Atmospheric Chemistry and Physics Discussions

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Comment on acp-2022-658

Anonymous Referee #1

Referee comment on "Chemical evolution of primary and secondary biomass burning aerosols during daytime and nighttime" by Amir Yazdani et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-658-RC1, 2022

This paper examines the chemical evolution of primary and secondary biomass burning aerosols using typical daytime and nighttime oxidants in the laboratory. The combination of online AMS and offline FTIR provides a unique analysis of the chemical characteristics of the aging of bbPOA and its conversion to bbSOA. The high-quality paper addresses an important area of atmospheric chemistry and is well-suited for publication in ACP. Below are minor comments on clarification issues for the authors' consideration.

- Page 3 Line 74, The authors should give more details of the UV light source in the text here. Also, see the last comment since there might be potential photo-induced reactions worth discussing in conclusions/implications.
- Page 5 Line 133, Sres(0), is it a typo? 0 should be t?
- Page 7 Line 171, What are "the first three principle components"? A clearer discussion of the figure using consistent terms in text and legend/caption would help. Please also note a few typos of "principle" components.

- Page 7 Line 179, it is interesting to see the differences between dark and dark/humid conditions. Please explain these differences. Also, what are the directions of these changes in the dark in the f44/f43 plot? I notice the trends for WB and PB under dark and dark/humid are not the same. Please explain the differences.

- Figure 2, please provide clearer legends. WB dark and PB dark mean dark and dry condition? What is WB total OA? Why did it not show PB total OA? Need clear descriptions.

- Figure 3, please give better figure captions to avoid ambiguity.

- Why does Fig. 5 use experiments 1, 4, 6, and 8, while Fig. 7 uses experiments 1, 4, 7, and 8? Typo?

- Page 10 line 273 – 275, please consider rewriting so that the changes in the gas phase and particle phase can be distinguished.

- Table 2, why is the kOA under UV larger than under dark conditions?

- The reference experiments are helpful, but why was there no 50% RH data? Also, why were different RH used in the wood and pellet experiments for the dark and humid conditions?

- Page 12, Line 345, heterogeneous reactions and photolysis of bbPOA are indeed complex. Recent work on bb particles and model bb chemical compounds has suggested photosensitization can be an important process in SOA and sulfate formation (Matabo et al., 2022, Liang et al., 2022). Furthermore, I would be interested in knowing if the particles contain nitrate. Furthermore, nitrate photolysis can be an effective pathway to form sulfate (from SO2) and possibly SOA due to the formation of in particle OH, NO2 and nitrite (Zhang et al., 2022). Some discussions on these possibilities and their potential influence on the experimental results would be helpful.

References:

Liang et al., Sulfate Formation in Incense Burning Particles: A Single-Particle Mass Spectrometric Study. *Environmental Science Technology Letters.* 2022, 9, 9, 718–725.

Mabato et al., Aqueous secondary organic aerosol formation from the direct photosensitized oxidation of vanillin in the absence and presence of ammonium nitrate. *Atmospheric Chemistry and Physics* 2022, 22, (1), 273-293.

Wang et al., Atmospheric Photosensitization: A New Pathway for Sulfate Formation

Environ. Sci. Technol. 2020, 54, 6, 3114–3120

Zhang et al., Photochemical Reactions of Glyoxal during Particulate Ammonium Nitrate Photolysis: Brown Carbon Formation, Enhanced Glyoxal Decay, and Organic Phase Formation. *Environ. Sci. Technol*. 2022, 56, (3), 1605-1614.