

Response to anonymous Referee #2

2 Specific comments

REFEREE COMMENT:

2.1 Site description

Most people will not be familiar with Suriname and it would be very helpful to have a brief description of the environment (vegetation cover etc.) in the vicinity of the site and regionally.

AUTHOR RESPONSE:

The following sentences have been added:

“

Paramaribo is the capital and largest city of Suriname, with a population of about 250,000 people.

Paramaribo is located in the northern, lowland coastal area. The southern part of Suriname consists of tropical rainforest, covering about 80% of Suriname's land surface.

“

REFEREE COMMENT:

2.2 In situ measurements

A brief description of the time of day and meteorological conditions (surface windspeed) when flask samples were acquired would help the reader interpret the surface data presented.

The top panel of Figure 2 does not illustrate the model-observation comparison well at all. I suggest a third panel is added, which shows model-obs scatter plots for the five campaigns (or similar). The model data could then be dropped from the upper panel. To my knowledge, the

method to correct observed CO₂ concentrations for local sources is not widely used. From the description in the text I assume it is applied as follows:

Formel

where are the regression slopes given in Figure 1 and $\delta^{13}\text{C}_{\text{CO}_2, \text{back}}$ are the NOAA/ESL measurements from Ascension Island and Ragged Point, as discussed in the text. This equation should be given explicitly in the text. More importantly, I do not see what benefit this correction has over the selection of the subset of observed data with $\delta^{13}\text{C}_{\text{CO}_2}$ within some specified range of the NOAA baseline measurements (time of day and surface windspeed might also be used to screen data which are strongly influenced by local sources due to near surface stratification). The authors should consider the use of subset selection, and/or make a clear case for favouring the correction method.

AUTHOR RESPONSE:

A figure showing model data vs the observations has been added in our modified manuscript.

The air-samples have not been taken during a specific time of the day, but whenever the observations allowed to do so. The subset selection would be a good idea if we would have a larger amount of samples. The correction for the local source increases the amount of datapoints available for the model comparison. The equations for the correction are included in the revised manuscript.

REFEREE COMMENT:

2.3 Column measurements

One of the important claims of this paper is that the TM3 model can simultaneously satisfy surface concentrations upwind from the site and observed column average dry air mole fractions

(XCO₂), with a unique scaling relating Spitzbergen and Paramaribo XCO₂ to the TM3 model equivalent. However, there are several reasons why the column measurements at the two sites might not have the same model scale factor:

1. the XCO₂ retrieval has a known airmass-dependent retrieval bias. Measurements from the high latitude Spitzbergen site and the low latitude Paramaribo site will sample quite different ranges of solar zenith angle. Some discussion of airmass dependence and correction (if performed) or resultant site dependent biases (if no correction is performed) should be given in the manuscript.
2. the resolution of the Spitzbergen TCCON measurements and the Paramaribo measurements differ significantly. This could give rise to systematic differences in the retrievals and/or their airmass dependence.
3. ILS errors, which may differ between the two instruments, or vary from campaign to campaign in the IFS 120M used for Paramaribo measurements.
4. representation of CO₂ in the TM3 model stratosphere and differing relative contributions of the stratospheric column to tropical and high latitude column measurements. While 1 is expected to be the most significant artifact, 2-4 should also be characterised/ discussed. The text also needs to describe exactly how the model equivalent was calculated: were measurement averaging kernels and retrieval a priori's used to derive the model XCO₂?

AUTHOR RESPONSE:

The scaling issue has been completely revised following the comments of referees 1 and 2. This answers the comment 1. For details we would like to refer to our our response to referee 1. In addition we would like to mention the following:

At Paramaribo the measurements were mostly performed at low air-mass, therefore the air-mass correction makes an insignificant contribution. The ILS of the instrument has been regularly monitored using gas cell measurements and was found similar for the different campaigns.

In the text it is now mentioned that the model measurement comparison includes averaging kernel and retrieval a priori. We use one representative averaging kernel for the comparisons. We have tested different resolutions and within the uncertainties the XCO₂ agrees for resolutions between 0.014 cm⁻¹ and 0.075 cm⁻¹.

REFEREE COMMENT:

2.4 Model predictions of CO₂ surface concentrations and XCO₂

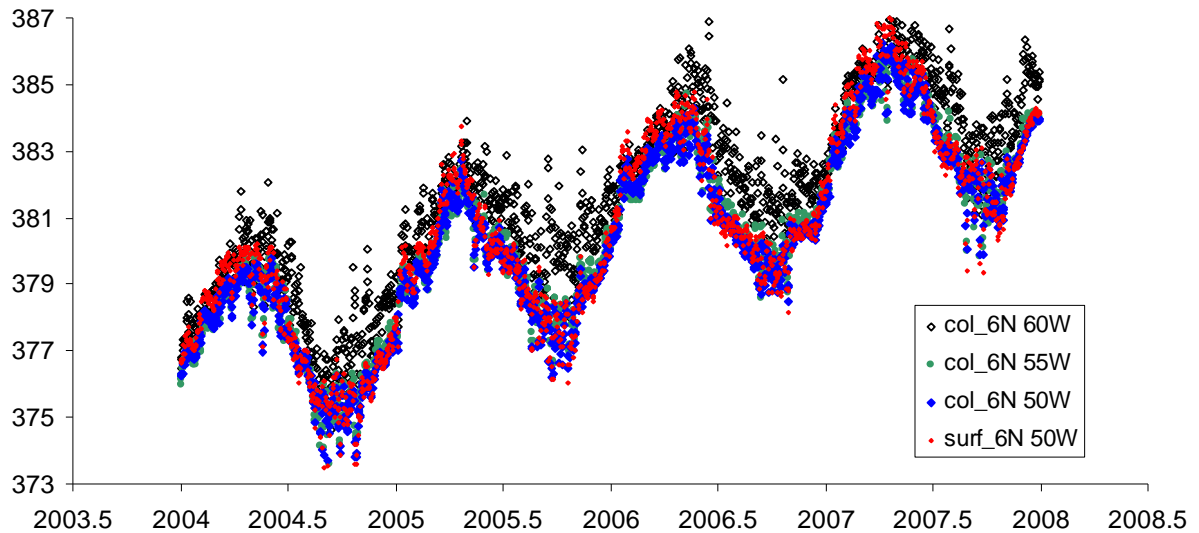
The model predictions of upwind surface CO₂ concentrations and XCO₂ illustrated in Figures 2 and 3 show an astonishing degree of correlation: the two timeseries are not identical, but they are very nearly so. If this is not an error, then the correlation predicted by the model surely deserves some comment and interpretation.

Subject to the comments in 2.2–2.4, I would be happy with the conclusion that the TM3 model is capable of simulating surface and column observations at the Paramaribo site (possibly with caveats on the local/regional fluxes). The phrase 'at the same location' is not justified by the current study.

AUTHOR RESPONSE:

In the plot below the model data for the column is shown for different grid cells from west to east, compared to the modeled surface data for the ocean grid cell. It can be seen that the column is not significantly different for the grid cell containing Paramaribo and the neighboring ocean grid cell and that the column data for these cells compare well with the surface data for the ocean

grid cell. The reason is that the air is transported from east to west to Paramaribo and that the fluxes from the South American continent have not a large impact on the column at Paramaribo.



The phrase 'at the same location' has been substituted.

REFeree COMMENT:

2.5 Title

Strictly the authors are justified in their claim to first ground-based column measurements in the tropics. However, it may be more meaningful to change 'the tropics' to 'tropical South America' and this would implicitly acknowledge the TCCON effort in Darwin, Australia.

AUTHOR RESPONSE:

We agree and have changed the title and first sentence to 'tropical South America' instead of 'the tropics'

REFEREE COMMENT:

3 Technical corrections

- use 'sampled' rather than 'probed'
- tidy up repeated use of '[XCO₂] was calculated by scaling the CO₂/O₂ column ratio ... to the degree required, constant in the atmosphere'.

- Abstract and Conclusions

'... TM3 model is capable OF simulatING surface concentrations and COLUMN AVERAGE DRY AIR MOLE FRACTION correctly' and 'at the Suriname site' rather than 'at the same location' as above.

- Introduction

- extra comma after Earth

- least constrainED

- expand TCCON acronym

- Results

- suggest 'weakly influenced', rather than 'marginal influenced'

AUTHOR RESPONSE: All technical corrections are incorporated in the revised manuscript..