

Comments for egosphere-2024-1599

This paper studies the formation of secondary organic aerosol from photo-oxidation of α -pinene reacting with NO_x. Experiments were conducted in batch mode in a simulation chamber. The SOA yields were investigated under varying concentrations of α -pinene and NO_x. The authors discussed the SOA yields as a function of organic aerosol mass concentration from the site of aerosol/gas-phase distribution ratio of semi-volatile products. In addition, SOA chemical composition at the bulk level for different NO_x concentrations was also studied.

There is merit to the topic of SOA formation from monoterpene oxidation in the presence of NO_x. However, several major and minor comments need to be addressed before the manuscript can be considered for publication.

General comments:

1. As the authors mentioned in the manuscript, this study uses unrealistically high VOC and NO_x concentrations which are much higher than in the general atmosphere. I am therefore wondering how the resulted chemical regime of the experiments could have affected the results presented and their implication to the real atmosphere. Can authors discuss more about the atmospheric implication of the results?
2. Also, there have been a large amount of investigations on the SOA formation from α -pinene oxidation during the past decades. What is the novelty of this study?
3. The effect of 'Aerosol/gas-phase distribution ratio of semi-volatile products' is one of the major points in this work. However, there is a lack of clear identification and quantification of 'Aerosol/gas-phase distribution ratio of semi-volatile products' in the manuscript. Can the authors explain it in more detail in the manuscript/supplement? Besides, the identification of 'semi-volatile products' is also not clear. Do they refer to the compounds in any range of saturation vapor pressures, or any range of partitioning coefficients, or other specific identification in this work? Or did I miss anything?
4. The whole section of '3.2 SOA chemical composition at different NO_x concentrations' is based on the calculation of N-containing compounds (NOCs). The authors use a constant R_{ON} value of 10 to quantify the NOCs by the equations 4 and 5. This value is from Takeuchi and Ng (2019). However, the VOC and NO_x concentrations in this work are largely different from the concentrations in the study of Takeuchi and Ng (2019). This may lead to different chemical composition of generated SOA between two works, which may affect the R_{ON} value (Xu et al., 2015). Also, the chemical compositions of SOA in different experimental conditions are mentioned to be different in this work. Thus, using a constant R_{ON} value for all experiments may lead to uncertainties in the quantification of NOCs. Can the authors discuss how the resulted chemical composition could have affected the quantification of NOCs (especially the major results showed in Figure 5)?
5. I would suggest authors to proofread the manuscript and check the grammar in English. Especially, terminology should be correctly used. Self-identified terms will need to be fully explained at the first time.

Specific comments:

1. Line161. The calculation of yields belongs to the section of Experimental Methods.
2. Line 200. What is the unit of decay ratio?
3. Are the results corrected by the effect of dilution?
4. The quantification of the particle concentration is important in this work. Can authors show the simultaneous measurements of SMPS, and state also the collection efficiency used for AMS measurement? What is the uncertainty of the yields in Table 1?
5. Line230. Does 'gas-particle distribution coefficients' mean gas-particle partition coefficients?
6. The period in each experiment for yields determination is not clear. This could be important when comparing the different SOA in batch-mode studies.
7. Line232. 'into the aerosol phase are larger at higher concentrations' of particle phase? The statement is not clear.
8. The calculation of the two-product model (line237-248, equation 1, Table 2) should be moved into the section of Experimental Methods.
9. Line259-261. The sentence is not clear. The results do not show any change of the volatility. How can it be concluded that 'the volatility of semi volatility products produced through α -pinene photooxidation increased with initial NO_x concentration'?
10. Line266-275 repeat that yields increase with increasing NO_x concentration. Please get them streamlined and delete the unnecessary repeats. Further, why the increasing yields with increasing NO_x are interpreted to be the contribution of higher contributions of semi-volatile products? Do authors mean higher NO_x concentrations lead to a higher fraction of semi-volatile products among total products than at lower NO_x concentrations?
11. Line283-286. What do the 'volatile oxidation products' refer to? Oxidation products in semi volatility or in all volatility groups? Do the proportions refer to the amount of total semi-volatile oxidation product in the sum of all gas- and particle-phase oxidation products? These confuse me. Also, I would suggest authors to give citations and explain why the assumption given here is correct.
12. Line367-373. The calculation belongs to the section of Experimental Methods.

Technical comments:

1. line60. Abbreviations should be identified when they show up for the first time.
2. Figure6. In the legend, 'completely' is incorrect.

References

Takeuchi, M., and Ng, N. L.: Chemical composition and hydrolysis of organic nitrate aerosol formed from hydroxyl and nitrate radical oxidation of α -pinene and β -pinene, *Atmos. Chem. Phys.*, 19, 12749-12766, 10.5194/acp-19-12749-2019, 2019.

Xu, L., Suresh, S., Guo, H., Weber, R. J., and Ng, N. L.: Aerosol characterization over the southeastern United States using high-resolution aerosol mass spectrometry: spatial and seasonal variation of aerosol composition and sources with a focus on organic nitrates, *Atmos. Chem. Phys.*, 15, 7307-7336, 10.5194/acp-15-7307-2015, 2015.