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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Global tropospheric hydroxyl distribution, budget and reactivity" *by* J. Lelieveld et al.

**Anonymous Referee #3**

Received and published: 29 March 2016

This paper discusses the global OH atmospheric chemistry and analyzes the levels and chemical properties and the recycling of OH and $HO_2$ using the global modelling system EMAC. The paper reads smoothly at the most part, providing a lot of information on the chemistry of OH, and an abundance of results both in the main manuscript and the supplementary material.

General Comments

The abstract should be more precise on what the main findings of this work are. The predecessor model as well as the previously assumed amounts of secondary sources should be specifically mentioned here.



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Discussion paper

The terms “buffering” and “buffered” are used throughout the manuscript without proper definition given. Even after reading the entire manuscript it remains uncertain what the OH buffer actually is.

The entire manuscript is based on the calculations made using an unpublished chemical mechanism (MOM) which is an update of a previous mechanism (MIM) using as reference a manuscript that is in preparation. Even though the full mechanism is included in the Supplementary material of the manuscript, a comparison of the model results using the updated mechanism to results of the previous mechanism and a more detailed comparison to measurements is needed. Also a better more complete budget analysis as well as a comparison and highlight of the differences between the two versions is clearly missing, especially since the authors give relative results such as “higher”, or “compared to predecessor models”.

The model description is rather short and feels incomplete. The EMAC modeling system is a complex system with a variety of options. The specific sub models used as well as the input used for the present study (i.e. emissions) should be clearly mentioned in the manuscript even if there is a small analysis in the supplementary material. The choice of RCP8.5 that suggests no further emission control also seems strange as it is often used to simulate the worst-case scenario. Even if in the year of interest (2013) the differences from the other scenarios are small, it still is an interesting choice and one that normally should be justified.

Finally I would suggest that a label is added by the colorbar of all figures, indicating the depicted property/substance and the units. This would make the interpretation of the figures quite easier.

Specific Comments

P1, L10: ...may be significant... → change to something more precise, or explain the reason that they might not be significant.

In all the reactions: Add the radical sign (dot) where necessary.

P3, L25: R6 does not directly produce OH, hence a more clear explanation of how OH is produced is needed.

P3, L26: While in polluted air peroxy.... → While in polluted air, peroxy...

P4, L15: By interconnected, do you mean coupled? If yes, the more used (and easier to understand) term should be used. If not, please give a definition of what an interconnected sub model is.

P4, L27/28: Since only one year of results is presented (2013), why is a range of emitted quantities provided?

P5, L24/25 and elsewhere in the manuscript: Add the $10^5$ term to the first number of all ranges.

P5, L27: Give the numbers calculated by Patra et al., since the discussion is based on them.

P7, L4: Reaction R1 of the manuscript should be referenced here.

P7, L7/8 and figure 2 caption: scaled **down** by a factor of 20.

P7, L28/29: $O_3$ from the stratosphere and $O_3$ from photochemically... → $O_3$ from both the stratosphere and photochemically...

P12, L15: The Physical-chemical tele-connections is here used without prior definition. Please give a clear definition.

Figure 5: Add the OH reactivity zonal means (latitudinal) since the height distribution

is mentioned during the discussion in section 5.

Figure 6: Enlarge the third panel of the figure since it is quite difficult to read the numbers in it. Also review the percentages given here since the numbers (as they are provided now) do not add up: e.g. for the OVOCs (red) the FT is 12% and the BL 19%. Multiplied by the 86% and 14% ratios respectively it gives a total of 13% (12.98) in the troposphere, where you present 12%. Maybe give the numbers with at least one decimal point so that the math comes out correct.

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Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-160, 2016.



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