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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Open burning of rice, corn and wheat straws: primary emissions, photochemical aging, and secondary organic aerosol formation" *by* Zheng Fang et al.

Anonymous Referee #1

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This manuscript investigated the emissions of various primary pollutants and photochemical evolution from burning three types of agricultural residues (corn, rice and wheat straws) by using a 30m3-smog chamber. The experimental design is reasonable, the results are reliable, and the conclusions are convincing. Considering the rare information on primary emissions and photochemical evolution of agricultural residues burning, the original data presented in this manuscript are very important for comprehensibly understanding the impact of the burning on the air quality, especially in China. The manuscript is well organized, and hence this reviewer recommends the manuscript be published in the journal. Specifics: Both biomass burning and domestic coal combustion have been recognized to make evident contribution to deteriorating

regional air quality especially in North China. If the authors had compared with the emission strengths between the biomass combustion and domestic coal combustion, the result would be more attractive. The authors only compared with the SO2 emission factors between the biomass burning and coal cake combustion, however the emission factor of coal cake might be outdated, because raw bituminous is currently prevailing for cooking and heating in rural areas. The emission factors of various pollutants from combustion of raw bituminous in domestic stove have been reported (e.g. SO2 emission factors of 4.16 $\pm$ 1.36 g SO2 kg-1, Du, Q. et al. (2016), An important missing source of atmospheric carbonyl sulfide: Domestic coal combustion, Geophys. Res. Lett., 43(16), 8720–8727, doi:10.1002/2016GL070075; NMHCs (57 species) average emission factor of 2981.1 mg kg-1, Liu et al.(2017), Emission of volatile organic compounds from domestic coal stove with the actual alternation of flaming and smoldering combustion processes, Environmental Pollution 221, 385-391). Although the emission factors of SO2 from the burning of corn and wheat straw is about 3-6 times less than that of coal combustion and of NMHCs is comparable to each other, the emissions of these pollutants from the biomass burning might largely exceed those from domestic coal combustion because the amount of the biomass burning might be one magnitude greater than that of domestic coal consumption in China. Therefore, greater attention should be paid on the emission of biomass burning for improving the air quality in China. The concentration of OH radical indirectly obtained by tracing the first order decay rate of toluene should represent its average concentration during the whole irradiation, why did you use the OH exposure of (1.87-4.97)$\times$1010 molecule cm-3s? Are your sure the lifetime of OH radical in the chamber is only 1s? I suggested to use the unit of average concentration (1.87-4.97)$\times$1010 molecule cm-3. Although the contribution of the 20 NMOGs to the SOA only accounted for 5-27.3% of the observed SOA mass, the increase of the SOA mass might not solely be ascribed to the aqueous-phase oxidation of alkenes, because the oxidation of the POM with more oxygen can also make evident contribution.

Page 16, line 366-368, The two OA enhancement ratios reported were evidently less

than those determined in this study, why did you concluded that the OA enhancement ratios determined were higher than those (0.7-2.9) for the combustion of vegetation, and comparable to those (0.7-6.9) for wood burning?

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