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Geoscientific Model Development Discussions
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Interactive comment on "The TOMCAT global chemical transport model: Description of chemical mechanism and model evaluation" *by* Sarah A. Monks et al.

Anonymous Referee #1

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Review of

"The TOMCAT global chemical transport model: Description of chemical mechanism and model evaluation" by Monks at al.

Overview:

The paper presents an evaluation of two 1-year runs with the latest version of the global TOMCAT CTM using observations and observation based climatologies for OH, O3, CO, NOy and some VOCs. The two runs are carried out with the same model version for two different years (2000 and 2008) using different emission data sets.

General remarks:

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Discussion paper

The presented evaluation of TOMCAT is reasonably comprehensive but the juxtaposition of the two runs is of little scientific value. Such an inter-comparison experiment, as any scientifically sound experiment, should only differ in the specific aspects, which are under investigation.

However, the two presented model runs differ in the year (2000 vs. 2008), in the biomass burning data set (GFED 3.1 vs. FINN), the anthropogenic emissions (ACCMIP vs Streets v1.2) and probably also in the prescribed CH4. Given the different years, not only the meteorology but also the biomass burning and VOC emissions will be different. It is not clear at all what reasonable conclusion can be drawn from the comparison of the two model runs.

As the paper reports on the update of the chemical mechanism, one would expect that two model runs with and without this update, which are otherwise identical (i.e. w.r.t emissions, year, meteorology, CH4) are compared. One should choose a year for which there are many observations available from campaigns or satellite observations.

The model description part is too short, in particular for the chemical mechanism. If this section – as the title suggest – is an important part of the paper, including only references or simply stating the fact of certain upgrades is not sufficient. It would be better to discuss the chemical mechanism in more detail and to give a motivation for the necessity and most importantly the impact of the upgrades.

Specific remarks:

P1 Abstract seems too long. It should be a single paragraph

P1 L18: The term “boundary conditions” is a bit confusing as you only change emissions. Better say ”emissions” as deposition is not considered. The fixed CH4 can be described as “effective emissions”

P2 L25: As a CTM does not simulate winds, it seems better to say the transport is “driven” rather than constrained.

P3 L4: Mention the motivations of the update. Introduce the choice of the setup of the different model runs you want to compare.

P3 L33: Aircraft emissions should be mentioned together with the rest of the emissions in section 2.2

P4 L12: Please provide more detail on the chemical scheme and motivate the several updates of the VOC chemistry. This would be of interest for the scientific community.

P4 L27: Please provide more detail, what uptake coefficients are used etc.

P5 L8: See my general comment. I think the two runs differ in too many and random aspect.

P5 L28: Explain how Streets differs from ACCMIP and what they have in common.

P5 L31: Are the biogenic emissions produced with exactly the same MEGAN model version and input.

P5 L33: Explain the differences between FINN and GFED.

P5 L34: It is not clear if the same method to constrain CH4 is used in both runs.

P6 L8: Please add an explanation how you tackle the problem that different years are evaluated. Mention more clearly when use timely data and when climatological data

P6 L39: Explain how you use the satellite for the different years. (GOME-2 was put in orbit only in 2006)

P7 L10: Should be “Surface data climatology”

P7 L30: Should be “Ozone data climatology”

P8 L 37: Did you verify the importance for the suggest pathway. It should result in higher OH values. The surface ozone concentrations also depend strongly on deposition. Is any dry deposition active over the ocean? Please comment how H2O is represented in the model.

P8 L 37: Please specify your choice of the tropopause

P9 L16-22: Consider putting the part on the observations in section 3

P10 L15: As you show the OH distribution of RUN_2000 and RUN_2008 please also discuss potential causes of the differences. Is the RUN_2000, which seems to have larger biases also worse in other aspects ? Are errors in OH related to errors in other species ?

P11 L14: Consider using the update of the MACCITY data suggest by Stein et al. (2014)

P11 L14: Consider also the role of transport.

P 11 L16: According to your Figure 4 there is too much OH in Tomcat in NH and SH in the lower troposphere.

P 11 L23: Do you discuss here RUN_2008 (?). In this run the FINN data and not GFAS is used. Please be more specific. Is the difference between FINN and GFED (table 1) due to the different years used or is there a systematic bias between FINN and GFAS?

P11 L33: Please specify what years do you use in the comparison. Note there is a CO trend of about 1%/yr (Worden et al. 2013)

P13 L34: It would be nice to also show the OH observations at Hohenpeissenberg. As far as I know OH is measured there as well.

P13 L42: Some comments on the assumed temporal profiles of the anthropogenic and biogenic VOC emissions would be interesting here.

P14 L8: The relation between emissions and concentrations seems a bit trivial if you do not specify in more detail, why the VOC emissions are different.

P14 L25: Please specify how r was calculated, i.e. using hourly, daily or monthly averages?

P14 L33: Is the overestimation over Europe also related to emissions ?

P 14 L38 Which biomass data set and year you are referring to? (see above)

P 15 (Summary)

P15 L1 -5: It would be great if the paper could show in any way the benefit of this upgrade. This is unfortunately not the case with the presented two model runs.

P16 L 19: Is there an explanation for the OH differences? Has the model upgrade improved the OH bias? Is the 2000 run generally worse because of the larger biases against Spivakovsky ?

Figures:

Figure 2 Use different colour range for O3 cross section to show more structures in the troposphere.

Figure 4. Rotate latitude vs CO graphs.

Figure 6 Which colour for which run?

Figure 9. Mark a-d) on panels. Consider including graph titles

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