

Interactive comment on “Assessing the near surface sensitivity of SCIAMACHY atmospheric CO₂ retrieved using (FSI) WFM-DOAS” by M. P. Barkley et al.

Anonymous Referee #1

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Referee comments on paper Barkley et al., Assessing the near surface sensitivity of SCIAMACHY atmospheric CO₂ retrieved using (FSI) WFM-DOAS, Atmos. Chem. Phys. Discuss., 7, 2477–2530, 2007

General comments:

The paper covers an interesting and important topic, provides new results and is relatively well written. I therefore recommend its publication after the detailed minor and major comments listed below have been carefully considered by the authors.

Specific comments:

Abstract, lines 16-18:

The SCIAMACHY measurements used are sensitive to changes of the CO₂ column but not specifically to changes in the lower troposphere. It is not shown in the paper that these measurements enable to separate CO₂ changes in the lower troposphere from changes in the region above. Therefore, the statement that it has been demonstrated that SCIAMACHY is capable to observe lower tropospheric variability is misleading. This sentence needs to be modified to avoid a misinterpretation. Similar remarks apply to section 7 Conclusions.

Abstract, line 24:

As pointed out below, the analysis made by the authors does not rule out the possibility that a significant part of the correlation of the retrieved CO₂ with vegetation activity is due to errors resulting from surface albedo changes. Therefore the conclusion that “It is evident ... that SCIAMACHY has the potential to detect ...” is too strong. I recommend to replace “It is evident ...” by, for example, “The presented analysis suggests that ...” or so.

Page 2486, line 2-5:

Boesch et al., 2006, used a different retrieval algorithm resulting in different averaging kernels which are closer to unity compared to the FSI kernels. The conclusions are

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therefore not necessarily valid. The authors should repeat this analysis using their averaging kernels.

Page 2487, Section 5.1:

I find this section somewhat difficult to read. It would probably be easier to understand if the authors first discuss the profile climatology in terms of how the column averaged VMRs compare with the VMRs at the various levels or vertical regions. After that the comparison with the retrieved column averaged VMR should be done. In this context I have some questions/comments: (i) An error analysis is done using simulated measurements. But it is not clear for me how appropriate this error analysis is for the paper because the simulated retrieval are done with a constant CO₂ profile (370 ppm) with is only used for this error analysis but not used for the actual FSI retrievals!? (ii) It has been found that the retrieval appears to overestimate the amplitude. What is the reason for this? (iii) Have the averaging kernels been considered when comparing the “true” with the retrieved column averaged VMR? (iv) Page 2487, Lines 14-15: “a simulated retrieval performed with the retrieved ... column”. I dont understand this. Please clarify. (v) End of section: What is the basis for the statements concerning the southern hemisphere?

Page 2491, Line 23:

The authors say that the agreement is “impressive” but is a perfect agreement expected taking into account the error analysis or does the good agreement point to a problem because two quantities are compared which are and should be different ?

Page 2491, Line 29:

The authors say that the comparison is hampered by the fact that they have chosen a too small scene. Why has this not been done with an appropriate scene ?

Page 2494, Line 10:

In contrast to the authors statement it has not been shown that SCIAMACHY is able to detect changes in surface CO₂ concentrations as only columns are measured. This sentence must be changed.

Page 2494, Line 15:

Why not using an appropriate scene (see also comment given above)?

Page 2495, Line 6:

Use of different a priori data sets: Here a more detailed explanation is needed.

Page 2495, Line 25 and following:

The arguments given why the albedo impact is considered to be small are not perfectly convincing. It is good that an estimate of the albedo is determined from the measurements which is then used by the retrieval. But this does not guarantee that albedo changes do not result in errors (residual clouds, imperfect radiative transfer due to aerosol variability, spectral dependence of the albedo in the fitting window, etc.).

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It is also not perfectly clear to what extent the comparison with AIRS fully rules out the albedo errors which may be relevant for this study, especially, at the smaller scales. It would be interesting to see if there is a correlation between, for example, the retrieved albedo, and the difference between SCIAMACHY and the in-situ measurements.

Page 2496, Line 8:

Because of the significant uncertainty (see above) I recommend to replace “thus the CO₂ variability arises from” by “thus the CO₂ variability most likely arises from” or so.

Caption Table 1:

Please add that this table refers to Park Falls.

Caption Figure 1:

Is the 1 sigma error simply the standard deviation or anything else (e.g., standard deviation divided by square root of number of measurements or so) ?

Caption Figure 2:

Please add for each curve its solar zenith angle.

Caption Figure 3:

Why/how does this figure show an assessment of the near surface sensitivity? Has the SCIAMACHY averaging kernel been applied to the true columns ?

Figure 9:

Very difficult to read. Please enlarge the text.

Figure 17:

Very difficult to read. Please enlarge the text.

Figure 18:

Very difficult to read. Please enlarge the text.

Technical corrections:

Page 2481, line 27 and following:

I recommend to replace “Global” by “Full longitudinal (global)” because it sounds strange that global coverage is achieved (only) at the equator.

Page 2484, line 24:

Probably Toronto.

Page 2485, line 18:

Probably 0.2095.

Page 2489, line 8:

Inconsistent notation: vmrs, VMRs.

Page 2490, line 20:

Probably WDCGG. Check entire manuscript (WDCGC, WDCCG, etc)!

Page 2496, line 2:

Probably spectrum.

Page 2498, line 18:

Probably “in which a given plant is located” or so.

Page 2499, line 26:

Please explain VI.

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Page 2501, line 5:

instrument's.

References:

Various typos: Please check: Bruhwiler (at least 2x), Pak, Breon, others ?

Caption Table 4:

given for both

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