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Atmospheric Measurement Techniques Discussions

Interactive comment on "SCIAMACHY WFM-DOAS XCO_2: comparison with CarbonTracker XCO_2 focusing on aerosols and thin clouds" *by* J. Heymann et al.

Anonymous Referee #1

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General comments

In this paper, the authors present an overview of the sensitivity to clouds and aerosol of SCIAMACHY XCO2 retrievals from a proxy method. They describe their two cloud filters, estimate their efficiency and then correlate the differences between SCIA XCO2 (cloud-filtered) and CarbonTracker XCO2 to models or measurements of cirrus and aerosol optical thickness.

I have found section 3 - about linking ad hod cloud filters to estimates of effective cloud optical thickness thresholds - very interesting and instructive. However I regret that the

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section about analysis of results (6.2, only 1 page of text in AMTD format) is so short, whereas it should be the core of the paper. The discussion could be lengthened.

In general, the paper is well written and well structured, the topic is very relevant to the community of trace gases retrievals from space but some aspects of results analysis may need improvements. I recommend its publication in AMT after the authors address a few points (see below).

Specific comments

Section 4.3: Why did you take monthly means for CALIOP data, and not the daily product to then co-locate SCIAMACHY retrievals? Were there not enough SCIAMACHY data? The way you are doing currently, I can imagine that the true variability of cirrus is smoothed out a lot.

Section 5.2: Can you comment on these results and the various correlations between the uncorrected and corrected datasets ; what do your learn from it? There is a clear seasonality in the correction term $\Delta XCO_2^{S^*-S}$ shown in Fig 9 for Southern Africa. Is it expected, does the scan angle depend on seasons? In general, I fail to see how relevant it is to quote the correlations (and without commenting these numbers) between the different terms: it could be, for instance, that your correction $\Delta XCO_2^{S^*-S}$ is seasonal just because of viewing angle geometry; and that the residual $\Delta XCO_2^{S^*-C}$ is also seasonal due to for instance seasonality of cirrus or wrong seasonal cycle in CarbonTracker; you would see a correlation between the two terms but there could be no physical link behind these two facts.

Actually I was wondering if could not used TCCON as a reference for seasonality, as CarbonTracker often underestimates the seasonal cycle in the northern hemisphere? This is just a suggestion. Regarding your analysis in the TCCON surroundings: you find a scatter of 7.4 ppm in the monthly XCO2 dataset but say that Schneising et al (2012) find a regional precision of 2.1 ppm. Where does the large difference between these two numbers come from? I understand that those are two very different studies,

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but still I'm surprised. Does that come from the strong XCO2 seasonal cycle that makes monthly means not appropriate for the estimation of standard deviation?

Section 6.2: I would like to see more discussion about your results. For instance, some of the differences between CarbonTracker and SCIAMACHY show a strong seasonality: it could come from the CarbonTracker data itself, which seasonal cycle is not accurate (indeed you mention it but I would emphasize this point a bit more), from seasonality of cirrus or aerosols but also from other parameters that vary with seasons: SZA or airmass, albedo, ...

Also, what does that mean when you find for some regions a strong temporal correlation with cirrus and/or aerosol but a weak spatial correlation? I would tend to say that you can only conclude on the source of errors when you find both, a temporal and spatial correlation with aerosol and/or cirrus. Finally, in Table 5, I don't understand the high temporal correlation with aerosol on the global scale, whereas it is very small for Northern Hemisphere or Southern Hemisphere taken separately.

Technical comments

Introduction: There is quite a lot of repetition in the introduction and section 2, as you say three times that you use WFMDv2.1. If I add these sentences (very close one to another in the text) together it gives:

"The latest version is WFMDv2.1 (Schneising et al., 2011, 2012), which is based on a fast look-up-table scheme. WFMDv2.1 has been used to generate a global XCO2 data set covering the years 2003–2009 (Schneising et al., 2011). **This data set is analysed in this study**. The largest multi-year global SCIAMACHY XCO2 data set described in the peer-reviewed literature is the WFMDv2.1 XCO2 data set of Schneising et al. (2011, 2012). **In this study, we present an investigation of the WFMDv2.1 2003–2009 XCO2 data set** which we compare with CarbonTracker XCO2. **For this study, we use the WFMDv2.1 data product** described in Schneising et al. (2011)."

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I'm sure there is a way to be more concise.

Section 2.2: About the 2 different cloud filters, could you precise if you filter out scenes if one out of the two filters is positive, or when both are positive (I guess it is the first case, but it is good to precise it)?

Section 4.3, p2899 line 4: At first it was not clear to me if you filter out scenes with COD < 0.1 or > 0.1. You can rephrase for instance with "the CALIPSO data have been filtered to keep only scenes with COD = 0.1 or less".

p2901, line 3: non-negative → positive

p2903, line 4, typo: but → by

Table 1, typo: gras → grass

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