Reviewer #4

The article by Jun Zhang et al. describes the emissions of biomass burning using different devices both on molecular level and on bulk. The emission factors and composition of emissions are shown to depend on the burned fuel and some marker compounds are identified. Article is well written and easy to read and follow. The information provided in the article is important for scientific community and the in my opinion the article should be accepted after revision. I have few comments mainly intending to clarify some aspects of the manuscript:

We would like to thank the reviewer for the comments and suggestions to improve the current work. We will have the reviewer comments in black, address the comments in blue, and modified sentences in blue and italics.

1. The results section is referring to PM. Please give the corresponding size class, PM1? PM0.5? is it always always same, from the SMPS, not AMS? I think it is fine if you add a sentence about this to experimental and then continue using PM abbreviation.

   Response: The SMPS applied in this work scans particle diameter from 16 to 638 nm, and the AMS uses PM1 aerodynamic lens as introduced in the method section. Particle size distribution measured by the SMPS does not appear to extend past 638 nm. Therefore, the PM referred to in the result section is in the range of PM1.

   It has been clarified in the method section below on line 129.

   "*Therefore, the class of the PM in this study belongs to PM1*"

2. Please describe the holding tank and its role in more detail. Why it was used and what was the impact on PM?

   Response: The holding tank and its role are added as follows (Line 111 to line 113).

   "*The holding tank is a stainless steel container (1 $m^3$) used to store emissions. It is also designed for averaging the emissions at different combustion efficiency in order to fully characterize the emission in the real ambient."*

3. Fig S1. maybe replace Dekati with Dekati Ejector

   Response: The "Dekati" has been replaced with "*Dekati Ejector*" in Figure S1.

4. Line 204: "The mass spectrum of plastic bags burning is not shown because considerable CxHyOz family was observed (23%), but it is more likely from the emission remaining in the tubing of other fuels than from the plastic bags given the fact that polyethylene is the main component of it." was this only affecting AMS results or are all plastic bag burning results suffering from this? did you measure blank values to ensure this same phenomenon was not affecting other results also?

   Response: The AMS results including mass spectrum, organic mass concentration, and elemental ratio, as well as the corresponding emission factors, have been corrected. The contamination of analysis of plastic bags has been added in the supplement as below. The overestimation of POA from plastic bags burning is 14.6% on average, which is mainly from semi-volatile oxygen-containing species. These species are important components emitted by other biomass materials used in this study. Therefore, the overestimation is minor for other burning fuels. The following discussion has been added from line 11 to line 23 in the SI.

   "***Plastic bags burning emission correction.*** *In three out of four plastic bags burning experiments, the mass spectrum at the middle to end burning stages had considerable $C_xH_yO_z$ family contribution (~23%). It is unlikely from the plastic bags, given the fact that polyethylene is the main component of plastic bags, but from the emission of other fuels remaining in the chimney. As the combustion progressed, the chimney was heated, and the volatile substances remaining on the chimney evaporated and were then partitioned to the particles for detection. However, at the early stage, before the chimney got hot, the mass spectra consisted mainly of hydrocarbons (see Figure S2a). Therefore, we take only the early burning stage of these three burning experiments into account for the average mass spectrum in Figure 1(f). The absolute concentration of the three AMS mass spectra derived from the early-stage burning is scaled to the uncontaminated burning experiment ions based on m/z 81 and m/z 83, which are stable and characteristic for hydrocarbons. The difference on average is 0.4% ± 1.0% which is very minor as shown in Figure S2b. The mass spectra of three contaminated burning over the whole burning stages indicate that the measured organics was 14.6% ± 8.7% overestimated. Correspondingly, the emission factors for PM and OM are corrected for each plastic bags burning.*

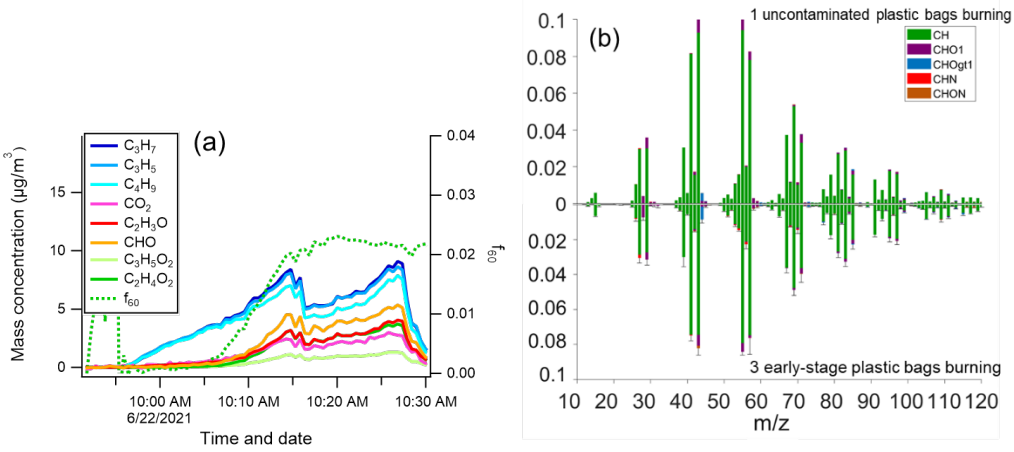


*Figure S2 (a) The time series of some ions measured by the AMS during the plastic bags burning for the contaminated case; (b) the mass spectrum comparison of uncontaminated plastic bags burning experiment at the top v.s. the average of 3 early-stage burning at the bottom."*

5. Line 199: how the PM/OM/BC Emission factors compare with literature values? are the literature available for e.g. plastic bags?

Response: The emission factors for PM, OM, and BC are compared to the literature as follows on line 210 to 214.

"*In general, the EF of PM, OM, and BC agrees well with some previous literature (Fang et al., 2017; Goetz et al., 2018; Tissari et al., 2008). Nevertheless, the reported EF values are highly dependent on the burning method (e.g. stove type) and combustion efficiency (Bertrand et al., 2017). Additionally, the reported EFs for plastics vary substantially with their composition, and the EF of the pure PE plastic bags are not often reported (Jayarathne et al., 2018; Wu et al., 2021; Hoffer et al., 2020).*"

6. Are the terms f44/f60/fxx etc explained somewhere? I may have missed this

Response: Yes, they are explained in Line 212-Line 213 in the original manuscript, but this was extended to include the meaning further (Line 224-Line 226):

"*Among these ions, the mass fractions of m/z 44 ($f_{44}$, mostly $CO_2^+$), mass fraction of m/z 43 ($f_{43}$, mostly $C_2H_3O^+$ and $C_3H_7^+$), and mass fraction of m/z 60 ($f_{60}$, mostly $C_2H_4O_2^+$) have the largest impact on the oxidation state of the aerosol.*"

7. Authors are using terms OA, OM, OC, and POA for the organic fraction. Maybe you could clarify what is the difference between them.

Response: OA includes POA, and equivalent to OM. OC only refers to the carbon in organics. The ratio of OM and OC are used in the emission factor calculation. In the result section, we use POA throughout denoting the organic fraction in the measurement. These concepts have been clarified in the manuscript as follows

"*Emissions from combustion are a major source of primary organic aerosol (POA),…*" (Line 36)

"*Organic aerosol (OA, including POA and SOA) source apportionment has been widely studied using receptor models,…*" (Line 55)

"*where $\Delta CO$, $\Delta CO_2$, $\Delta THC$, $\Delta OC$, and $\Delta BC$ are the background-corrected carbon mass concentrations of CO, $CO_2$, THC, OC (organic carbon), and BC.*" (Line 157-158)

"*OC was calculated from the ratio of organic aerosol and the ratio of organic mass (OM) to OC (OM/OC) measured by AMS*" (Line 158-159)