Atmospheric Chemistry and Physics Discussions

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Comment on acp-2021-560

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Community comment on "Synergetic effect of NH3 and NOx on the production and optical absorption of secondary organic aerosol formation from toluene photooxidation" by Shijie Liu et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-560-CC1, 2021

The authors of this manuscript investigated the influence of NH_3 and NOx on SOA formation from photooxidation of toluene. They concluded that there was a synergistic effect of NH3 and NOx on toluene-SOA formation based on the evident increase of SOA concentration as well as the mass absorption coefficient for the photooxidation system of toluene +H2O2+ NH3 +NOx in comparison with those of toluene +H2O2, toluene +H2O2 +NH3 and toluene +H2O2 + NOx. If the conclusion was reliable, it would be of great importance for evaluating atmospheric SOA formation from photooxidation of VOCs. The manuscript is recommended to be published in the journal after considering the following aspects:

- It is better to use SOA yields, rather than SOA mass concentrations, to elucidate the influence of NH_3 and NOx on SOA formation from photooxidation of toluene, because the consumption of toluene was different for the four experiments especially for the irradiated mixtures with the presence of NOx which would significantly suppress the OH level in the photochemical chamber. Did you measure the concentration variation of toluene during the experiments?
- It is better to present the variation trend of particle mass concentration measured by the SMPS for each experiment because the readers will not understand the detail information about the maximal mass concentration in Fig. 1. Did you conduct duplicate or triplicate experiments for each case? This information should mention in the experimental section, or readers cannot understand how the error bars in Fig. 1 come from.
- Particle mass concentration measured by the SMPS couldn’t be simply attributed to SOA because evident amount of secondary inorganic aerosol (such as ammonium and nitrate) could be formed in the photochemical reaction systems with the presence of NH3 and NOx. If NH3 was totally converted into particulate ammonium, there would be no evident influence of NH3 on toluene-SOA. As the reaction of NO2 with OH radical is very fast, most of NO2 will be quickly converted into HNO3 and NH4NO3 (with the NH3 presence), which may act as a seed to accelerate toluene-SOA formation. Did you measure the concentration variations of NH3, NOx, NO3- and NH4+ during the experiments? This information is valuable for explaining the experimental results.
- The exact concentrations of the reactants listed in Table 1 are unbelievable, it is better replaced by “~value”.

- The concentration of toluene used for the experiments is more than two orders of magnitude than those observed in polluted areas, and thus the results may be less representative for the actual atmosphere and exaggerate the influence of NH3 on toluene-SOA because of significant formation of carbonyl and carboxyl compounds. The authors are suggested to conduct experiments by using lower concentrations of toluene (e.g., ~50-100ppb) to check the possible dependence of the influence on the initial concentration of toluene.
- SOA formation is usually affected by OH levels, could you estimate the OH levels based on the first order decay of toluene?