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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Oligomer and highly oxygenated organic molecule formation from oxidation of oxygenated monoterpenes emitted by California sage plants" *by* Archit Mehra et al.

Anonymous Referee #2

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The authors describe a study in a PAM/OFR reactor. They oxidized emissions from two plant species and three of the major single VOC in the emissions, two of them oxidized. They studied the importance of oligomers and highly oxygenated organic molecules (HOM) for SOA formation. The focus was on oxygenated MT emitted by the Californian sage species. The study is new and original, and provided interesting and fruitful results within the scope of ACP. So the manuscript could be published in ACP. However, there are some major issues that need improvement/extension. The manuscript is relatively short so there should be room for that. In summary: 1.) Experimental details are scarce: one would need to know about the applied VOC concentrations, VOC/NOX ratios, and VOC/ oxidant ratios. I guess experiments were performed at high VOC and

high oxidant concentration. In this context it should be discussed in the conclusions under which conditions and in how far the results mean anything under atmospheric conditions. 2.) There is no information on the reproducibility or the significance of the findings, although differences between the different chemical systems are stated as results. Further there is no attempt to discuss "missing calibrations" although the relative importance of different two compound classes is presented as a important result.

Major comments in detail:

Kourtchev et al. (2016) showed that oligomer content in SOA depends on the precursor concentration and simulation experiments tend to overestimate oligomer formation compared to atmospheric situations. What were VOC/OH ratio and VOC/NOX ratio in your experiments. A table giving an overview on experimental conditions and number of replications per system will be helpful. Were experiments performed at different VOC and the results compared? If so are there any trends with VOC/OH and VOC/NOX?

Line 206-211: Isn't that statement kind of trivial? One can only observe molecules with smaller carbon number in the particulate phase when they are more oxidized and vice versa larger molecules can make it into the particulate phase even if they are less oxidized? So what do we really learn from this? Only that camphene fragments stronger in thermodesorption?

Line 212: Was the concentration of eucalyptol higher than the other species?

I understand this is a laboratory study, which has its own right. Although not really stated, I guess the VOC input was high. Therefore I am wondering about OH lifetime for the (single) VOC as a measure of VOC/oxidant, and the VOC/NOX ratio. And, I am wondering in how far and under which conditions the results can be transferred to atmospheric situations? This is also in context with the missing information on errors and significance for the discussed differences Low NOX / medium NOX, single compounds vs mixture, MT vs. oxidized MT.

Table 2 and line 229 -242: How many experiments were performed per VOC (mixture)? How significant are the differences, discussed in the text? Which differences are really significant? And if the differences are significant, what does it eventually mean? The paragraph is difficult to follow and should be structured clearer. E.g. I don't see some of the points made so clearly in the table. Line 264-269: I am sorry but this comparison is empty. Didn't you made some a-pinene reference experiments under same conditions, so that you could connect your new findings with something better established? Section 4: Please, put your results in perspective to the atmosphere, explicitly considering the experimental conditions under which they were achieved. (A few sentences: what can be learned, where one should be careful.) Line 140, 275, and 281: I understand that calibrations are inherently difficult. However, since you are comparing two different types of SOA contribution: do you have any idea about the relative sensitivity? Please, discuss in section 2.2 your estimate and in section 4 the limitations of your findings, because of missing (possibility for) calibrations.

Minor comments:

In general, figures and tables need to be adapted to ACP format.

Line 35: Bianchi et al. 2019 is a review, one should give the authors of the original articles also credits. I suggest to add at least e.g. Ehn et al. , Nature, 2014 here.

Line 88: A short description of the plant-chamber and /or a reference is missing.

Line 250 Figure 6 -> Figure 5

Figure 2 Venn -> Venn diagram

Figure 2b and 3: legend should not cover information.

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