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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Flight-based chemical characterization of biomass burning aerosols within two prescribed burn smoke plumes" *by* K. A. Pratt et al.

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We thank the referee for helpful comments and suggestions.

Reviewer: This paper presents a thorough physico-chemical analysis of a smoke plume from prescribed burns over Wyoming, USA. Measurements were taken from the interception of the NSF/NCAR C-130 aircraft with two different fire plumes during the ICE-L study. A suite of instrumentation was onboard the aircraft for aerosol single particle and bulk analysis, EC/OC analysis, as well as CCN and IN measurements. This is a well written and clearly structured paper which presents new and interesting results. The topic of the paper is well in the scope of ACP, and I recommend the paper for

publication in ACP with only a few minor corrections suggested below.

Reviewer: Comments: Tab. 2: I guess the standard deviations are the numbers in parenthesis. If so please more clearly mention that somewhere. Also indicate from which instrument the size thresholds were taken for the analysis. If it was the UHSAS, an instrument later in the text body, please also give an idea to the reader which equivalent particle diameters are given here and how this compares to the vacuum aerodynamic diameters used by the aerosol mass spectrometers. Also please explain where the background concentrations given in Table 2 have been measured, upsream or downstream of the plume area.

Authors: It is now noted in the Table 2 caption that standard deviations are shown in parentheses.

Reviewer: It is stated in methods section 2.1 that "An Ultra High Sensitivity Aerosol Spectrometer (UHSAS, Particle Metrics Inc., Boulder, CO) provided size-resolved aerosol number concentrations (0.1-1.0 μm in diameter)." As discussed below, the UHSAS was calibrated using polystyrene latex spheres, and spherical particles were assumed to be present. For spherical particles with no voids, particle geometric diameter and vacuum aerodynamic diameter are related by particle density (DeCarlo et al., 2004). Considering an average smoke particle density of $\sim$1.2 g/cm3 (Reid et al., 2005), as noted in section 2.3, the equivalent vacuum aerodynamic diameter would be 1.2x greater than the geometric diameter. However, chemically-resolved size distributions are not discussed in this manuscript.

Authors: The following sentence has been added to section 2.1: "Background concentrations were measured immediately before and after sampling of the plume (generally $\sim$30 s to 2.5 min)."

Reviewer: p.7, l.165: I wonder how the volume distribution was calculated from the UHSAS data which is an optical single particle counter. If this was done for the smoke plume particles, it should be explained, how the actual geometric diameter was calcu-

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lated from the optical diameter for the probably rather irregular smoke particles, and how accurate or uncertain this conversion is. Or do you refer here to lab studies with standard aerosols of known shape and refractive index?

Authors: The following sentence has been added to section 2.1: "Calibration of the UHSAS was performed using standard polystyrene latex spheres; spherical particles were assumed to obtain a size-resolved volume distribution, consistent with previous wildfire studies (e.g., Yokelson et al., 2009)." Given the high mass fractions of organics (see Figure 3), this is likely a reasonable assumption based on previous microscopy studies (e.g. Pósfai et al., 2003).

Reviewer: p.9, l.196: Should be subsection 2.5, because preceeding section already is numbered as 2.4

Authors: These subsections were corrected in the ACPD version.

Reviewer: p.9, l.205: (. . . in aerodynamic diameter)

Authors: This has been clarified as requested.

Reviewer: p.24, l.550: For the discussion of the ice nuclei (IN) results in comparison to the parameterization by DeMott et al. 2010, it seems obvious that the plume situation may not perfectly match the average situation in the troposphere, in particuler if one considers the general variability of IN number concentrations. A direct comparison of the IN concentration measured in the plume to the background concentration in the air upstream of the fire may help to quantify the efficiency of fire plume particles as ice nuclei. Was the IN concentration also measured in the background air around the fire plume? Was the IN concentration really enhanced in the plume or was it even diminished. The latter could happen if the plume somehow chemically processes and deactivates ambient IN and the fire does not emit IN.

Authors: This is a good point. The following sentence has been added to section 3.4.2: "Overall, IN concentrations within the smoke plumes were enhanced compared

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to background concentrations of ∼6-8 L-1 for RF01 and ∼4-6 L-1 for RF03."

Reviewer: For further studies close to sources like fires it may be worth putting some more emphasis in the analysis of the background conditions, in particular upstream of the fire place. The aircraft studies may also be complemented by ground-based measurements upstream of the fire place.

Authors: We agree that these are excellent suggestions for future studies focused on wildfire measurements.

References: DeCarlo, P. F., Slowik, J. G., Worsnop, D. R., Davidovits, P., and Jimenez, J. L.: Particle morphology and density characterization by combined mobility and aerodynamic diameter measurements. Part 1: Theory, Aerosol Sci. Technol., 38, 1185-1205, 2004.

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Reid, J. S., Koppmann, R., Eck, T. F., and Eleuterio, D. P.: A review of biomass burning emissions part II: Intensive physical properties of biomass burning particles, Atmos. Chem. Phys., 5, 799-825, 2005.

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Interactive comment on Atmos. Chem. Phys. Discuss., 11, 17507, 2011.