

Atmos. Chem. Phys. Discuss., referee comment RC1
<https://doi.org/10.5194/acp-2021-340-RC1>, 2021
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Comment on acp-2021-340

Anonymous Referee #1

Referee comment on "Atmospheric photooxidation and ozonolysis of Δ^3 -carene and 3-caronaldehyde: rate constants and product yields" by Luisa Hantschke et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-340-RC1>, 2021

In this manuscript, the reaction rate constants of Δ^3 -carene with OH and O₃, OH yield in ozonolysis, and organic nitrate yield in photooxidation were first studied by combining model simulation and laboratory investigation. Caronaldehyde, as one of the main products of Δ^3 -carene oxidation, its yield from OH-initiated oxidation and photolysis, and the yield of organic nitrate were further calculated. The data obtained in the present study were compared with the corresponding values in the literature and nearly all the determined values are in good agreement with the reported values. Overall, the method is mostly reasonable and the uncertainty has been well considered. However, my main concern is what is the motivation of the focus on Δ^3 -carene? Just considering its atmospheric abundance? As demonstrated by the authors, the reaction mechanism of α -pinene has been investigated in many studies and, Δ^3 -carene behaves similarly like α -pinene regarding its oxidation mechanism. In the fact, the rate constants of the reaction of Δ^3 -carene with OH and O₃, the OH yield, as well as the organic nitrate yield have been already reported in the literature. A better introduction of the research background and motivation of learning the reaction rate constants and OH yield, as well as the significance of these studies are suggested. Overall though, this study could be published on Atmospheric Chemistry and Physics once the following comments are addressed.

Specific comments,

- Page 4, line 85, what is the value of the detection limit of the instruments, e.g PTR-MS for the detection of Δ^3 -carene?
- Page 5, line 90, 30%, how the RH in Table 1 obtained? Is 30% the averaged RH measured at the beginning and at the end of the experiment? This is suggested to be noted in Table 1 by footnote.
- Page 6, line 121, 'aproton', 'a proton'?
- Page 7, line 165, line 165-167, why the fraction of RO₂ radicals produced by Δ^3 -carene to the total RO₂ concentration could be assumed to be equal to the ratio of OH-reactivity from the Δ^3 -carene + OH reaction to the total measured OH reactivity? As shown in equation 2, OH can react with NO₂ but without RO₂ generation. And if this assumption is right, why is kOHVOC but not kOH,obs used in Equation 4?
- Page 12, figure 2, which curve represents the time evolution of CO? The legend should be added.
- If the chamber was flushed with synthetic air until the concentrations of trace gases

were below the detection limit of the instruments (Page 4), how this can be achieved for experiments E3 and E4? Figure 1 showed no time interval for such an operation.

- Page 15, references for the ozonolysis mechanism is suggested to be cited.
- Figure 4, What do the solid line and the dashed line represent? For OH oxidation, why there are different corrected caronaldehyde concentrations at one reacted α -3-carene concentration?
- Page 18, Figure 5, where is 35% derived from? The top 'HO2' in this figure should be NO₂.
- Page 21, When 249, while the calculation of $RO_{2, \text{carene}}$ is reconsidered, the nitrate yield Φ_{RONO_2} needs to be checked.