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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Size-dependent wet removal of black carbon in Canadian biomass burning plumes" *by* J. W. Taylor et al.

Anonymous Referee #1

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This paper discusses an analysis of field campaign data to examine the wet removal rate of black carbon from biomass burning plumes. Overall, the study includes an interesting analysis. Below are some suggestions for improving the paper.

Abstract. "There are few qualitative studies of wet removal in ambient environments." Yes, but there are additional relevant studies (e.g., Kreidenweis et al., 1997; Jacobson, 2003). Please discuss.

Abstract. The conclusion, "...suggesting that nucleation scavenging was the likely dominant mechanism" should be clarified to state whether this is referring to mass or number. If mass, the result appears consistent with that of Jacobson (2003), who states in the abstract, "washout (aerosol- hydrometeor coagulation) may be a more important

in-plus below-cloud removal mechanism of aerosol number than rainout (the opposite is true for aerosol mass)."

Introduction. "Wet deposition is the dominant mechanism for BC's removal" and "Such (vertical) profiles are often poorly represented." However, when wet deposition is treated physically, vertical profiles can be relatively consistent with data, supporting the contention that wet removal is the dominant mechanism of BC removal (Jacobson, 2012, Figure 9 and Table 3).

Introduction. "Alternatively, many models use parameterizations designed to emulate..." Please clarify that some global models treat explicit size-resolved cloud liquid, ice, and mixed-phase microphysics (e.g., Jacobson, 2012, 2003).

Introduction. "Below-cloud scavenging is calculated by multiplying the precipitation rate by a scavenging coefficient." Again, please clarify that some global models treat explicit size-resolved collision-coalescence and activation, accounting for composition (Jacobson, 2012, 2003).

Introduction. "For typical BC size distributions, ..., impaction scavenging therefore favours smaller BC, whereas nucleation scavenging favours larger." This conclusion was drawn in Jacobson (2003). Please clarify.

P. 19481. Please state up front whether the BC/CO, etc. ratios in the plumes are measured or modeled and for what time period they apply to.

Figures 4-7. It is not clear at what time during the plume the measurements are valid for.

With respect to the shell to core ratio, at what relative humidity was the coating determined at? As the RH approaches 100%, the particle swells to a large ratio of shell to core, increasing the MAC. If only the shell to core ratio of a dried particle is examined, this will underestimate the MAC (Jacobson, 2012). The authors may need to re-do calculations if they used the shell to core ratio of a dried particle.

References

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Kreidenweis et al., The effects of clouds on aerosol and chemical species production and distribution, 2, Chemistry model description and sensitivity analysis, J. Geophys. Res., 102, 23,867-23,882, 1997.

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