

Geosci. Model Dev. Discuss., referee comment RC1
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Comment on gmd-2021-119

Anonymous Referee #1

Referee comment on "Improvements to the representation of BVOC chemistry–climate interactions in UKCA (v11.5) with the CRI-Strat 2 mechanism: incorporation and evaluation" by James Weber et al., Geosci. Model Dev. Discuss.,
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General comments

This manuscript presents the impact of updates of the chemistry of biogenic organic compounds and other ozone-related reactions in the UKCA model. At reasonable additional computational cost the chemistry–climate interactions mediated by biogenic organics via ozone and organic aerosols can now be investigated with an up-to-date representation of tropospheric gas-phase chemistry. The manuscript is written very well. The results and the discussion there of is very well structured and comprehensive. With the help of targeted sensitivity simulations the authors back up their explanations for the differences to the results obtained with previous chemical mechanisms used in the UKCA model. Comparison of model results with observational datasets is also very extensive. Interestingly, the model updates result in a significant higher prediction of tropospheric ozone burden exacerbating the positive bias that is typical of other models. Hopefully this gives more stimulus to improve the representation of relevant multiphase chemistry and emissions of precursors in the UKCA model.

Specific comments

p2,l54-60: certainly many other studies have investigated these impacts but only two studies from the UKCA are cited. I suggest to cite studies from other modelling communities

p2,l60: the term "chemical behavior" is borrowed from psychology and just triggers an idiosyncrasy. It is used in other parts of the manuscript. I would not use it.

p4,l114-116: the authors omit the models developed by the groups that discovered and first elucidated the OH-recycling in isoprene chemistry (MAGRITTE in Müller et al., 2019; MOM in Sander et al., 2019 and Novelli et al., 2020).

p14,l499: at this point it is not very clear what isop_ox is made of and that ISOPPOOH gives the same PTR-MS signal as MVK and MACR. It would be good if this could be clearly defined.

Technical corrections

p8,l269: the verb "are" is missing

Additional references

Müller, J.-F., Stavrakou, T., and Peeters, J.: Chemistry and deposition in the Model of Atmospheric composition at Global and Regional scales using Inversion Techniques for Trace gas Emissions (MAGRITTE v1.1) – Part 1: Chemical mechanism, *Geosci. Model Dev.*, 12, 2307–2356, <https://doi.org/10.5194/gmd-12-2307-2019>, 2019.

Sander, R., Baumgaertner, A., Cabrera-Perez, D., Frank, F., Gromov, S., Grooß, J.-U., Harder, H., Huijnen, V., Jöckel, P., Karydis, V. A., Niemeyer, K. E., Pozzer, A., Riede, H., Schultz, M. G., Taraborrelli, D., and Tauer, S.: The community atmospheric chemistry box model CAABA/MECCA-4.0, *Geosci. Model Dev.*, 12, 1365–1385, <https://doi.org/10.5194/gmd-12-1365-2019>, 2019.

Novelli, A., Vereecken, L., Bohn, B., Dorn, H.-P., Gkatzelis, G. I., Hofzumahaus, A., Holland, F., Reimer, D., Rohrer, F., Rosanka, S., Taraborrelli, D., Tillmann, R., Wegener, R., Yu, Z., Kiendler-Scharr, A., Wahner, A., and Fuchs, H.: Importance of isomerization reactions for OH radical regeneration from the photo-oxidation of isoprene investigated in the atmospheric simulation chamber SAPHIR, *Atmos. Chem. Phys.*, 20, 3333–3355, <https://doi.org/10.5194/acp-20-3333-2020>, 2020.