

Interactive comment on “The roles of volatile organic compound deposition and oxidation mechanisms in determining secondary organic aerosol production: A global perspective using the UKCA chemistry-climate model (vn8.4)” by Jamie M. Kelly et al.

Anonymous Referee #3

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Secondary organic aerosol (SOA) is an important but the least understood component of atmospheric aerosols. SOA life-cycle involves many chemical and physical processes, including emission, gas-phase chemistry, aqueous/solid phase chemistry, condensation, deposition and etc. This makes the global SOA modeling really challenging. This manuscript investigated the sensitivities of SOA formation to the different volatile organic compound (VOC) deposition and oxidation mechanism use a global chemistry-climate model (UKCA). It also compared these sensitivity simulations

against the observations to see how these difference mechanisms affect the model-observation agreements. Overall, this manuscript is organized well and provide readers deep insights on how VOC deposition and oxidation reactions affect the SOA production. I recommend publishing it after the authors address my comments below.

General comments

It is not clear to me why the authors only use aromatics as the biomass burning SOA precursor. How representative are the aromatics for the biomass burning SOA precursor?

All model simulations underestimate the observed OA concentrations. The authors should at least discuss the reasons for this underestimation and its potential impact on this paper's conclusions.

Specific comments

P3, line 1. Kelly et al., 2018 is not listed in the reference list.

P3, line 7. Suggesting changing “an aspects of SOA” to “another aspect of SOA”, because the previous sentence already described one aspect of SOA difference between different models.

P4, line 8-9. Can you list some references to support this statement?

P8, line 20. Section 2.4 should be section 2.3. And also please change the section 2.5 number.

P8, line 27. Please change VOCBB and VOCANT to “VOCBB” and “VOCANT” to be consistent with the rest of paper.

P8, line 27. The second “insoluble” should be “soluble”.

P9, line 24-26. So the model includes both the isoprene oxidation that leads to SOA formation and the isoprene oxidation in the Mainz Isoprene Mechanism? Isn't this

double-counting the isoprene oxidation?

P11, line 20. Can the authors briefly describe the kinetics for aromatic oxidations here? So the readers don't have to read the table when reading the text.

P12, line 18. "Different molecular masses". What molecular weights are used for RO₂ and SOG in the model. SOG is a lumped species, right? So how do the authors know the molecular weight of SOG?

P13, line 20-25. Did the authors account for the seasonal variation of biomass burning VOC emissions in the model (i.e. monthly change emissions)?

P18, line 15. OH can be indirectly constrained by the CH₄ lifetime.

P24, line 24. "Favors the likelihood of RO₂ radicals entering the high-yield HO₂ pathway". Why? I don't understand the reason for that.

P26, line 30. "Figure 12", is it meant to be Figure 13?

P27, line 11-17. This argument is confusing to me. Can the authors elaborate that?

Reference list. There are some references with titles being all capital letters. Please change them.

Table 1. Please add the VOCANT and VOCBB oxidation kinetics in the "existing reaction kinetics" subsection.

Interactive comment on Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2018-142>, 2018.

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Discussion paper

