

Interactive comment on “An advanced method of contributing emissions to short-lived chemical species (OH and HO₂): The TAGGING 1.1 submodel based on the Modular Earth Submodel System (MESSy 2.53)” by Vanessa S. Rieger et al.

Anonymous Referee #2

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1 General Comments

This paper presents an improvement to an existing and already implemented scheme, describing in detail the "tagging" of OH, HO₂, and H, by source sector. This is certainly a useful exercise. However, I found this paper confusing, as well as containing numerous errors. In its current form I am unable to recommend its publication in GMD.

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2 Specific Comments

I found the description of the tagging (Section 3.4) very confusing - the terms "explicit tagging" and "specific tagging" are used, and seem to mean different things. Longer-lived species are also tagged by source region, but the paper does not make clear the difference in this tagging and the explicit or specific tagging mentioned. It is clear that this process is complicated and requires careful consideration, but it is not explained in a way that I could easily understand. Perhaps some sort of graphical description would be helpful here?

When extending the tagging scheme to include more reactions (listed in Table 1 of the paper), reactions 19 ($\text{H}_2\text{O}_2 + h\nu \rightarrow 2\text{OH}$), 28 ($\text{HOCl} + h\nu \rightarrow \text{OH} + \text{Cl}$), and 30 ($\text{HOBr} + h\nu \rightarrow \text{OH} + \text{Br}$) are highlighted as being unable to be considered in the tagging scheme. However, the authors then include these reactions in Table 2 ("reduced - V1.1 all") and also in the line plots in Figure 1. They seem to make-up around 9% of the OH production rate, so I can see why they should be mentioned, but I was frustrated that they were given prominence over the "reduced - V1.1 tag" scheme, which is what was actually implemented in the model. Indeed, in Table 2 the OH loss and HO_2 production and loss rates are given alongside the "all" row and not the "tag", which I personally do not think is correct. I would see the "tag" scheme presented as the baseline, and the "all" is an extension to this. There is discussion in Section 3.3 about how good the "all" scheme is, but given it can't be used, why discuss it at all in this context?

I was also confused about the rest terms introduced in Section 3.5. I appreciated that closing the budget is desirable, but I do not believe that the text in Section 3.5 justifies or explains their introduction sufficiently, and they seem very artificial. Can the authors please expand on this justification and the necessity for having these terms?

Significant work is required by the authors to refine and clarify the manuscript. I suggest much more proof reading and editing are necessary prior to any resubmission.

3 Technical Corrections

1. I personally did not like the authors stating the species chemical formula after the name, without using either parentheses or parenthetical commas, e.g.

The radicals hydroxyl OH and hydroperoxyl HO₂ are crucial for the atmospheric chemistry.

rather than

The radicals hydroxyl (OH) and hydroperoxyl (HO₂) are crucial for the atmospheric chemistry.

or

The radicals hydroxyl, OH, and hydroperoxyl, HO₂, are crucial for the atmospheric chemistry.

This first format is used throughout the document (including the abstract). I would advise the authors to correct this to one of the others.

2. Page 1, line 16: remove "the" before "atmospheric chemistry".
3. Page 3, line 5: remove "the" before HO_x.
4. Page 4, line 6: could the authors please explain what a "cataster" is?
5. Page 4, lines 20-21: I would suggest either "The mechanism in V1.0" or "The V1.0 mechanism".
6. Page 5, lines 6-7: I don't quite understand what the authors mean by "Each reaction occurring in a simulation was precisely added up" in the context of the paragraph. Could the authors please re-phrase this?
7. Page 5, line 16: I would not use the phrase "boil down". I would suggest using "reduce" instead.

8. There is discussion in Section 3.2 about the relative contributions of various reactions to the OH and HO₂ budgets. It might be helpful to also visualise this, perhaps using bar- or pie-charts, perhaps in the Supplementary Information?
9. Page 13 equations 17, 18, 23, and Page 14 equation 24: Why does the term $resOH/n$ appear in both equation 17 and 23, and the terms $resHO_2/n$ and $resH/n$ appear in both 18 and 24. Looking at equations 15 and 16, shouldn't these terms appear only once each?
10. I was slightly frustrated by the use of different scales in the various sub-plots in Figure 2 (and also 3). While I appreciate there are orders of magnitude differences between various sectors, it would be helpful to have these all plotted on the same scale (with different common scales between Figures 2 and 3). I think that it would be helpful, as these are contrasted with Figures A1 and A2, which *do* have a common scale for all the sub-plots of each figure.
11. In Figures 4 and 5, is the use of the 0.1 to 0.5 (and -0.5 to -0.1) band useful? The authors explicitly discount changes this small, and would changes on these levels even be significant?
12. In Figures 4 and 5, could the authors explain the jagged feature seen in the OH biomass burning, the HO₂ N₂O decomposition, and to a certain extent, the HO₂ lightning plots?
13. Page 19, line 4: I believe the authors mean "no large changes", not "no changes", as this is the wording they use in two other places in the manuscript.
14. Page 19, line 11: "long-lived tracers".
15. Page 19, line 11: I would not use "Exemplary", and would instead use "For example".

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16. Page 19, last paragraph: Is this referencing the plots in the Supplementary Information? If so, please say so.
17. In the Supplementary Information, I would suggest labelling the figures as S1, S2 etc., especially since these figures should be referenced in the main text in some way, and it would be confusing otherwise.

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