

## Comment on acp-2021-414

Anonymous Referee #1

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Referee comment on "Observations of supermicron-sized aerosols originating from biomass burning in southern Central Africa" by Rose M. Miller et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-414-RC1>, 2021

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### General comments:

This manuscript by Miller et al. observed supermicron aerosol particles over the Atlantic Ocean, ~1000 km from the coastal line. They conclude that these particles are unburned plant material originated from biomass burning. Their finding is interesting and could be important to understanding biomass burning and its regional influence. On the other hand, I found that this manuscript needs to be largely revised and improved to support the conclusion. I also found many technical issues to be revised.

### Major comments:

1: The authors conclude that the supermicron aerosol particles (SAPs) are unburned plant materials (e.g., page 1 line 36). However, I could not find strong evidence to support that the SAPs are unburned plant materials. BC and other particles may not be excluded. In page 2 line 61-66, the authors showed the possibility of large BC. Burned plant materials (ash) may also be possible. I could not find the reference that supports "previously seen in biomass burning smoke close to the source (page 1 line 37)". Here and relevant discussions (see below) are confusing and contradictive.

Page 2 line 70-74: Evidence from transmission electron microscopy (TEM) analysis of aerosol particles, BB aerosol composition analysis, particle shape and size, and prevailing atmospheric conditions together demonstrates that SAPs observed during this campaign were not soot, but rather supermicronized unburnt plant material.

Page 9 line 246-248: The particles found on RF 12 most likely were either unburned plant material or supermicron black carbon aggregates that were formed near the fire and transported in the BB plume over the Atlantic Ocean.

Page 9 line 254-256: The filters contained numerous black carbon and organic particles that were captured during the time that the 2D-S observed SAPs. It is therefore likely that the SAPs are unburnt plant material.

Page 19 line 402-405: However, given the source location, presence of rBC, and the TEM-identified carbonaceous particles, it is hypothesized that based in observed particle shapes, the SAPs imaged by the 2D-S are examples of unburned plant material previously seen in biomass burning smoke.

Minor and technical comments:

2. Page 1 line 22-23 (maximum dimension): What does the maximum dimension mean here? Is this Feret diameter?
3. Page 1 line 23 (supermicron-sized aerosol particles (SAPs)): "SAPs" is also defined as "supermicron aerosol particles (Page 2 line 67)".
4. Page 1 line 27: black carbon (rBC): rBC is defined as refractory black carbon (page 3 line 139), and black carbon is defined as BC. Please make them consistent.
5. Page 1 line 29: "black carbon": Here and elsewhere, black carbon is used as either "black carbon" or BC. Please make it consistent.
6. Page 1 line 28-31: "Transmission electron microscopy images of submicron particulates, collected on Holey carbon grid filters, revealed particles with potassium salts, black carbon and organics while energy-dispersive X-ray spectroscopy spectra detected potassium, a tracer for biomass burning, indicating that the submicron particles originated from biomass burning in addition to black carbon." This sentence is hard to interpret.
7. Page 2 line 58: "KCL" should be KCl.
8. Page 2 line 62: Please define "D<sub>p</sub>". "D" is defined as "maximum dimension" in abstract. Is this the same?
9. Page 3 line 97: "No SAPS were detected during the 2016 IOP." This sentence may be placed in the result section. "SAPS" should be SAPs.

10. Page 4 line 148: "The inlet size for the AFS allowed aerosols of 2.0 - 3.1  $\mu\text{m}$  diameters" This sentence reads the measured sizes are between 2.0 and 3.1  $\mu\text{m}$ . However, in the next paragraph (2.7), these sizes are 50% transmission efficiency of the inlet. It looks like something is missing.

11. Page 5 line 200: "mb" may need to be replaced with hPa.

12. Page 5: Figure 1: Flight tracks are difficult to read because of their color.

13. Page 6 Figure 2: I am not familiar with the instrument, but is there any artifact caused by aircraft speed for the long, straight particles on the 2D-S prove images?

14. Page 9 line 253-255. "The soot particles showed silicon inclusions and the organic particles contained potassium, both molecular markers for biomass burning emissions (Andreae et al. 1998)." I could not find that silicon inclusions are a marker for biomass burning emission in Andreae et al. (1998) or any other references. I think silicon can originate from various sources, including biomass burning, dust, and plant, and is difficult to be used for the biomass burning tracer.

15. Page 10 line 259. Here the sentence mentions that "gold grid" was used for the sampling. On the other hand, in Figure 7, I found Cu signal possibly from the grids but no Au signal. Please check it.

16. Page 11 Figure 7. It is difficult to read the elements, some of which may be under the detection limits (e.g., Na, S, and Cl). It looks N has a large difference between round organic and soot.

17. Page 12 line 282. Add a period.

18. Page 13 line 308-310: "Higher intensity fires with active flaming with high combustion temperatures most likely produce more SAPs than smaller smoldering fires as higher intensity fires inject more aerosols and unburned plant material into the atmosphere." It is possible that active flaming emits not only unburned plant materials but also various SAPs (e.g., BC).

19. Page 14 Figure 10. What do the colors indicate?

20. Page 15 Table 1. The decimal places are inconsistent. An example is soot mass concentration (1.75, 1.1, and 5).

21. Page 18 Figure 12: The bin sizes are different in the two panels. Please consider using the same bin size for both panels so that both panels are directly comparable.

22. Page 18 line 364-366: "The bounds for the fall speed times were the longest and shortest times from the HYSPLIT back trajectories, which ranged from 48 hrs and 144 hrs. The range of fall velocities were then calculated to be at most, between 24.7 cm s<sup>-1</sup> and 0.4 cm s<sup>-1</sup>." This estimation could be interesting. I suggest considering if the estimated fall velocities are reasonable for the measured SAPs by assuming their sizes and densities.

23. Page 18 line 369-371. "There were too few days without SAPs during the 2018 campaign to determine whether chemical composition, plume age, or temperature was related to the presence of SAPs in the BB plume." This sentence seems strange. Does it mean "too few days with SAPs"? If not, it may be discussed using airmasses with SAPs.

24. Page 18 line 391-and Page 19 404-405 "Similar particles emitted from biomass burning have been observed previously in localized field studies as well as laboratory experiments" and "the SAPs imaged by the 2D-S are examples of unburned plant material previously seen in biomass burning smoke" Where do these sentences indicate in the main text (result or discussion)? I could not find the previous study in the reference.

25. Page 20 References: The reference order is not consistent. An example is those on page 20 line 466-474.

Suggestion: Many references were published more than 20 years ago, and some can be replaced with recent ones. An example is in page 1 Line 41: "Particulates generated by BB scatter and absorb solar radiation, affect the properties and lifetime of clouds (Andreae 1991, Penner et al. 1992, Ackerman et al. 2000, Bond et al. 2013), and influence regional and global climate (Crutzen & Andreae 1990, Andreae 1991; Bond et al., 2013)."