

Atmos. Chem. Phys. Discuss., referee comment RC2
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Comment on acp-2022-438

Anonymous Referee #2

Referee comment on "An improved representation of fire non-methane organic gases (NMOGs) in models: emissions to reactivity" by Therese S. Carter et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-438-RC2>, 2022

Carter et al. present an analysis in which they update the treatment of fire VOCs in the GEOS-Chem CTM to account for recent emission studies. Along with EF updates they incorporate recent expansions of the model chemical mechanism, and add fire emissions for relevant species where that source was previously missing. They compare the model output to atmospheric observations and draw some conclusions regarding the importance of fires for global emissions of reactive carbon and reactivity, and point to some areas needing future work.

Overall the paper is straightforward and relevant to ACP. I recommend publication with a few minor comments/suggestions below.

254-256 and associated discussion of the percentage mass and reactivity captured by the model. If I understand correctly, with the updates you now have ~40TgC of fire emissions in the model, and you estimate that this is capturing 72% of the total mass emissions and 45% of the emitted reactivity. But earlier it was indicated that fires emit > 400Tg/y, based on Akagi. Please discuss the reasons for and implications of this disparity. The paper does include some discussion and caveats about the estimates being a likely lower limit, but that discussion does not appear to cover a potential disparity of this magnitude.

250, "In the model, the oxidation of FURA with OH produces butenedial since that has been shown experimentally with an estimated carbon balance of 100% C". This is true for furan but not for the species lumped into FURA.

The writing is in generally very well-done. In places awkward or excessive use of punctuation (e.g. commas, nested parentheses) renders

things less clear than they could be. The authors may wish to revisit this

307, things get a bit awkward here with the use of FIREX vs FIREX-AQ. Earlier FIREX was used to refer to the lab component but here it appears to refer to the airborne campaign. And later in the section you spell out the FIREX-AQ acronym when it has already appeared numerous times before that. Likewise ARCTAS is not spelled out at first use but rather on line 390 which makes things confusing

103, "greater variability". Unclear, greater than what?

105, extra parenthesis

153, please indicate time resolution of the boundary conditions.

197, I think you mean "product" rather than "sum" here

221-222 and Fig 1 caption, please state the assumed OH concentration that is implicit in the lifetimes provided

Fig 1, the use of an outer black circle to designate species whose oxidation products are known is not ideal since some of the symbols are solid black

244, placement of "(RCHO)" in this sentence makes it seem as though it is referring to furfural when I believe it is actually referring to "aldehydes with three or more carbon atoms"

295, there appears to be an inconsistency between the values given here versus the abstract, 45% / 49% for reactivity?