

Interactive comment on “The impact of orbital sampling, monthly averaging and vertical resolution on climate chemistry model evaluation with satellite observations” by A. M. Aghedo et al.

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We would like to thank the Anonymous Referee #2 for the comments. We provide our response below each of the comments (now italicized):

General comments:

The paper addresses important aspects of comparing remote sensing data with model data. The problem is well formulated, and methodology is sound. However, the abstract does not clearly summarize the results. Figures are too small to decipher letters and numbers – need to be enlarged by a factor of 2. Several specific but relatively minor comments need to be addressed before the paper can be accepted for

C5160

publication.

Specific comments:

1. An earlier paper (Luo et al, 2002) on influence of TES orbital sampling on comparison with models should be mentioned in the introduction as it basically outlines the approach used in the present manuscript. Also, it is interesting to compare the present results based on 2005-2008 data with those early estimates from Luo, M., R. Beer, D. J. Jacob, J. A. Logan, and C. D. Rodgers (2002), Simulated observation of tropospheric ozone and CO with the Tropospheric Emission Spectrometer (TES) satellite instrument, Journal of Geophysical Research, 107(D15), 1-10, doi:10.1029/2001JD000804.

Our manuscript focused on the influence of sampling on a monthly-mean time scale, rather than on a daily mean, in consideration for our objective to provide TES observational data that are useful for monthly to decadal multi-model evaluation. In this regard our results are not directly comparable to Luo et al., 2002. We are nevertheless consistent with their results because we found lesser biases due to the longer temporal averages. The paper is now mentioned in the introduction and compared to our results in Section 4.

2. P 9713, l 18-22: Need to address effects of quality filtering and missing point due to clouds and other factors on sampling size. This will even further reduce the number of points used in computing averages in this paper, thus increasing m even further.

The revised manuscript now contains a new section 4.2 discussing the influence of screening the data with quality flags, and comparison of the results to those computed from non screened data.

C5161

3. P 9716, l 6: It is not clear whether authors computed zonal mean of percentage error by correctly summing up the absolute errors and then dividing the result by the sum of the measured column values or, in fact, they directly averaged the percentage errors. The results depicted in Figs 4a, 5a, and 6a could be quite different depending on which method has been used. This needs to be clarified or (if done incorrectly) addressed.

We calculated the percentage error by summing up the absolute errors and dividing by the total number of values in the latitudinal zone at each level. This is now stated in the text.

Technical corrections:

1. P 9713, l 4-5: How can the averaged monthly data be used for addressing spatial sampling? This is what a reader might ask when reading these lines. In fact, only in P9714, l5,6 one can read that the 3-hour output data have been used? Please describe what model data are used in the beginning of section 4, otherwise it is very confusing.

We use the 3-hourly model output in both models. This is now stated at the beginning of Section 4.

2. P 9713, l 15: It is not clear what temporal resolution model data have been used. See my tech comment #1.

Both models have 3-hourly temporal resolution. This is now mentioned in Section 4 as

C5162

suggested in tech comment #1.

3. P 9713, l 24: It makes sense to mention that a visible spatial pattern in Figure 2 is due to TES 26-hour sampling.

Done, thanks.

4. P 9714, l 4: What is "raw model output belonging to the grid-box?" Most likely, it is a number of model data points belonging to a grid box that is equal to the number of model time steps in a month.

We have changed the statement to "the total number of model points belonging to a grid box, which is equal to the number of model time steps in a month".

5. P 9714, l 11: The statement " $N_g < N$ " might be not true in general for other sensors. For TES it is true due to poor spatial sampling.

The focus of the manuscript is a sun-synchronous infrared nadir-viewing instrument similar to TES, e.g., CLARREO. We agree that this inequality may not hold for all observing systems, e.g., a geostationary sensor.

6. P 9716 l 3-5: This statement is superficial here as the limited TES spatial and temporal coverage is well known, so the statement can be dropped. How the authors suggest to increase the coverage of a nadir-looking instrument?

Done.

C5163

7. P9718, I I 7-10 and I 14: Eq 15 and the second line of Eq 16 can be dropped. The derivation of the last line of Eq 16 is straightforward from Eq 14.

We remove the second line of Equations 15 and 16.

8. P 1920, I 23: Sentence starting with "If" is incomplete.

"If" is removed. Thanks.

9. Fig 3: The panels are too small – they need be much bigger. It is very difficult to distinguish grey lines and mean values. Instead of repeating the lat/lon information on each panel, it would be better to show a legend for symbols somewhere on the plot.

The smallness of the figures are due to the half page format for the ACPD. The figures size is now doubled to fill the A4 page format of the ACP.

10. Fig 5a: change "first column" to "left column" and "second column" to "right column".

Done.

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