the impact of variable CH<sub>4</sub> on the CO<sub>2</sub> correction factor?*

We checked this based on the data used to determine the CH<sub>4</sub> saturation correction (where CH<sub>4</sub> is varied and CO<sub>2</sub> is kept constant). The impact of variable CH<sub>4</sub> on the retrieved CO<sub>2</sub> is very low, usually much less than 1–2%. For the CO<sub>2</sub> correction this is uncritical. We will add a corresponding sentence in the paper.

5. *page 4813, l 10 + 17: I would add 'estimated' as in 'The estimated mean error', since all other parameters have been derived from the ACE vs. SCIA comparisons and mean error could be confused with the mean standard error.*

OK, will be done.

6. *page 4814, l 5-6: Why were the effects of the applied corrections not considered? Did you not look into them or did you find them to be negligible with respect to other error sources? Please clarify. In fact you might want to consider a designated small chapter (2.4.4?) on the SCIAMACHY error assessment prior to the part on the preliminary validation.*

The effects of the applied corrections are difficult to be quantified. The error as currently shown in the paper is essentially determined from the RMS of the residuals divided by the corresponding weighting function (which converts the spectral error into a trace gas error). As mentioned above, the fit residual – and therefore also the RMS – is rather constant with altitude, but the weighting functions significantly decrease with altitude. This is why the errors increase with altitude. Smoothing changes the vertical resolution of the data, and therefore also the weighting functions; one could guess that applying a 4.1 km boxcar (which

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is similar to averaging) would reduce the error by a factor of  $\sim 2$ . However, the vertical sampling of the original measurements is only about 3 km, whereas the retrieval is performed on a 1 km grid using interpolated measurements (which is not considered in the errors). The estimation of the impact of the additional saturation correction and CO<sub>2</sub> correction is even more difficult, as these also affect potential systematic errors. Therefore we decided to specify only the error based on the residuals (and weighting functions), as this is the only error which is well defined and comes directly out of the retrieval.

Following your suggestion we will add this information in a corresponding new section of the paper.

7. *Fig 4: The 'Avg. Tropopause' label on the bottom right side of the figure is hard to read, I would suggest increasing the font size a bit (and turn it 90°, if the increase forces you to decrease the entire figure size)*

The font size will be increased.

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Interactive comment on Atmos. Meas. Tech. Discuss., 4, 4801, 2011.

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