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Aerosol microphysical processes and properties in Canadian boreal forest fire plumes measured during BORTAS

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Biomass burning emissions contribute significantly to aerosol concentrations and clound condensation nuclei in many regions of the atmosphere. Plume-aerosol characteristics vary according to age, fuel type, and region. These differences are poorly represented in regional and global aerosol models, and they contribute to large uncertainties in predicted size distributions in biomass-burning-dominated regions. The Quantifying the impact of BOReal forest fires on Tropospheric oxidants over the Atlantic using Aircraft and Satellites (BORTAS) measurement campaign was designed to invesigate boreal biomass burning emissions over Atlantic Canada during July-August of 2011. Aged (2-3 days) biomass burning aerosols originating from western Ontario were measured by an SMPS and AMS on board the British Atmospheric Research Aircraft. We identify the presence of plumes using CO concentrations and acetonitrile enhancement ratios. In-plume aerosol size distributions were collected for six aged plume profiles. The size distributions show an accumulation-mode median diameter of $\sim$240 nm. However, there are persistant nucleation and Aitken modes present in the profiles, even 2-3 days from the source. Without continuous nucleation and condensation (likely SOA production), these small modes would be lost by coagulation in less than 1 day. We use an aerosol microphysics plume model to estimate the mean nucleation and condensation rates necessary to maintain the small aerosols, and calculate how these processes enhance the total number of particles and cloud condensation nuclei in the aged plume.