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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The importance of transport model uncertainties for the estimation of CO_2 sources and sinks using satellite measurements" *by* S. Houweling et al.

Anonymous Referee #1

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This study looks at the sensitivity of CO2 flux estimates inferred from satellite measurements to model transport error. This source of error is often ignored or grossly simplified in data assimilation studies so a study that explicitly addresses this issue is of great importance. The paper is focused on the interpretation of CO2 column concentration measurements from an active sensor that provides data with a spot size of less than 100m. The model error appears to be the limiting factor for interpreting the resulting high resolution data, and the authors rightly suggest that model error will

also limit the interpretation of GOSAT data. The authors conclude correctly that model development should receive high priority.

On the whole the paper is sound but limited in scope. I was particularly disappointed by 1) the assumption that model error is random and 2) the lack of recommendations for further model development. There is no reason to believe that model error is just a random process – one could imagine a number of incorrect/incomplete model processes that would lead to systematic error in XCO2 fields. I think the authors are well placed to provide a comprehensive list of model developments that would improve model performance – adding such a list would significantly increase the importance of the paper in the wider community. My specific comments are below.

The abstract requires some simple statistical measures of the differences between different model XCO2 fields.

So many qualitative descriptors, e.g., encouraging agreement, fairly close agreement, correspond fairly well, reasonably realistic. . . These mean very little to this reader and add nothing to the paper. The authors should stick to the numbers and comment on those.

The authors assume that model error is random and Gaussian. Why? This paper is about transport error so I would think that the authors should also consider the systematic components of model error. At the very least, the authors should acknowledge this and discuss how their results would be affected.

Page 14744, line 1. Are all the models sampled in a similar way?

I disagree with the statement on page 14744, line 7. Substantial scatter in the model XCO2 fields (even though 3 out of the 4 use the same met fields) does not mean that this model ensemble captures the major components of the real uncertainty. I would like to know why the authors think that.

Page 14744, line 15. Some brief information about convergence criteria would be

useful.

Page 14745, line 20. Both sides of the globe. Do you simply mean that you take measurements during day and night? This is definitely an advantage over passive instruments that rely on an external light source.

Page 14745, line 25. It would useful to this reader if the authors included a figure of the averaging kernel. I think that having a measurement of a tropospheric column with equal weight through the troposphere would be more difficult to interpret than a measurement that is weighted towards the lower troposphere. It would also be useful to see how many cloud-free measurements are available per degree latitude for a few months.

Page 14747, line 22. Please replace or remove reference to the AGU fall conference presentation. To my knowledge, this is not publicly available and not peer-reviewed.

Section 3.2. Are the modes of XCO2 variability similar between models? Would an EOF analysis be useful? This is only a suggestion but without a more rigorous statistical analysis I think that the authors cannot confirm a substantial spatial coherence of transport model differences.

As stated above, I think the paper is missing a comprehensive list of model errors that needs to be prioritized and addressed. The authors include some of the leading atmospheric transport modellers and as a group are extremely well placed to do this. This simple request would also make the paper more relevant to the wider community.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 14737, 2010.