ACPD Interactive comment Printer-friendly version Discussion paper Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2020-756-RC1, 2020 © Author(s) 2020. This work is distributed under the Creative Commons Attribution 4.0 License. Interactive comment on "A global model perturbed parameter ensemble study of secondary organic aerosol formation" by Kamalika Sengupta et al. Anonymous Referee #1 Received and published: 13 September 2020 This manuscript explores the impacts of six yield parameters on particle number concentration and organic aerosol concentration based on 60 sensitivity simulations in global models. The six parameters include the yields of ELVOC/LVOC/SVOC from the oxidation of isoprene, monoterpenes, and anthropogenic VOCs. The simulated concentration of particles >3nm (N3), particles > 50nm (N50), and OA are extensively compared against measurements around the world. The manuscript discussed critical compensating parameter effects, which limit our ability to retrieve best set of parameters by comparing model and measurements. Further, it is found that parameters leading to best simulation of N3 and N50 are the worst of OA concentration, because these three attributes are driven by OVOCs with different volatilities. It is delightful to read the manuscript. The authors do a terrific job in clearly commuting and visualizC1 ACPD Interactive comment Printer-friendly version Discussion paper ing the results from 60 sensitivity simulations. Overall, the manuscript has immediate impacts on the atmospheric chemistry community and nicely fits in the scope of ACP. I recommend publication after minor revision.

Thank you for the constructive feedback. Please see our replies inline. Any text added in the revised manuscript is shown below in ***bold, italics***.

Comments 1. As clearly demonstrated in the manuscript, it is challenging to retrieve best set of parameters by comparing model and measurements. To some extent, this emphasizes the importance of provide accurate parameters based on laboratory experiments. It would be great if the authors could provide some suggestions to experimentalists.

Suggested ranges are discussed in the Results and Conclusion sections. For example in P35 L24:

We find the best model skills scores in N3, N50 and OA are achieved when the ELVOC yield from precursor VOCs is between 6-26%, with the most plausible ELVOC yield estimate being around 12.8%.

2. One clarification question: does N3 refer to particles larger or smaller than 3nm? If it is larger than 3nm as defined in Page 4 Line 20, is N50 part of N3?

N3 refers to particles larger than 3nm.

Yes, N50 is part of N3. More information on N3 and N50 has been added in Section 2.3, in the revised manuscript.

3. Page 14 Line 24. Based on the index in figure 4, simulation 9 should be subplot (4,3), instead of subplot (3,4).

Corrected.

4. Figures 4-6. I wonder if it is better to organize the subplots in the same order as figure 2, which will facilitate locating the simulations that are discussed in the manuscript. Just a thought.

Currently Figure 4 is arranged in order of increasing global mean OA. This order makes it easy to see how simulations that have very close global mean values of OA, have widely different regional distributions (simulations 9 and 36, lines 11-20 in P15).

Figures 5 and 6 are both arranged in increasing order of global mean N3. This order makes it easy to spot simulations in which the particle growth from 3nm to 50nm has been affected by the parameter combinations (P20 L2-10). Such simulations are easy to spot in Figure 6 because of the sudden blue plots appearing amidst increasingly red ones.

Ordering the subplots in Figures 4-6 from 1-60 (as in Figure 2) will make it harder to spot the above patterns. To help the reader locate the simulations, we have the subplot numbering system.

Based on the above we think it is best to keep the order of subplots in Figures 4-6 unchanged.

5. Figure 7. It is “Q2” in the caption, but “IQR” in the legend. Please be consistent. Also, “N3” is mentioned in the caption, but not included in the figure. Please add N3 plots to the figure to provide a complete picture.

Corrected.

6. Please elaborate the discussions in section 3.2, as it is not straightforward how to read figures 10-12. Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2020-756, 2020. C2

The following text on how to interpret Figures 10-12 is added P26 L6 in the revised manuscript.

Each scatter plot in Figures 10, 11 and 12 show the relationship between two ox-VOCs for each of the sixty ensemble members. Note the values for B_ELVOC yields shown in Figures 10, 11 and 12 and Figures A3, A4 and A5 are scaling factors which have to be multiplied to the baseline model yields (Table 2) to get the B_ELVOC

yields for the ensemble members. For the rest of the ox-VOCs the values shown are yield values in % which can be converted to Tg yr^{-1} using Table 2. Because it is a 6-D space, it is also important to note that the other four parameters are varying randomly across each plane.

We use Figures 10, 11 and 12 to identify patterns of dependencies of the Taylor skill scores for N3, N50 and OA on the ox-VOC yields within the 6-D parameter space. A weak dependency between an ox-VOC and model skill does not imply that the contribution of the ox-VOC to OA and particle number concentration is unimportant. Rather, it implies that within the current modelling framework its contribution can be compensated by changes in other ox-VOCs.

To identify the plausible and implausible parts of the parameter space using the patterns of dependencies, the ensemble simulations (denoted by triangles in Figures 10, 11 and 12) in the subplots are shaded blue to red. Darker shades of blue indicate low/poor Taylor skill score and darker shades of red represent high/good Taylor skill score within the ensemble. We note the relative rank of the simulations in Taylor skill score and their relative positions in each 2-D subplot and use these two information to identify clusters of blue or red triangles in the parameter space. For absolute values of Taylor skill scores of each simulation see Table A1 and A3, A4 and A5 (which are Figures 10, 11 and 12 labelled with simulation number).