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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Large difference in aerosol radiative effects from BVOC-SOA treatment in three ESMs" *by* Moa K. Sporre et al.

Anonymous Referee #2

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This manuscript investigates the differences in the radiative effects induced by biogenic secondary organic aerosol (SOA) as computed by three different ESMs. It points as drivers of these differences, in particular, to the parameterizations of new particle formation, biogenic SOA treatment and biogenic volatile organic compounds emissions changes by climate-feedbacks and by land-use changes. The manuscript is nicely written and suitable for publication in ACP after further improvements as detailed by the two other reviewers. I have some comments in addition to the long list already provided by the two other reviewers.

I suggest the authors discuss/compare not only with the Tsigaridis et al (2014) paper on organic aerosols but also with the Fanourgakis et al (2019) on CCN, where several models with different treatment of NPF and of OA have been compared. How the SOA

budget calculated in this study compare with the earlier estimates reported in both the above mentioned papers. How the aerosol number concentrations and the CCN calculated compare with Fanourgakis et al. What do we learn from comparison with these earlier studies?

Furthermore, I would like to see some conclusive discussion on the importance of the interactive calculations of the oxidants (only EC-Earth having this feature) and shows very different behavior compared to the other two ESMs for the simulations without biogenic VOCs, pointing to potentially some chemical feedback mechanisms though oxidants impact on SOA formation that is not discussed.

Extra specific comments:

1- Line 45: Kanakidou et al. (2000) and Carlton et al (2008) have discussed the anthropogenic control on BSOA before Spracklen et al. (2011) I think they deserve citation here.

2- Lines 60-62: Assumption of irreversible condensation of organics is a working assumption for ELVOC but not for SVOC. I think this has to be discussed here since for SVOC this will lead to an overestimate of SOA formation.

3- Lines 129 & Table 1: The model description leaves the impression to the reader that MEGAN is used on line in all three ESMs while in Table 1 it is stated that two among the three ESMs use recalculated fields. This has to be clarified.

Ref:

Carlton et al., To What Extent Can Biogenic SOA be Controlled? Environ. Sci. Technol. 2010, 44, 3376–3380

Fanourgakis et al. Evaluation of global simulations of aerosol particle and cloud condensation nuclei number, with implications for cloud droplet formation Atmos. Chem. Phys., 19, 8591–8617, 2019, https://doi.org/10.5194/acp-19-8591-2019

Kanakidou et al., Human-activity-enhanced formation of organic aerosols from biogenic hydrocarbon oxidation, JGR, 105,D7,9243-9254, 2000

Tsigaridis et al. The AeroCom evaluation and intercomparison of organic aerosol in global models Atmos. Chem. Phys., 14, 10845–10895, 2014, www.atmos-chem-phys.net/14/10845/2014

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