Biomass Burning and Pollution Aerosol over North America: Organic Components and Their Influence on Spectral Optical Properties and Humidification Response

Antony Clarke [tclarke@soest.hawaii.edu], C. McNaughton, V. Kapustin1, Y. Shinozuka, S. Howell, J. Dibb, J. Zhou, B. Anderson, V. Brekhovskikh, H. Turner, and M. Pinkerton, University of Hawaii, Honolulu.

Thermal analysis of aerosol size distributions provided size resolved volatility up to temperatures of 400C during extensive NASA DC-8 flights over North America (NA) for the INTEX/ICARTT experiment in summer 2004. Biomass burning (BB) and pollution plumes (PP) had distinct size distributions and were evaluated for their aerosol physio-chemical and optical signatures. Soluble ionic mass and refractory black carbon (BC) mass, inferred from light-absorption, were combined with volatility to identify residual volatile organic carbon (VolatileOC) and refractory organic carbon, RefractoryOC. Different constituent mass fractions were present in BB and PP and with regional haze dominated by pollution near the surface and BB aloft.

VolatileOC included most water-soluble organic carbon. RefractoryOC dominated enhanced shortwave absorption in plumes from Alaskan and Canadian forest fires (BB). The mass absorption efficiency for RefractoryOC was found to be 0.51 m2g-1 at 470 nm and 0.16 m2g-1 at 530nm. Due to the large mass fraction of RefractoryOC in BB the OC absorption was about equal to BC absorption at 470 nm and about 15% of BC at 530nm. The BB, PP and dust aerosol could be stratified by their spectral scattering and absorption properties. The OC was only weakly hygroscopic resulting in a general decrease of overall humidity response, f(RH), with increasing OC mass fractions. Systematic relations between physio-chemical properties, optical properties and f(RH) constrains the ambient single scattering albedo (SSA) to a simple dependency on the absorption per unit dry mass [SSAambient = 1-K*absorption(Mm-1)/mass (µg m-3)]. INTEX data yielded K=0.09 for PP and K= 0.06 for BB that may be used to challenge modeled or retrieved SSAambient.