Reply to the Reviewers

---For the manuscript “egusphere-2025-5992”

Reviewer 1#:

This is a chamber study on SOA formation promoted by atmospheric ammonia. This manuscript investigates the influence of NH_3 on secondary organic aerosol (SOA) formation during the photo-oxidation of mixed anthropogenic (n-heptylcyclohexane) and biogenic (α-pinene) volatile organic compounds using a large outdoor photochemical smog chamber. The study demonstrates that NH_3 significantly accelerates VOC degradation and enhances SOA production by facilitating nucleation and participating in particle-phase reactions, including the formation of nitrogen-containing light-absorbing substances such as imidazoles. The work addresses an important gap in understanding NH_3-involved interactions in complex mixed precursor systems and provides valuable insights into the formation of light-absorbing aerosols in AVOC-BVOC mixtures. The experimental design using a large-scale outdoor chamber is a notable strength, offering realistic atmospheric conditions. Overall, this research contributes meaningfully to the scientific basis for assessing NH_3 effects on the co-oxidation of anthropogenic and biogenic gases in urban environments.

1. It is not clear if these figures are from specific experiments (which ones) or an average of all experiments (which wouldn't make sense). Are these averages from all experiments, or data from specific experiments in Fig.1? Are there corresponding blank measurements from the chamber that are used for a baseline subtraction?

   Thank you for your helpful question. The data presented in the figures are from one of multiple replicate experiments, rather than averages across all experiments. Since consistent results from replicate experiments effectively ruled out interference from random uncertainties, this study selected one representative dataset for presentation. The mass spectrometry data shown in the figures are from the MIX-N2, AL-N1, and AP-N5 experiments. Under background conditions (i.e., blank measurements), the SO_2 concentration in the chamber environment was ≤ 0.5 ppb, NOx ≤ 2 ppb, O_3 ≤ 0.5 ppb, and released or generated VOCs and particulate matter were negligible (<0.01 μg m^{-3}). Therefore, even without additional background subtraction for each experiment, the results remain reliable. We have added clarifications regarding these questions to the revised manuscript. Detailed revisions can be found on page 5, line 148−149, and page 4, line 97−98 of the revised manuscript.

2. What were the starting concentrations of all trace gases in a clean chamber? How were the trace gases measured? When were filter collected from the chamber? This is not clear in the text, the whole first 3.5 hours?

   Thanks for the question. In a clean chamber, the SO_2 concentration was ≤0.5 ppb, NOx ≤2 ppb, and O_3 ≤0.5 ppb, as measured by online SO_2 (EC 9850, Ecotech, Australia), NOx (EC 9841, Ecotech, Australia) and O_3 analyzers (EC 9830, Ecotech, Australia), respectively. Sampling commenced immediately when the enclosure was opened. The first filter collected samples continuously for 3.5 hours, and was then replaced with a fresh one for an additional 3.5 hours of continuous collection. We have added clarifications regarding these questions to the revised manuscript. Detailed revisions can be found on page 4, line 97−98 and 112−114, and page 3, line 93−96 of the revised manuscript.

3. Figure 8 is scaled by Nitrogen number which may create a massive bias in that plot toward nitrogen containing species. Why is this done?

   Thanks for the question. The nitrogen-number scaling was intentionally applied to visually distinguish how molecular species distributions vary across different nitrogen -number ranges, thereby potentially offering preliminary clues for subsequent analysis of NH_3-involved reaction pathways in mixed organic oxidation systems. From a methodological perspective, this scaling approach was justified by its intended purpose. We have added clarifications regarding this issue to the revised manuscript. Detailed revisions can be found on page 14, line 304−307 of the revised manuscript.

4. How do the authors make an estimation of the mass concentration of the different functional groups in Figure 4?

Thanks for the question. In FTIR spectroscopy, the relative magnitudes of absorbance peak areas were used to estimate the relative mass concentrations of different functional groups. In UV spectroscopy, the absolute values of mass absorption efficiency (MAE) were employed for similar estimations. It is important to note that we only assessed the relative mass concentrations across different experiments, rather than estimating absolute mass concentration values. We have added clarifications regarding this issue to the revised manuscript. Detailed revisions can be found on page 9, line 226−228 of the revised manuscript.

5. The figure caption should explain the content of the figure, and the meanings of different symbols or patterns should be clarified. For example, what do the solid and hollow patterns represent in Figure 1(b) and 1(c)?

Thanks for the recommendation. In Fig(b) and (c), the solid and hollow symbols denoted NH_3-free and NH_3-containing experimental systems, respectively. We have clarified the meanings of different symbols or patterns. Detailed revisions can be found on page 6, line 167–168 of the revised manuscript.