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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Interpreting the variability of CO_2 columns over North America using a chemistry transport model: application to SCIAMACHY data" *by* P. I. Palmer et al.

Anonymous Referee #1

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The focus of the paper is on interpreting the variability of atmospheric CO_2 columns over North America using a chemistry transport model. It is investigated to what extent the variability of the CO_2 column and the corresponding column-averaged mixing ratio is caused by local and remote CO_2 sources. This analysis is considered as a first step towards interpreting satellite CO_2 measurements in terms of CO_2 surface fluxes using inverse modelling. The approach is to sample the model output in space and time as the SCIAMACHY satellite instrument measures and taking the vertical sensitivity of the satellite data into account. The performance of the model (sampled as the satellite measures) is assessed using accurate surface CO_2 measurements and the model data are compared with the satellite retrievals. The paper covers an important

topic appropriate for ACP and is relatively well written. Its is shown that significant differences exist between the model and the satellite data and it is argued that this is likely due to shortcomings of the model simulations but also likely due to systematic biases of the satellite data, i.e., due to both data sets. A clear interpretation of the differences is not given. I can imagine that this is a challenge but the lack of a clear interpretation is a weak aspect of the paper. Nevertheless, I recommend its publication after the comments given below have been considered by the authors.

Abstract:

It is stated in the first sentence that the model has been used to interprete the satellite CO_2 measurements. Whereas the title of the paper is somewhat more general the first sentence suggests that a more or less clear interpretation of the satellite data can be offered to the reader which is not the case. It is shown that the model agrees faily well with the surface CO_2 measurements but shows large difference when compared with the satellite data. A clear interpretation of what the likely causes are for the large differences is not offered by the authors except that the differences are likely due to shortcomings of the model and potential retrieval biases. Taking this into account it is a bit misleading to use the term “model bias” in the abstract as this suggests that all differences are entirely due to the model. Later in the paper it is explained that the term “model bias” simply refers to the difference model minus satellite, i.e., positive values mean that the model values are higher that the satellite data. I recommend to modify the abstract taking these comments into account.

It is stated in the abstract that the CVMRs are only weakly correlated. For me this appears to be a somewhat misleading statement. The correlation coefficients for the monthly mean maps are given in Fig. 2. For the six months shown the correlation coefficient (r) is 0.24 for two months, even slightly negative for two other months and

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close to zero (0.07) for the two remaining months. From this I would conclude that no significant correlation has been found and I recommend that the authors modify the abstract to take this comment into account.

In the last sentence it is stated that the different flux signatures should permit independent flux estimation. It is not clear from the paper to what extent this conclusion depends on the random and systematic errors of the satellite data and shortcomings of the model. As far as I see this statement assumes essentially error free satellite data and a perfect (transport) model. This statement needs clarification.

Page 7344, line 8:

Please delete “adequately” as it is not clear for me why accepting only data within a certain range of values is an adequate procedure for constraining the light path.

Page 7351, line 20:

From Fig. 2 I would conclude that the contribution of the fuel source is up to 2 ppm (red color over eastern parts of the US) and not up to 0.5 ppm. If this is true this needs to be corrected. I also strongly recommend to significantly enlarge Figures 1 and 2 (or split each Figure it into two figures) as the individual panels are too small to see any details in a printout.

Caption of Figures 1 and 2:

Are the number which are given valid for the black or the red data points ? I assume

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they are valid for the black data points but I recommend to add this information explicitely.

Figure 4:

Please add latitude and longitude for each station.

Figure 5:

What is the reason for the somewhat lower sensitivity at 0 km compared to 1 km ? Is this a numerical artefact (e.g., due to the use of discrete altitude levels) or is it supposed to be real ?

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 7339, 2008.