Atmos. Chem. Phys. Discuss., 11, C8521–C8523, 2011
www.atmos-chem-phys-discuss.net/11/C8521/2011/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "A method for evaluating bias in global measurements of CO_2 total columns from space" *by* D. Wunch et al.

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Received and published: 4 September 2011

This paper presents a method for reducing biases in satellite retrievals of column-averaged CO2 mole fraction (xCO2) by comparison with highly accurate xCO2 measurements from the ground-based Total Carbon Column Observing Network (TCCON). The method assumes the southern hemisphere extratropics are uniform compared to spurious variability in the retrievals and seeks explanatory correlates for this spurious variability. With these correlates the authors develop an empirical model for correcting the satellite retrievals which they can then employ globally. They apply this procedure to version 2.8 of the ACOS retrievals of the GOSAT measurements. They test the procedure by comparing the corrected ACOS/GOSAT retrievals with TCCON measurements in the northern hemisphere. Their main conclusions are that the procedure

works to improve the match to TCCON data but that residual noise still makes it difficult to retrieve geophysically significant signals such as interannual variability from the data.

The paper is potentially important but is also a potential victim of history. It represents a step on a long road to extracting useful information from satellite greenhouse gas measurements. Its importance is not, I think, in developing a bias correction scheme, there are many of these for meteorological satellite information and Bergamaschi et al. (2007, doi:10.1029/2006JD007268) have already shown how to include them within the inversion process, probably accounting for a wider range of errors than discussed in the present paper. Nor is the cautionary note about the difficulty of interpreting the curreng teneration of ACOS/GOSAT retrievals likely (one hopes) to be a longstanding finding. Even as the paper works through the publication process the next generation of retrievals is about to be released, addressing some of the problems highlighted here.

The most important contribution of the paper is to have identified a series of explanatory variables for problems in the retrieval. The procedure of "training" the correction on one relatively simple dataset (the clean southern hemisphere) then verifying it more widely is probably generally applicable. I would have preferred the authors to explore their findings more in this direction: Which corrections are more or less important where and when? How orthogonal are they and, if not, do they occasionally manifest different faces of a single underlying problem?

There is also a disturbing result noted by the authors which warrants more comment. The regression slope between the corrected ACOS/GOSAT and TCCON data seems far enough from 1 to suggest serious systematic problems in one or both measurements. Presumably the validation of the TCCON measurements by direct profile measurement rules out TCCON so something is happening to the ACOS/GOSAT estimates either as a function of time or of CO2. given that CO2 is increasing with time this isn't trivial to tease out but the seasonal cycle should make this possible. If it is a drift with time it would reward some more digging.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 20899, 2011.