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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Co-located column and in situ measurements of CO_2 in the tropics compared with model simulations" *by* T. Warneke et al.

Anonymous Referee #1

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This manuscript of Warneke et al. presents the first column measurements of CO2 in the inner tropics at Paramaribo, Suriname. The main focus of the presented study is on comparing the column observations together with co-located surface in-situ measurements of CO2 to calculations of a global transport model. After correcting the surface observations for effects of local sources, they find a good agreement of the model calculations with the surface and column data and they conclude that the used transport model can reproduce surface and column data for the same location.

Tropics are an area of great interest for the carbon cycle, however, current surface networks do not provide strong constrains on surface fluxes in the Tropics and there is

much debate about the role of the Tropics. Recently, the description of vertical mixing in models had come under scrutiny and it had been found that models tend to have difficulties in reproducing the vertical gradient of aircraft measurements which can lead to biases estimates of surface fluxes. In contrast, the authors of this study find a good agreement of surface and column data with the TM3 model for a tropical region which is an important finding. Unfortunately, the manuscript is very brief so that several points are not clear. Furthermore, the manuscript should also include a discussion of the relevance of the results, specifically in comparison to previous studies that have pointed to difficulties of models in reproducing the vertical gradient in observed CO2. Overall, the manuscript will be clearly of interest to the readership of ACP and I recommend publishing the manuscript after appropriately addressing my comments below.

Main comments:

1) Correction of local sources for the surface observations: a) Can you describe in more detail how the local source component is corrected in the in-situ observations of CO2 from the Delta13 values for Ascension island and Ragged point. b) Is the Paramaribo measurement after correction of local sources any different to the observations of Ascension Island or Ragged point? c) The surface fluxes used in the TM3 model calculation are most likely based on these in-situ observations so that it is not surprising that the calculations match these observations well.

2) FTS Observations: The column observations have been scaled with 1.018 to match the TM3 calculations for Spitsbergen. a) Is this a correction factor needed to compensate a constant spectroscopic offset? If so, how does it compare to correction factors inferred from aircraft comparisons for other FTS sites? How do you know that the same scaling factor applies to a tropical site? b) Since the FTS columns have been scaled to match the TM3 calculation. Does this mean that the main focus of the column-model comparison should be rather on the seasonal differences than the absolute values?

3) Column-surface-model comparison a) The FTS-model comparison is for Paramaribo

itself without any correction for local effects. The surface data is corrected for local effects and then compared to a TM3 model grid point hundreds of kilometer away from Paramaribo. I wonder if the in-situ-model and FTS-model comparison really represent the same thing. b) The column seasonal cycle is roughly +/-2 ppm (again assuming that we should focus on the seasonal amplitude rather than absolute values). The standard deviation for the column observations is 0.9ppm so that the relative error in the model can still be rather large. Since the column observation is an average over the atmospheric CO2, there could still be a large error in the free-tropospheric CO2 from the model. c) This study seems to contradict earlier studies that found that models have difficulties in reproducing the vertical distribution measured by aircrafts. Could you please discuss your findings with respect to those findings? Will column observations with a standard deviation of 0.9ppm have enough sensitive to observe discrepancies observed by aircrafts?

Minor comments: p.3174 Overall the comparison demonstrates that the TM3 model is capable to simulate surface concentrations as well as column densities of CO2 correctly at the same location. -> it should be stated that this is for one tropical site only so that it cannot be concluded in a general sense

p. 3175 This is especially important in the tropics since a spatial bias is likely to arise from (a) the frequent occurrence of (subvisual) cirrus clouds, which are suggested to be a significant error source in CO2 retrievals from SCIAMACHY (Schneising et al., 2008) and (b) the high abundance of water vapour, an inferring gas in the spectral region of the satellite retrievals, which has shown to have a strong impact on the CH4 retrievals from SCIAMACHY in the tropics (Frankenberg et al., 2008). -> This is somewhat an overstatement. Bias might or might not arise in the Tropics. Schneising et al. found biases due to cirrus clouds when cirrus clouds are not taken into account in the retrieval algorithm. However, most current algorithms used for GOSAT retrievals have an explicit treatment cirrus clouds so that potentially biases should be much smaller. Furthermore, Frankenberg et al. has found that the H2O spectroscopy had been insufficient in the

HITRAN database and that updates to the spectroscopy have largely removed such biases.

p. 3176 Spectral line parameters for the O2 retrieval were taken from an updated version (December 2006) of the ATMOS database (Brown et al., 1996). -> How does this compare to the current HITRAN database?

p. 3176: The initial vmr-profiles are taken from the GFIT-package and are based on balloon observations at Ft Sumner (35_ N, 104_ W) using the JPL MkIV Interferometer. -> Is this a good representation of the CO2 profiles for Paramaribo?

p. 3178 The isotopic signature of the local source component as well as that the calculated CO2 for the local source does not correlate with the measured CO in the flasks (not shown) suggests that the measurements are not strongly influenced by urban pollution and the local source component is the terrestrial biosphere. -> . . .as well as the calculated CO2 . . . -> . . .CO in the flasks (not shown) suggesting that . . .

p. 3179 . . . modeled values are within the errors of the corrected vmrs. -> How are these errors for the data corrected for local sources calculated?

p. 3180 requires the DC recording. . . -> Define DC

p. 3180 Only spectra with an O2 vmr within 2.5% of the mean retrieved vmr of O2 were used for this study. -> Would it not be better to compare it to the observed surface pressure (corrected for the H2O column)?

p. 3181 The measurements agree very well with the model simulations for the SDS and LDS in 2006 -> Does this take into account the averaging kernel of the measurement?

p. 3186: Figure 2 – Upper panel. From the cloud of the individual dots it is very hard to see something. Maybe a correlation plot would show it better?

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 3173, 2010.