Atmospheric Chemistry and Physics Discussions

Interactive comment on **"Atmospheric carbon gases retrieved from SCIAMACHY by WFM-DOAS: improved global CO and CH$_4$ and initial verification of CO$_2$ over Park Falls (46° N, 90° W)"** *by* **R. de Beek et al.**

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Authors answers to Anonymous Referee #2 on paper de Beek et al., Atmospheric carbon gases retrieved from SCIAMACHY by WFM-DOAS: Improved global CO and CH$_4$ and initial verification of CO$_2$ over Park Falls (46°N, 90°W), Atmos. Chem. Phys. Discuss., 6, 363–399, 2006

We thank the referee for the constructive comments on our paper. Each comment will be carefully considered for the revised version of the paper. Below we give answers to

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each of the referees comments.

Answers to "General comments":

As recommended by the referee we will add a more detailed analysis of several of the items listed by the referee (details are given below).

Answers to "Specific comments":

Abstract, line 15

For the revised version of the paper we will add a more detailed quantitative comparison with MOPITT. The SCIAMACHY WFM-DOAS version 0.5 CO column year 2003 data set has recently been compared with a network of FTS ground stations (submitted revised version of Dils et al., ACPD (Special Issue Geophysical Validation of SCIAMACHY), 2005). The additional information on the quality of the SCIAMACHY CO columns and a short discussion of the main findings of the FTS comparison will be added to the revised version of our paper.

Page 366, lines 17-19

The sentence will be deleted in the revised version of the paper.

Page 369, line 13

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Yes, it was the change of the fitting window. We will explain this more clearly in the revised version of the paper.

Page 369, ice correction

For the revised version of the paper we will add more details concerning the effect of the ice layer on CO and on the methane used for correction. The ice layer affects CO and CH_4 in a similar but not exactly identical way (see also Gloudemans et al., ACP, 5, 2369–2383, 2005). This means that dividing CO by simultaneously measured methane reduces the CO error but some error remains. This will be discussed in more detail in the revised version.

Page 371, line 26

For the revised version of the paper we will add more details concerning the calibrations improvements and its impact on the CO_2 retrieval. We will add more details to demonstrate that the improved calibration results in (quite systematic) CO_2 column changes of about 20%. This means that the application of a large scaling factor (1.27) is not necessary any more because of the improved calibration.

Page 372, PMD 1 cloud correction

Our algorithm has been designed to reliably identify cloud free scenes. FRESCO gives effective cloud fraction. In principle one could use FRESCO cloud fraction to identify cloud free scenes using FRESCO cloud fractions close to zero but it is not clear without detailed study which threshold to take and if the final result will be good

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enough for our application. Our algorithm is based on sub-pixel PMD readouts with higher spatial resolution than the much larger O_2 A band pixels used by FRESCO. We think that using sub-pixel information is more appropriate for our application. An algorithm based on sub-pixel information is, for example, more flexible as it can be applied to any SCIAMACHY ground pixel size (the SCIAMACHY ground pixel size is not a constant but depends on spectral interval and orbital position). FRESCO had known problems over highly reflecting surfaces such as over deserts, a problem has been at least partially solved recently (Fournier et al., ACP, 6, 163-172, 2006).

Page 375, lines 8-9

This statement mainly refers to improved (grid cell) resolution due to the possibility to use multiple zoom regions (the data set we have used has high resolution only over Europe) and latest emission data bases. For the revised version of the paper we will add more details to explain this.

Page 375, lines 18-25

For the revised version of the paper we will add a more detailed comparison with TM5 methane. We agree that it is not appropriate to derived precision and accuracy estimates from only two orbits. This will be changed for the revised version of the paper.

Page 376, line 19

For the revised version of the paper we will add more details concerning the methane solar zenith angle bias problem and its first order correction. The SCIAMACHY

WFM-DOAS version 0.5 XCH4 year 2003 data set has recently been compared with a network of FTS ground stations (submitted revised version of Dils et al., ACPD (Special Issue Geophysical Validation of SCIAMACHY), 2005). Comparisons have been done with and without bias correction. The additional information on the quality of the SCIAMACHY XCH4 and a short discussion of the main findings of the FTS comparison will be added to the revised version of our paper.

Page 377, lines 1-3

The references will be given in the revised version of the paper.

Page 378, description of SCIA processing, lines 23-29

We will consider to describe this shorter.

Page 379, line 11

We have not yet used the latest HITRAN edition but will consider this for future versions.

Page 380, lines 11-13

The CO_2 part of this paper will be substantially revised. We will limit ourselves mainly to a detailed discussion of the CO_2 column scaling factor issue (see also our answer to Anonymous Referee #1).

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Page 380, line 23

For the revised version of the paper we will aim at providing more details concerning the CO maps for China.

Page 381, lines 27-

The CO_2 part of this paper will be substantially revised (see comment given above). We will remove Fig. 11 (CO_2 over China) from this paper because it raises many question which cannot all be answered without significant additional study. The CO_2 map for China has been included to show all three carbon gases over the same area for the same time period. We thought that this makes sense even if the interpretation of the CO_2 is difficult. The referee is right that over some areas the seasonal amplitude is higher than over Park Falls. Of course one does not expect the same amplitude everywhere. However at present we cannot offer a clear explanation why the measured amplitude is larger over certain areas compared to others, especially how much of this is due to atmospheric CO_2 variability and to what extent this is influenced by measurement error (e.g., albedo, aerosol, and temperature sensitivity).

Fig. 1

For the revised version of the paper we will add a more detailed quantitative comparison with MOPITT (see also the comment given above).

Fig. 6

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The block-like pattern is due to the TM5 horizontal resolution in combination with the sampling of TM5 at the SCIAMACHY footprints. The SCIAMACHY resolution is typically higher than the model resolution. This gives typically one TM5 grid box value for several SCIAMACHY pixels resulting in a block-like pattern when averaged (we simply sample the TM5 model field without any spatial interpolation).

Answers to "Technical corrections":

Page 381, line 24

The typo will be corrected.

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