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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Impact of gas-to-particle partitioning approaches on the simulated radiative effects of biogenic secondary organic aerosol" *by* C. E. Scott et al.

Anonymous Referee #2

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The authors have investigated the effects of thermodynamic equilibrium and kinetic condensation treatments for partitioning biogenic SOA on the magnitude of the direct and first indirect effects. The effects of two new particle formation schemes – one based on activation rate of H2SO4 clusters and the other based on organically mediated cluster formation rate – are also investigated. While the topic of this study is within the scope of ACP, I am unable to recommend it for final publication in the current form due to several issues listed below.

Comments:

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1. I had some difficulty in assessing what major insights this study provides that were not already provided by Riipinen et al., ACP, 2011 – that kinetic condensation leads to an increase in CCN while thermodynamic partitioning suppresses it. While this study computes CDNC from CCN and the radiative effects, I am not convinced that is enough to qualify it as a unique scientific contribution, especially when the thermodynamic approach used here seems somewhat flawed (see next comment). Comparing the effects of two new particle formation schemes is new, but that does not seem to be the main focus of the study.

2. The thermodynamic approach used in this study is not the one typically used in a thermodynamic partitioning model. It simply partitions the SOA mass (predicted by the kinetic approach) according to organic mass (MOA), and does not let it evaporate, undergo further oxidation in the gas phase, and repartition in subsequent time steps. While I understand the rationale behind this approach, it would be incorrect to call it thermodynamic approach.

3. Comparison of observed size distribution with model predictions is shown for only one site. More comparisons at different locations are necessary as this is a global study.

4. This study focuses biogenic SOA, but uses only monoterpenes as precursor VOCs. What about isoprene, which is also an important biogenic VOC that can produce substantial amounts of SOA in certain regions of the globe? Other sources such as anthropogenic VOCs and biomass burning VOCs can be important as well. Ignoring these key SOA precursors would lead to underprediction of global SOA budget and skew the magnitudes of direct and indirect effects, and hence the main results of this study.

5. Page 4149, line 25: It is stated that 5 log-normal size modes are used in the

ACPD
15, C2229–C2231, 2015

model, implying that the model uses some sort of modal dynamics approach to simulate aerosol size distribution. This could be problematic if the mode widths are assumed to remain fixed after kinetic condensation, which produces a characteristic narrowing the mode. Please provide some details on the modal dynamics approach used and how this issue is handled in the model?

6. Page 4150, line 4: It is mentioned that six-hourly mean offline oxidant concentrations are used to oxidise monoterpenes to form SOA at 13% molar yield. What time splitting interval is used to perform coagulation and condensation calculations? Also, in which order are these calculations done? And are the results sensitive to the order?

7. Editorial comment: Abstract, line 17: Change “medicated” to “mediated”.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 4145, 2015.

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15, C2229–C2231, 2015