

## ***Interactive comment on “Evidence of systematic errors in SCIAMACHY-observed CO<sub>2</sub> due to aerosols” by S. Houweling et al.***

**S. Houweling et al.**

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### General comment

The reviewer questions the value of performing flux inversions if the observations show errors up to 5-10%. The authors agree that if the average error level were 5-10% then this would probably be devastating for source and sink inversions. As pointed out in Figure 5a, however, such errors only occur over the Sahara and a few other desert locations. In other regions the aerosol errors should be much lower (<1%). In fact, we are not much worried by the large flux errors over the Sahara, because one obviously wouldn't be able to draw any conclusions from the inversion results there. We didn't believe it was obvious, however, how these large errors over the Sahara would affect the flux estimates elsewhere. We felt strengthened in our opinion that there

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was still a point in showing these results because for regions outside the Sahara the flux errors were significant (deviations of the order of  $\sim 0.1$ - $0.3$  PgC/yr) but not that devastating. Now it turns out, however, that there was a mistake in the plotting program that was used to produce Figure 5b. In fact, this largely explains why the results weren't devastating. In the corrected version the errors are much larger, for some regions exceeding 1 PgC/yr. In light of this correction we agree to the reviewer that showing inversion results is premature given the level of error that we are dealing with here. We have revised the document as suggested by the reviewer putting less weight on the inverse modelling part and more on the retrieval. More specifically, we took out Figure 5b and the associated text explaining and interpreting this figure. We've kept the global extrapolation of the Sahara results, but not to provide the required input for global inverse modeling but to show how aerosol errors over the Sahara compare with the model predicted errors elsewhere. We agree with the reviewer that the size and sign of the aerosol induced error over the Sahara and how that compares to other regions is the most interesting part of the paper. Because of this, however, we also believe that, although we have made substantial modifications to some parts of the manuscript, the main scientific conclusions didn't change.

Specific comments:

'P 3314, line 15 - 17: as already said above, I do not think this is a very surprising result.' See the previous point

P3315, line 9: please quantify 'high measurement accuracy' Added '( $\sim 1\%$  or better)'

P3315, lines 10 - 11: add something like 'for SWIR observations' Added '... fulfilled for short wave infrared measurements ...'

P3315, line 13: I would appreciate adding Engelen et al., 2004, JGR, doi:10.1029/2004JD004777 as a reference for AIRS CO<sub>2</sub> estimates Sure, thanks for pointing to this omission. Added '... Crevoisier et al (2004) and Engelen et al (2004) ...'

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P3317, line 18: please add some information about the cloud detection, especially the apparent difference between the detection of cirrus clouds and aerosol Added: 'The cloud detection algorithm makes use of SCIAMACHY's broadband polarization measurement devices (PMD 2,3 and 4) as described by Krijger et al. (ACPD, 2005).'

Of course, to some extent cirrus clouds will remain undetected. To address this issue we included the following text in the discussion section: 'Part of the remaining variance may also be explained by undetected cirrus clouds, although this should only play a minor role over the Sahara owing to the large scale subsidence of air at these latitudes suppressing cloud formation.'

P3324, section 3.3: The first part of this section (retrieval errors) is useful information that fits within the paper, but the second part (inversion errors) does not add anything to what we already know. See the discussion on the first point.

P3326, line 23: 'If the same procedure...'. It is not clear to me what procedure the authors mean. Changed to '... if the same data selection procedure is used ...'

P3326, line 24: what does 'they' refer to? Changed to 'to compute correlations between SCIAMACHY and TOMS, however, it turns out that these correlations are in fact lower by  $r \approx 0.1$ '

P3327, lines 5 - 7: please expand on the seasonal cycle effect. Is it much larger than what is already shown in Figure 2 due to aerosol? Added 'of 20 ppm in the retrievals versus 5ppm in the model'. Note, however, that this is observed as a global phenomenon and not limited to arid regions only.

P3327, lines 13 - 17: I find this the most interesting bit of the paper! It did surprise us indeed, but makes a lot of sense after all.

P3327, line 25: do the authors really mean to use the word 'although' here? Although changed to 'as'

P3328, lines 6 - 16: I think this really needs further investigation, if not in this paper

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than in a follow-up paper. This is a difficult problem. Any solution that might solve or mitigate the effect of aerosols will take time to investigate, which is why it is considered outside the scope of the current paper.

P3328, lines 16 - 17: how would one detect the aerosol to distinguish between low and high aerosol loads? Please, expand. The aerosol information could come from other instruments.

P3328, lines 25 - 26: please, expand a bit on this suggestion. How do the authors envisage the use of Sciamachy data to verify certain assumptions of theoretical performance assessments? Added: 'Although SCIAMACHY cannot be used to fully test the OCO approach, it might nevertheless be possible to verify certain assumptions of theoretical performance assessments, for example, related to the path length perturbation due to aerosol scattering when measuring in sun glint'

P3315, line 5: add the following: 'parts of THE world, particularly' Corrected

P3329, line 1: replace 'to' by 'the' Corrected

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