This paper presents a new approach by using fullerenes and metals in PMF analyses of HR-SAP-AMS data, and shows that BC from more than one biomass burning sources can be separated. The work can be a good contribution to the aerosol chemistry, however, there are quite a number of important issues to be addressed first before considering its possible publication in ACP. Please see below:

(1) This work uses fullerenes and metals to help the BC source apportionment via SP-AMS, however, it is surprised that the authors seem to completely overlook a few important papers very closely related with your current analyses. Necessary citations and incorporation of findings from these studies has to be added in your work. And I also suggest the authors to do a more thorough search on the recent SP-AMS studies. These papers at least include: Distribution of carbon cluster ions in different BC types (Aerosol Sci Tech 2015;49:409-422); detection, quantification and source apportionment of fullerenes by using SP-AMS (Environ Sci Technol Lett 2016,3,121-126); Characterization of OA via BC fragments and metals detected by SP-AMS (Atmos. Chem. Phys., 20, 5977–5993, 2020); Source identification of BC by using SP-AMS (Atmos Environ 2018,185,147-152); Another study combining SP-AMS and SP2 data to apportion BC into different sources (Atmos Chem Phys 2019,19,6749-6769)

(2) Line 115: What is the role of a catalytic stripper? And why data under this mode is not used then？

(3) Line 120：Why no ionization efficency was not obtained? Due to what difficulty? If other studies can determine the IE, then why this work cannot? It is not explained clearly to the readers. If the IE or RIE of different species, especially fullerenes, are not determined, this is a fatal issue. This reviewer doubts the credibility of PMF results and subsequent analyses.

(4) Section 2.2: Some necessary technical details are still missing here: what is the chemical resolution, and how does this allow you to detect the ions with low signals? For example, different metals? What is the time resolution? And what are the detection limits of different species by using SP-AMS? At last, did the SP-AMS here only detect BC-containing particles? Then it is not clearly specified that the SP-AMS is operated with only laser vaporizer? Or with laser and tungsten vaporizer? Is the thermal vaporizer physically removed? The different modes significantly influenced the aerosol components detected (Check and cite if necessary: Atmos. Meas. Tech. 2014, 7, 4507−4516; Atmos Chem Phys 2019,19,447-458)

(5) Section 2.3: m/z up to 3200 was determined, however, the m/z range of your PMF results is only up to 1000. Can you explain?

(6) Figure 4. More details are needed. How did you determine BrC for example?

(7) Figure 5. How to determine PON etc? A citation of previous work is not enough.

(8) Figure 6. You have a high resolution SP-AMS, why not use different colors to differentiate different ion categories? (Figure 7 is redundant). This helps justification of your PMF results and better for readers to judge and understand your results. Also, the justification of your PMF results is not clear. I am not sure for example, why factor 5 is fullerenes, and why factor 1 is BC and HULIS, and so on？

The O/C and H/C are too high and they seem to be wrong. This has to be addressed well, otherwise, analyses based on the PMF are not trustworthy.

(9) How about the diurnal patterns of your factors?

(10) Figure 9 is not clear, please replace with a high resolution one