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High-Resolution Aerosol Mass Spectrometric Measurements of the Arctic Troposphere on-board the NASA DC-8 during ARCTAS

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A High-Resolution Time-of-Flight Aerosol Mass Spectrometer (HR-ToF-AMS, DeCarlo et al., Anal. Chem., 2006) was deployed aboard the NASA DC-8 research aircraft as part of the Arctic Research of the Composition of the Troposphere from Aircraft and Satellites (ARCTAS) campaign during the spring and summer of 2008.

The main focus of the spring phase, operated out of Fairbanks, Alaska, was to investigate the composition and sources of Arctic Haze (e.g. Quinn et al., Tellus B, 2007), a persistent pollution layer that accumulates under the stable springtime Polar High anti-cyclonic weather pattern. The sulphate-dominated aerosol in the Arctic Haze almost always contained smaller amounts of organic matter. Multiple biomass-burning plumes and some plumes from North-American pollution were observed. Comparison of tracers for biomass-burning in both the gas- and aerosol-phases show good correlation and point to the long-term persistence of organic aerosol of biomass-burning origin in the springtime Arctic. The organic aerosol was typically highly oxidized.

During the summer phase, operated out of Palmdale, California, and Cold Lake, Canada, the focus was investigating California pollution and the composition and evolution of the outflow from large-scale boreal forest fires, respectively. However, the numerous fires burning in Northern California during the project timeframe allowed for the sampling of biomass-burning plumes from both locations. The persistence and correlation of the gas- and aerosol-phase fire markers observed during the spring phase was once again apparent. This observation, over a range of transport timescales and geographical locations, suggests that certain components of the AMS mass spectrum can be used as robust markers for biomass-burning in the organic aerosol composition.

Measurements from multiple fires of aerosol chemical composition, including volatility profiles of important organic components, are compared to monitor the evolution of biomass-burning plumes from source as they are advected into the polar region. Using co-located gas-phase measurements, emissions profiles of biomass-burning plumes from the Canadian boreal forest fires are compared to those from California. In addition, the source profiles of multiple biomass-burning plumes from both field (Aiken et al., submitted ACPD; Huffman et al., submitted ACPD) and laboratory (Aiken et al., 2007) studies are contrasted with those measured during the ARCTAS campaign.