Comment on acp-2021-340
Anonymous Referee #1

In this manuscript, the reaction rate constants of Δ3-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 Δ3-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 Δ3-carene? Just considering its atmospheric abundance? As demonstrated by the authors, the reaction mechanism of α-pinene has been investigated in many studies and, Δ3-carene behaves similarly like α-pinene regarding its oxidation mechanism. In the fact, the rate constants of the reaction of Δ3-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 Δ3-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 Δ3-carene to the total RO2 concentration could be assumed to be equal to the ratio of OH-reactivity from the Δ3-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 $k_{OHVOC}$ but not $k_{OH,obs}$ 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 â-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 $RO_{2, carene}$ is reconsidered, the nitrate yield $\Phi_{RONO2}$ needs to be checked.