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## ***Interactive comment on “Properties and evolution of biomass burning organic aerosol from Canadian boreal forest fires” by M. D. Jolleys et al.***

**Anonymous Referee #2**

Received and published: 2 November 2014

This manuscript focuses on characterizing variations in AMS organic aerosol signatures from boreal forest fires sampled by aircraft near and away from the source. The study reports on respective increase and decrease in mass fragments 44 and 60, respectively, with plume evolution as determined by burning tracers; these conclusions are generally consistent with past observations but additionally shows the range of variability. The increase in mass fragment 43 within the fresh plume is in contradiction to what might be assumed with photochemical aging under the assumption of mass fragment 43 being a tracer for hydrocarbon like organic aerosol; the authors are clear in suggesting an alternative interpretation. While the interplay of source strength and atmospheric aging in this data set is difficult to interpret due to experimental design, this is rather a limitation of collecting measurements by aircraft (to which better alter-

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natives are not readily available). The spectral signature of OA from fire emissions and its transformation with ensuing chemical and physical processes is an important topic for the atmospheric chemistry community, and this study carefully contrasts a set of new field measurements with both laboratory measurements and previous field measurements. Therefore, the manuscript is recommended for publication in Atmospheric Chemistry and Physics with minor revisions as suggested below.

At its core, the manuscript tries to tease out the contributions of fire type (smoldering vs. flaming), source conditions (e.g., fire size), and extent of atmospheric processing on the interpretation of mass spectral signatures of OA. A cohesive paragraph in the methods section summarizing which flights and flight segments are used to make conclusions between fresh and aged plumes; near and far-field characteristics would be very helpful. This information is currently buried in the text, among further discussions of measurement analyses by which other flights that were excluded from the analysis. The level of detail and disclosure by the authors is commendable, but makes for difficult extraction. Also, the terminology is confusing as fresh “plumes” is always referred to in the plural form while only measured in a single flight (B626). The number of plumes/flights used to make conclusions should also be reflected in the abstract and conclusions so that they do not seem more general than they are. The authors mention two flights (B622 and B624) as having captured a decrease in  $\Delta\text{OA}/\Delta\text{CO}$  over various segments of its flights (Section 3.1); can other conclusions in the manuscript regarding the contribution of atmospheric processing be strengthened by further examination of these two scenarios?

While “aging” and atmospheric “processing” is used very often in the community, the authors may find it useful to describe the processes embodied in this term (e.g., heterogeneous reaction, condensation/evaporation) such that the discussion regarding observed variations in f44, f43, and f60 can be tied to specific mechanisms.

Should not the  $\Delta\text{CO}$  and  $\Delta\text{OA}$  be defined with respect to altitude? As the authors point out, their background concentrations have different altitude-dependent profiles.

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Minor comments:

Section 3.1: The discussion of ER and NEMR and its use should appear sooner, e.g. in the Methods section, as ratioed values are used extensively throughout the manuscript. There should also be a caveat that the proposed interpretation applies along a Lagrangian trajectory, which corresponds only to a few contexts in this study (when a liberal interpretation of a Lagrangian trajectory is used).

Figure 4 caption (f):  $\Delta\text{OA}/\Delta\text{CO}$ .

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Interactive comment on Atmos. Chem. Phys. Discuss., 14, 25095, 2014.

ACPD

14, C8744–C8746, 2014

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