

Atmos. Chem. Phys. Discuss., referee comment RC2
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Comment on acp-2022-573

Anonymous Referee #2

Referee comment on "Multiple pathways for the formation of secondary organic aerosol in the North China Plain in summer" by Yifang Gu et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-573-RC2>, 2023

This manuscript investigates the formation of secondary organic aerosol in the summertime North China Plain (NCP). The authors observed that both photo-oxidation and aqueous-phase chemistry contribute to the formation of SOA in NCP. Results highlight that the SOA formation is related to residential coal combustion, and the SOA formed could be further oxidized rapidly under high-RH conditions. Overall, the manuscript is well-written. The results are interesting. I recommend the manuscript be considered for publication only after my following comments are fully addressed.

1. What were the concentrations of inorganic cations such as Fe, Mg, and Ca? How would it affect the calculation of ALWC?
2. What was the pH of the aerosol particles? Did it contribute to the photochemical and aqueous formation of SOA? Please discuss.
3. Lines 167-170: A sentence is needed here to briefly illustrate how these SOA factors were defined. For example, what was fresh SOA? Was it LOOOA?
4. It seems that fresh-SOA and aq-SOA were quite similar (Figures 2, 4, 5, S4). Why did the authors separate them into two factors? Please clarify.
5. Lines 212-224: The authors mentioned that the primary-related SOA might be transformed from locally emitted POA, as suggested by the PAH ions in the primary-related SOA. What was the correlation of PAH ions in the primary-related SOA and POA? It seems that the patterns are quite different.

In addition, in my view, the correlations between the "primary-related SOA" and CO, NO₂, and HOA were not high. The highest R-value was only 0.6, with $R^2 < 0.5$. Could it be just primarily emitted OA?

Also, why did the "primary-related SOA" mostly peak at night? Please explain.

6. Lines 274-277: If SP-LToF-AMS collected PM_{2.5}, how can aq-SOA in droplets be sampled and analyzed? Please provide the size distribution of the particle sampled. The authors can compare the size distribution of aq-SOA to sulfate or other inorganic ions to support their conclusions.

7. Figure S3: Please explain why aq-SOA concentration decreased with ozone concentration, and why phochem-SOA concentration decreased with ALWC?

8. Figure 5: How could aq-SOA be formed when ALWC was 0?

9. Figure 6: There was a substantial amount of phochem-SOA at night. Can the authors discuss if it was possible that "phochem-SOA" can also be formed at night? Could it be just SOA formed via ozone oxidation? Maybe using a different name for "phochem-SOA" would avoid confusion.

10. Most of the results provided in this study are based on correlation analysis. Although I believe that correlations provide valuable insights, the results from correlations solely may not be conclusive and convincing enough. Can the authors provide additional evidence (e.g., from the perspective of chemical composition and tracers) to support the conclusions of this study?