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Atmospheric Measurement Techniques Discussions

Interactive comment on "Validation of five years (2003–2007) of SCIAMACHY CO total column measurements using ground-based spectrometer observations" *by* A. T. J. de Laat et al.

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Response to the referee reports for AMTD paper amtd-3-2891-2010 by de Laat et al.

First of all, on behalf of all my co-authors I would like to thank the referees for spending their valuable time refereeing this paper.

Below follows a detailed response to the remarks made by the referees.

Referee #1, and also for referee #2 for issue (4).

1) The effect of the FTS averaging kernels – smoothing error - is small. For the IR

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measurements we found two estimates of 0.3 [Senten et al., 2008] and 0.6 % [Barret et al., 2003], while for the NIR measurements (Darwin) a smoothing error of 5.8% was reported [Paton-Walsh et al., 2005], in agreement with the SCIAMACHY CO smoothing error [de Laat et al., 2010] who report a smoothing error range (2σ) of 0-8%. Based on chemistry-transport model calculations of CO with the TM5 model the SCIAMACHY smoothing error for the Darwin location is approximately 5%, assuming a solar zenith angle of 25 degrees. Note that SCIAMACHY observes at the same wavelengths as the Darwin instrument – opposite to the other FTS instruments that measured in the IR, hence the similarity in smoothing errors is not surprising. We added a paragraph at the end of section 2.2 explaining the effect of the smoothing error.

2) We have extended table 2 with the TM4 estimate of partial column that is missed for SCIAMACHY cloud ocean pixels ("contamination", as the referee calls it). We provide both the relative and absolute partial column values. We also included the relative contribution of ocean pixels to the mean. We added to section 4.5 that the "contamination" depends not only on the model results, but also the number of ocean pixels that go into the mean as well as the weighting used for calculating the mean: for some locations the ocean pixels contribute relatively more because their reflectance is larger than that of the land within the sampling area.

3) Since it still is unclear what is causing the Southern Hemisphere bias in 2003 and 2004 we would prefer to avoid speculating about its causes as long as no clear explanation has been found. We already note in the paper that it is under investigation.

4) The reason for using only GBS measurements is twofold. First of all, SCIAMACHY does not provide any vertical information. Hence, comparing SCIAMACHY with GBS measurements that also provide total columns is the obvious first step of the validation, rather than including also aircraft profile measurements that must be translated into total columns. Note that aircraft profiles miss any CO measurements above the maximum flight level so that an additional estimate of this missing part of the column must be provided. Secondly, given the characteristics of the SCIAMACHY measure-

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ments and the many factors complicating the validation (collocation issues, the use of measurements over oceans over low clouds etc.) it requires quite a considerable paper to describe the optimal settings for the validation. Adding other measurements that introduce some additional complications would lead to a much longer paper, which, as referee #2 notes, is better suited for a different paper. We added a small paragraph to the introduction explaining this reasoning.

Nevertheless, we recently have been comparing SCIAMACHY with MOZAIC aircraft data. That comparison confirms the findings presented in this paper, but, as referee #2 notes, this really is a topic for a separate paper. We plan to write a paper which includes the aircraft validation once a new and improved SCIAMACHY dataset is processed, which should also lengthen the record with the years 2008 and 2009. Furthermore, we plan to include an update of the comparison with MOPITT whose v4 was released last year (de Laat et al. [2010] provides a comparison with MOPITT v3). And until now we have used TM4, but we have also performed a new multi-year model simulation with TM5, the successor of TM5 with for example improved chemistry and updated emissions.

Referee #2

De Laat et al. [2010] showed that the effect of the SCIAMACHY averaging kernel – smoothing error - was a few percent (0-8% for the 2σ range). Given the length of the paper in combination with the secondary importance of the SCIAMACHY smoothing error compared to other effects there appears no immediate need include another figure. However, a more detailed investigation of the effect of the SCIAMACHY averaging kernel will be subject of upcoming studies.

Minor comments, typos, errors etc.

We have added to table 2 an “identification” of the situation of the station, as suggested by referee #1

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Typos and errors have been corrected.

Paton-Walsh et al. [2009, submitted to JGR] has been published. The reference has been updated accordingly.

Duflot et al. [2010, submitted to JGR] is now “in press”. The reference has been updated accordingly.

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 2891, 2010.