Atmos. Chem. Phys. Discuss., 11, C14728–C14734, 2012
www.atmos-chem-phys-discuss.net/11/C14728/2012/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Atmospheric greenhouse gases retrieved from SCIAMACHY: comparison to ground-based FTS measurements and model results" *by* O. Schneising et al.

O. Schneising et al.

oliver.schneising@iup.physik.uni-bremen.de

Received and published: 26 January 2012

First of all, we would like to thank the reviewer for the helpful comments. Below we give answers and clarifications to all comments made by the referee. Please note that some numbers in the Tables have slightly changed in the revised version due to an update of the TCCON data.

Specific Comments

Reading the manuscript I felt that unless there is a major breakthrough in the analysis of the observed spectra or a new source of evaluation data becomes available for the 2002-2009 timeframe this is probably the last word on the quality of SCIAMACHY CO2 and CH4 data.

This will not be the last word on the SCIAMACHY CO2 and CH4 data quality because this and other algorithms will be further refined aiming at resolving known issues. Whether the future development is well characterised by the label "major breakthrough" will be left to one's own discretion.

page 28715, line 11: I am surprised that the authors do not comment on the ability of SCIAMACHY to observe year to year variability of CO2 and CH4.

For a discussion of the year to year variability of the CO2 and CH4 growth rates a less regional approach than in this paper would probably be more appropriate because the focus on localised TCCON sites makes such an analysis difficult because gaps in the time series occur. Indications on the ability of SCIAMACHY to observe variations in the growth rates can be found in Schneising et al., 2011 based on hemispheric means.

page 28716, line 6: If the retrieved products include a proper error characterisation post-2005 SCIAMACHY data can in principle be used for inverse modelling.

The statement refers to the user requirements of the inverse modelling community concerning the magnitude of the estimated errors of the satellite data. The estimated errors of the post-2005 SCIAMACHY XCH4 data are probably too large to achieve a significant uncertainty reduction of the fluxes. This is formulated more clearly in the revised version.

Page 28716, line 25: Explain why reductions of regional-scale flux uncertainties cannot in practice be reduced by thermal IR measurements – there is plenty of evidence from

ACPD
11, C14728–C14734, 2012

AIRS that CO2 variations can be observed in the free troposphere.

Thermal infrared sounders like AIRS providing information of variations in the upper troposphere are only of limited interest for surface flux estimation (e.g., Chevallier et al., 2005) because upper tropospheric concentrations are essentially zonal due to atmospheric mixing. Hence, the insensitivity to the boundary layer entails that at most very broad features of the surface fluxes can be obtained. This is explained in more detail in the revised version.

Page 28717, line 9: Revise OCO-2 launch date.

"to be launched in 2013" is replaced by "originally scheduled to be launched in 2013 but temporarily put on hold due to re-evaluation of launch vehicle options"

Page 28717, line 13: Suggest adding that it will be launched in 2018 if selected.

The statement "to be launched in 2018" refers to Earth Explorer 8 (EE-8). That CarbonSat is one of two candidate mission means implicitly that it has to be selected to be launched. The sentence is changed to "CarbonSat, which is one of two candidate Earth Explorer Opportunity Missions (EE-8, to be launched in 2018), ..."

Page 28717, line 26: Are you sure that this method was via correlation analyses?

Bloom et al. try to parameterise wetland emissions using a simple model with its calibration being based on correlations of atmospheric methane with water table and surface temperatures. In contrast to Bergamaschi et al., this is not really atmospheric modelling, but more correlation analysis. This is clarified in the revised version.

Page 28721: I am surprised that the authors did not adopt one model that could provide CO2 and CH4 values using consistent representations of the meteorology – just using the same driving meteorological fields does not guarantee a consistent representation.

To our knowledge, there is no joint model available that can provide CO2 and CH4 at the same time with a comparable quality to the two models considered here. Carbon-

ACPD
11, C14728–C14734, 2012

Tracker and TM5-4DVAR are not only using the same driving meteorological fields, but also the same transport model TM5.

Page 28724, paragraph 1: It seems that SCIAMACHY can observe a seasonal cycle where there is a strong local biosphere signal. One could interpret the noise over Darwin and Wollongong as the real estimates of measurement noise. But of course the authors could wriggle out of this comment by telling the reader (and this reviewer) the distance (time and space) criteria they used to match the model, SCIAMACHY, and TCCON data, and/or explaining that Darwin, for example, has a reasonably heteorogenous landscape and that the model is a smooth representation (over some 60,000 km2) of the truth. In any case, more details are required.

The paragraph describes that there is good agreement (e.g., of the seasonal cycle) between SCIAMACHY and the reference data with the exception of Darwin. These deviations at Darwin cannot be explained by measurement noise which is masked when there is a strong local biosphere signal because the seasonal variability at Wollongong is even lower than at Darwin (as can be seen from the reference data) but the agreement of SCIAMACHY with TCCON and Carbon Tracker is much better there than at Darwin. Additionally, measurement noise is not expected to introduce a distinct seasonal variation which looks similar from year to year. Moreover, the retrieved seasonal cycle at Darwin is correlated with the strong variability of thin clouds at this location providing a potential alternative explanation beyond noise. The heterogeneous landscape and the fact that all satellite measurements within a radius of 500 km are considered might also contribute to the observed differences.

Page 28724, line 18 onwards: We would all appreciate a nice uniform global offset that we could subtract but unfortunately, you've shown that your estimates of regional bias are, well, regional and therefore couldn't be applied to the globe. Consequently, I question the value of even presenting global bias statistics.

We think that the global offset is an appropriate first check that the retrieval does not

ACPD

11, C14728–C14734, 2012

suffer from obvious shortcomings. However, as we already pointed out in the text, the relative accuracy quantifying regional biases is much more important.

Page 28725, line 16: Consistent only if one uses the SCIAMACHY error.

Agreement of two data sets within error bars means that the error bars of both data sets overlap.

Page 28726, line 17: The authors cite clouds but I recommend they consider other effects, too.

The statement that the seasonal cycle at Darwin is probably influenced by clouds is based on earlier results. It has been shown in the past that strong variability of undetected subvisual thin cirrus clouds (as in the case in Darwin) is highly correlated with potential artefacts in the XCO_2 seasonal cycle. This interpretation is also supported qualitatively by an error analysis based on simulated measurements. Moreover, this issue at Darwin can be largely resolved by using alternative SCIAMACHY retrievals based on computationally expensive online radiative transfer calculations including selected cloud parameters in the state vector (Reuter et al., 2011). We don't know of any other effect that can potentially explain the variability at Darwin (if interpreted as an artefact) that conclusive.

Page 28730, line 2: multi-variate regression approaches are all well and good iff the regression coefficients have some physical meaning, otherwise this approach is ad hoc and is of limited scientific worth.

The sentence is restated accordingly.

Tables: Please include the number of points used the statistics. Worth stating somewhere the period that you are investigating (Table 1).

The number of months n used is included in the Tables. The analysed period is added in Table 1.

ACPD

11, C14728–C14734, 2012

Tables: Have the authors included somewhere the column fitting uncertainty in their statistics?

The column fitting uncertainty is not included in the statistics with good reason. It is conceivable that regions with good fit quality (e.g., due to large signal over bright surfaces) can nevertheless be affected by regional biases. Therefore, a potential bias over desert regions could lead to an overestimation of the obtained overall errors if the results are weighted according to fit quality.

Figure: The authors really ought to decrease the y-axes limit. For example, they have used a 60 ppmv range for a 20 ppmv signal for Figure. Tut, tut!

The y-axes limits were chosen generous to include all essential informations in the plots (error bars, which colour corresponds to which data set, key numbers of the comparison). Nevertheless, the limits are decreased as much as possible in the revised version.

References

Chevallier, F., Engelen, R. J., and Peylin, P.: The contribution of AIRS data to the estimation of CO_2 sources and sinks, Geophys. Res. Lett., 32, L23801, doi:10.1029/2005GL024229, 2005.

Reuter, M., Bovensmann, H., Buchwitz, M., Burrows, J. P., Connor, B. J., Deutscher, N. M., Griffith, D. W. T., Heymann, J., Keppel-Aleks, G., Messerschmidt, J., Notholt, J., Petri, C., Robinson, J., Schneising, O., Sherlock, V., Velazco, V., Warneke, T., Wennberg, P. O., and Wunch, D.: Retrieval of atmospheric CO_2 with enhanced accuracy and precision from SCIAMACHY: validation with FTS measurements and comparison with model results, J. Geophys. Res., 116, D04301, doi:10.1029/2010JD015047, 2011.

ACPD

11, C14728–C14734, 2012

Schneising, O., Buchwitz, M., Reuter, M., Heymann, J., Bovensmann, H., and Burrows, J. P.: Long-term analysis of carbon dioxide and methane column-averaged mole fractions retrieved from SCIAMACHY, Atmos. Chem. Phys., 11, 2863–2880, doi:10.5194/acp-11-2863-2011, 2011.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 28713, 2011.

ACPD

11, C14728–C14734, 2012

Interactive Comment