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Interactive comment on "Single particle characterization of biomass burning organic aerosol (BBOA): evidence for non-uniform mixing of high molecular weight organics and potassium" *by* A. K. Y. Lee et al.

Anonymous Referee #2

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The paper describes measurements of single particle composition from a wildfire plume in Canada. The authors perform cluster analysis to demonstrate that there were 5 different types of particles in the biomass plume, indicating that the emissions are not internally mixed. They demonstrate that BrC appears to be associated with lower/non volatility organics.

Aerosol optical properties and aerosol mixing state are critical issues to resolve regarding the effects of biomass burning on climate. This paper provides new insight into these attributes of wildfire emissions that are consistent with recent laboratory studies and field work. This is an interesting and well written paper. I recommend that it be published after the authors address the following comments.

Specific

Are there issues with sensitivity / uncertainty of single particle analysis? I am not that familiar with the capabilities of the SP-AMS in this regard. The paper mentions issues with the ATOFMS (e.g. high sensitivity to K) but did not really discuss this with the new results. I don't see this changing the conclusions that there are multiple particle classes in the emissions, but it may alter the relative importance of the different classes. More discussion of the uncertainty of the LS-SP-AMS are needed.

A shortcoming of the experiment design is the very short residence time (1.9 s) in the thermodenuder. The aerosol will certainly not reach equilibrium in this system. Therefore classifying the residual material as low- or non-volatile may be misleading. It may simply be semivolatile material that has not had sufficient time to evaporate. A simple time scale analysis can be done to estimate whether the system has reached equilibrium (e.g. May et al. JGR 2013 doi:10.1002/jgrd.50828). If it has not this should be noted and the caveat added about the residual mass may not actually be low volatility.

Figure 4 – Not sure how much this figure adds. Four of the diagrams are pretty similar (Org dominated) with one showing contribution of K. The contribution of K in one particle type is illustrated in Figure 3. The limited contribution of rBC was made in text.

Figure 6 – The figure shows regression lines and states r2 values. I was interested in the value of the slopes and their physical interpretation – these slopes should mean something. Basically this way of presenting the data did not really make sense to me. A bit more text describing how to interpret would be helpful. Also, the caption says estimated mass rBC and non- and low-volatility mass – wasn't this measured downstream of the thermodenuder?

"It is clear that rBC mass alone cannot explain the observed aerosol volatility (R2 =

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0.31, black solid circles in Fig. 6a).” This sentence does not make sense. Are you trying to say that rBC mass by itself cannot explain the mass downstream of thermodenuder? Which then implies that there is other low volatility material beyond rBC? What about non-spherical particle issues and SMPS measurements?

“the strong absorption characteristics observed during the BB period cannot be explained by the presence of rBC alone, because the rBC loading was roughly constant throughout the sampling period ($R2 = 0.33$, black solid circles in Fig. 6b).” This is based just on r2. Or is it based on optical closure using the measured rBC mass and mass absorption cross section? Need to clarify.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 32157, 2015.

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Interactive Comment