

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.

Anonymous Referee #1

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General comments

This paper quantifies the uncertainties associated with the technical steps required for using nadir sun-synchronous satellite observations for multi-model evaluation. In particular, the impacts of orbital sampling, monthly averaging of the averaging kernel (AK), and the satellite operators are evaluated with two chemistry climate models (ECHAM5-MOZ and GISS-PUCCINI) and TES observations for ozone, CO, atmospheric temperature, and water vapor. It is an interesting paper and the questions brought up here are ignored by many previous studies comparing model outputs with satellite data. The main problem undermining this paper is the overstatement of the results, which could

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be solved by additional work. Before publishing in ACP, the following questions and comments should be considered and answered.

Specific comments

1. What is the impact of clouds? Nadir infrared satellite observations are inevitably affected by clouds. Especially for those instruments like TES, with sparse sampling footprint, clouds are likely to have large influence over cloudy regions (e.g., ITCZ). As shown in Fig. 2 and 3, TES can at most have four measurements at given grid boxes over tropics for one month, if one or two (or even more) of them are contaminated by clouds (which is probably true for tropics), can the remaining data still capture the monthly mean value? Also, the C-shape profiles should be removed for TES ozone (see user guide). What is the influence from the data screening? Besides the steps covered by the paper, the data screening process is also a required step for making comparisons. It is worth adding it, as the goal of this paper is to quantify the uncertainties of these required steps.

2. Many conclusions in this paper are exaggerated. Some of them may not be wrong, but cannot be fully supported by the results. For example, p9716, l18-20, the altitude by latitude plots of monthly mean errors (Fig. 4a and 4b) can only tell if the zonal means and zonal distributions are consistent. It does not provide information about horizontal distributions and the variance as well. The authors, however, conclude that “...adequately capture the magnitude, the distribution and the variability of ozone and...”. In order to draw such conclusions, geographical plots of monthly mean biases and plots of variables, such as the standard deviation, are required. The model and observations can have very different variability with similar mean values. In addition, the conclusions about monthly means are generally for zonal monthly means, as the analysis is mainly done with zonal differences on monthly scale. It should be expressed explicitly to avoid misleading.

3. P9710, l3: How much lightning NO_x is emitted annually in the ECHAM5-MOZ

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model?

4. p9712, l2: TES only has varying layer thickness for the lowest layer above clouds. The rest layers have fixed thickness.
5. p9715, l15: with only four measurements for a month, it is even inadequate to capture weekly variations.
6. p9717, l8: on zonal mean ozone, carbon monoxide ...
7. p9717, remove equations (12) and (13) and change the text accordingly. These two equations only rewrite the third term of Eq. (11) in different forms and seem redundant.
8. p9718, l10: 1/nG is missing for the second term in Eq. (15).
9. p9723, l27: the zonal distribution. The synoptic scale variability? No result about variability is shown in the paper, except for Fig. 3.
10. Fig. 4-6: Are the results shown here the mean of all the months (2005-2008)? Note that TES misses observations for many months.

Minor corrections

p9706,l16: satellite -> instrument. TES is one of the instruments on Aura satellite.

p9707,l23: spatial -> horizontal. Spatial resolution includes both horizontal and vertical directions.

p9709,l8: longitude (T42). T42 is used later. It is better to define it here.

p9709,l14: includes

p9710,l9: delete "modelE"

p9712,l12: a priori

p9714,l19: figure...shows or figures...show

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p9715,l21: change "ECHAM5-MOZ (and GISS-PUCCINI)" to "two". L17 already says the model names.

p9716,l11: make the "UTLS" consistent with that on p9719, l12.

p9718,l3: construct

p9719,l7: Fig. 5a and 5b?

p9722,l27-28: 2008 (Table 2). Delete "The summary ... models".

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