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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Error analysis for CO and CH_4 total column retrievals fromSCIAMACHY 2.3 μm spectra" *by* A. M. S. Gloudemans et al.

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Below is a small update of the previous author comment.

We would like to thank the referee for his/her useful comments on our paper. We agree with the referee's point of view that it would be better to start the paper with figure 7 and summarizing the SCIAMACHY instrumental problems which have been discussed in previous papers. We have therefore restructured the paper accordingly, now starting with mentioning the largest problems with the SCIAMACHY 2.3 micron spectra, i.e. the ice layer, the variation of the dark signal within an orbit, and the increasing number of damaged detector pixels. After correction for these problems, the instrument-noise error is the dominant error source in the retrieval of CO and CH_4 from SCIAMACHY's 2.3 micron spectra, which is then discussed in detail as described in Section 4.2 of the Discussion paper (which has become section 3.1 of the revised version of the paper), followed by a discussion of the minor calibration problems (Section 4.3 of the Discussion paper; now Section 3.2). Since de Laat et al. (2007) show that for small instrument-noise errors a small bias exists, a discussion of other error sources, such as presented in Section 3 of the Discussion paper is meaningful and is now included in the revised paper as Section 4. In this way, the largest error sources of the SCIAMACHY 2.3 micron spectra are mentioned first, so that the reader will get a good feeling for the magnitude and importance of the different error sources.

The discussion whether the 1.2-3 micron wavelength range is better for satellite monitoring of tropospheric species than the thermal infrared is not addressed in this paper.

The reason why spectra with noise $>$1.5e18 molec/cm^2 are considered is that de Laat et al. (2007) found a bias for measurements with such high noise levels. Based on that finding such measurements are therefore excluded from their analysis. In this paper we try to find an explanation for this bias. If the reason is known then the bias could possibly be reduced and even measurements with noise $>$1.5e18 molec/cm^2 may turn out to contain useful information. It should be noted that this is the noise of a single SCIAMACHY spectrum and denotes a random error, so that averaging several of these spectra may still result in useful CO total columns with noise errors smaller than 1.5e18 molec/cm^2. Also, it should be noted that in source regions, such as during biomass-burning events, the CO total columns are much higher than 1.5e18 molec/cm^2, so that noise errors $>$1.5e18 molec/cm^2 may still result in S/N$>$1 for these spectra.For CH_4, a noise error of 1.5e18 molec/cm^2 indicates a S/N of 25. We understand the remark of the referee about this issue since this was not explained properly in the text. Thus, we have added a few sentences to clarify this.

Also, we have added a global map of the SCIAMACHY noise error, similar to that published by de Laat et al. (2007) showing the global variations of the noise error (figure 2 of the revised version). Since the dominant error source of the SCIAMACHY spectra is the instrument-noise error the global variation of the noise error indicates the favorable and less favorable conditions for using the SCIAMACHY data. This was the

ACPD

8, S3611–S3613, 2008

goal of the paper by de Laat et al. (2007) and we have repeated their conclusion for clarity.

As far as aerosols are concerned, it is not possible to give one error for Saharan dust or for African biomass burning or for Chinese emission regions, nor to add a statement whether these regions are less favorable or not, since the impact of aerosols depends on the surface albedo and the aerosol optical thickness (AOT) which is a highly variable quantity within such regions, both spatially and temporally. Instead we have indicated in the text for which AOT the effects start to become significant when no aerosol information is included in the retrieval algorithm. This can then be used to track less favorable conditions. In section 3.4.5 (i.e. Section 4.5.5 of the revised version) solutions are then provided to substantially reduce this error. For example, for CO the error becomes negligible when using CH_4 as a proxy for the aerosol light path. We have tried to clarify this better in the text and hope it is now more clear.

If there are any other major issues that the referee would like to have added to or removed from this paper we would appreciate it if he/she could let us know so that we can include it in the revised version of the paper.

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Interactive comment on Atmos. Chem. Phys. Discuss., 8, 5183, 2008.

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