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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Global impact of monocyclic aromatics on tropospheric composition" *by* David Cabrera-Perez et al.

Anonymous Referee #3

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In this work, the authors compare differences in predicted tropospheric species distributions and relative concentrations between two model simulations: (1) a base case (REF) in which no aromatics are emitted globally to (2) a case in which C6-C11 aromatics are emitted globally (AROM). Both model simulations include detailed aromatic chemistry, but since there are no aromatic emissions in REF, only AROM contains aromatic chemistry impacts. The base case (REF) is not consistent with recent, state-of-the-art models (GEOS-chem, MOZART-4, etc.), in which benzene, toluene, xylenes, or some parameterized combination of these and their chemistry is included. A comparison between a model simulation in which a subset of aromatics are parameterized as one or two or three species and then compared to the AROM simulation would be more scientifically relevant. It is likely, however that the differences (globally) of such a

model simulation would be insignificant, as the differences in the AROM-REF situation presented here have very little significant globally. The other issue is that the model resolution is very coarse, which is also probably why there isn't a significant impact from the addition of the larger, more reactive aromatics – they're simply lost into such a coarse grid.

In general, the comparisons shown simply reinforce that it is worthwhile to include aromatics and aromatic chemistry in global models, but this is not at all novel as aromatic chemistry has been included in global models for years.

A comparison of a reasonable current chemistry scheme with emissions of a subset of aromatics compared to the full aromatic scheme and expanded aromatics emissions using a finer model grid over a regional scale may be more appropriate to look at the impacts of including larger aromatics (C9+ aromatics) on urban and regional scales, where the reactive aromatics likely have a more significant impact on tropospheric chemistry. This would be a more novel and valuable approach.

Throughout the paper, and in particular the introduction, there are awkwardly-worded sentences that would significantly benefit from having a careful once-over/proofread/edit by a native or strong English speaker. E.g., Page 1, line 20; Page 3, lines 63-64; Page 4, line 74; Page 6, line 161; Page 10, line 193; Page 11, Table 2 title.

Specific comments

Page 1, line 5 – in referring to the inclusion of "aromatic compounds" in the abstract, perhaps state which species and/or class of aromatics are included, and to what degree their chemistry is included. Even stating C6-C11 aromatics would be helpful.

Page 1, line 7 – Be specific about the changes – relative or absolute. Also, here and elsewhere in the paper, the word "found" is used to refer to differences between the base REF case with no aromatic hydrocarbon emissions and the AROM case in

which aromatics emissions are included. I would argue that nothing is “found”, but rather, a difference in the atmospheric burden of particular species in the simulation results was noted. “Found” implies that measurements were made, and there were no measurements made or reported in this paper. I would suggest replacing “found” with “predicted”, or something similar (see also page 1, lines 9, 12, etc.)

Page 6, line 121 - It would be nice if I didn’t have to go read another paper to get all the details about the additional chemistry. A summary or brief description of the detailed aromatic chemistry in Cabrera-Perez et al. 2016 would be nice to include in this paper.

Page 6, line 143 – define “daytime”. Also, define “surface”.

Table 1 – the title stating “This emissions are the same as in . . . but for higher aromatics” is both grammatically incorrect and not clear. This should be a footnote in the table, and more specific, or perhaps, to make it more clear, show the 2016 paper emissions in the table as another column. More importantly, there is an inconsistency between the table and text: the total aromatic emissions in the table are 39.3 TgC/yr of which 3.8 TgC/yr are higher aromatics, while the text (Page 5, line 120) states that it is 35 TgC/yr, of which 3.4 TgC/yr are higher aromatics. This needs to be reconciled. Also, Trimethyl-benzene should indicate “trimethylbenzenes” (there are three different trimethylbenzenes). Also, what about the ethyltoluenes?

Technical corrections

Figures - rather than saying “upper left panel”, “top panel”, etc., simply label the different panels of each figure a, b, c, etc., and then refer to them in the figure caption with (a), (b), (c), etc. When referring to the supplement, refer the reader to a specific Table (S1, S2, etc.) or Figure S1, S2 in the supplement, and not the document as a whole.

Page 1, line 16 – change “comprises” to “comprise”.

Page 2, line 25 – RO2 is not “the peroxy radical”, but rather “an organic peroxy radical”.

Page 3, line 57 – change “In contrast, the high NOx. . .” to “In contrast, O3 in the high

NOx regime. . .” (It is the O3 that is limited by VOC concentration, not the high NOx regime.

Figure 2 – there is an extra space after Aromatic VOC in the “title” of the bottom panel. Also, there is inconsistency throughout the paper in the capitalization of figure titles (which is odd – typically figures do not have titles).

Page 7, line 157 and elsewhere – mlc is not an acceptable shortform for molecules. Either spell it out entirely (preferred), or use the somewhat acceptable “molec” as a shortform.

Page 9, Figure 4 caption – Internally inconsistent – refers to O3 and OH.\

Page 13, line 246 – add a space between 7 and km.

Page 13, line 254 – add a space between e.g. and Butler.

Supplement – Table (S)1. “higher” does not need to be capitalized. The sentences after the * in the table title should be in the footnotes. Also, the reference to extra-tropical forests is unclear. Define the references to PTR (naphthalene and C11 Aromatics).

Supplement Figure (S)1. Change “(Arom – base)/base, %” to “(AROM-REF)/REF, %” to be consistent with the main text, and this should really be the y-axis title, not the figure title. For the y-axis labels, use decimals instead of commas, or just use integer values.

Figure S2 – units in %?

Figures S3 and S4 – the titles are redundant with the figure captions.

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