Comment on acp-2022-327
Anonymous Referee #2

Referee comment on "Modeling Day and Nighttime SOA Formation via Multiphase Reactions of Biogenic Hydrocarbons" by Sanghee Han and Myoseon Jang, Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-327-RC2, 2022

General Comments

Han et al present a series of experiments conducted in a rooftop chamber examining the oxidation of three biogenic hydrocarbons (isoprene, a-pinene, b-caryophyllene) during both daytime and nighttime conditions. They examine the role of four different oxidants (OH, O₃, NO₃, O(3P)) and a series of environmental conditions, including hydrocarbon to NOₓ levels, relative humidity, temperature and particle seed composition.

The major emphasis of the paper is on a gas-particle partitioning model, UNIPAR, that is first fit to the experimental data and then used to make predictions about the variation in SOA yields with different parameters. Major conclusions are that there is a strong positive NOₓ dependence to SOA yield during nighttime conditions and a weaker negative NOₓ dependence during daytime, and that there is a modest negative temperature dependence.

Overall the paper is in line with other studies of these systems in the recent literature, but offers some new insights based on the explicit gas-particle partitioning model. Some aspects of the presentation should be clarified prior to publication, however, as outlined in the more specific comments below.

Specific Comments
Line 43: Give the total SOA budget for reference. Also add the caveat in this line that these are models of global SOA, and that the cited work is just one of several estimates of this quantity.

Line 54: Not clear what is meant by a sustainable NO$_3$ radical – perhaps this refers to production of NO$_3$ radicals being sustained?

Line 58: There are more recent references to the organic nitrate yield from NO$_3$ + isoprene. See for example:


Line 97: The definitions of high and low NO$_x$ seem arbitrary and as though they might both be high NO$_x$. Was the fate of RO$_2$ radicals considered in defining the high and low NO$_x$ conditions – i.e., the rate of RO$_2$ + NO compared to other RO$_2$ losses?

Line 145: Inclusion of O(3P) is relatively unusual and not normally important in the lower atmosphere (also a conclusion of this study). What motivated the inclusion of this oxidant rather than other minor oxidants such as chlorine radicals or Criegee intermediates?

Line 214: At what rate was N$_2$O$_5$ hydrolysis included, and how efficiently does this compete with gas phase NO$_3$ reactions?

Figure 2: The abbreviations NS, SA, wAS, etc. are not defined in the figure or the caption and not easy to find in the text. Clarify the meaning of these abbreviations in the figure.

Line 230: Conclusion not clear in this sentence. Is this stating that in the presence of aerosol there is no NO$_3$ reaction with the biogenic hydrocarbons?
Line 248: The biogenic mixing ratios used in the simulations are unrealistically large – does this also bias the SOA yields high?

Line 254: SOA yields from NO$_3$ said to be low during daytime, but Figure 4 shows them to be larger than OH? Is this correct? The description of isoprene SOA beginning in this line does not appear consistent with what appears in the figure.

Line 279: This paragraph contains a series of qualitative statements about the roles of different mechanistic pathways in forming SOA. Presumably, all of these could be quantified with the model and shown as a figure?

Line 362: What is the chemical composition of gasoline fuel? Presumably this is in the gas phase? Is the high mixing ratio used here realistic to ambient conditions?

Line 403: Suggest removing the reference to “government agency” and referring instead to NO$_x$ control measures.

Line 415: The term “electrolytic” appears out of place here.