



Ozone photochemistry in boreal biomass burning plumes observed during the BORTAS aircraft measurement campaign

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We present an analysis of ozone photochemistry observed in boreal biomass burning plumes over eastern Canada in the summer of 2011. Measurements of ozone and a number of key chemical species associated with ozone photochemistry, including non-methane hydrocarbons (NMHCs), nitrogen oxides (NO_x) and total nitrogen containing species (NO_y), were made from the UK FAAM BAe-146 research aircraft as part of the quantifying the impact of BOREal forest fires on Tropospheric oxidants over the Atlantic using Aircraft and Satellites (BORTAS) experiment between 12 July and 3 August 2011. We show that ozone mixing ratios measured in biomass burning plumes were indistinguishable from non-plume measurements, but comparison against measurements of carbon monoxide (CO), total alkyl nitrates (ΣAN) and a surrogate species for photo-oxidation of NO_x ($\text{NO}_z = \text{NO}_y - \text{NO}_x$) revealed that the potential for ozone production increased with plume age. We calculated photochemical ages, from NMHC ratios, for the plumes sampled during BORTAS to range from 0 to 15 days. Ozone production, calculated from $\Delta\text{O}_3/\Delta\text{CO}$ enhancement ratios, increased from 0.020 ± 0.008 ppbv ppbv⁻¹ in plumes with photochemical ages less than 2 days to 0.55 ± 0.29 ppbv ppbv⁻¹ in plumes with photochemical ages greater than 5 days. In comparing ozone mixing ratios with components of the NO_y budget we show that plumes with ages between 2 and 4 days were characterised by high aerosol loading, relative humidity greater than 40%, and low ozone production efficiencies of 8 ppbv ppbv⁻¹ relative to ΣAN and 2 ppbv ppbv⁻¹ relative to NO_z . In plumes with ages greater than 4 days, ozone production efficiency was increased to 473 ppbv ppbv⁻¹ relative to ΣAN and 155 ppbv ppbv⁻¹ relative to NO_z . We present the observed plume ozone photochemistry in relation to other geophysical parameters measured from the aircraft and previous measurement campaigns that sampled boreal biomass burning plumes over the same region.