University of New Hampshire Soluble Acidic Gases and Aerosol (UNH SAGA) contributions to ARCTAS

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As part of the measurement team on the NASA DC-8 we operate two related installations: a mist chamber/ion chromatograph (MC/IC) sampling/analysis system providing near real time results for selected species, and a bulk aerosol system that collects particulates onto filters for subsequent analysis.

The MC/IC system provides atmospheric distributions of nitric acid (HNO_3) and fine (< 1 μm) aerosol sulfate at approximately 90 second resolution. In particular, we focus on the spatial and vertical distribution of HNO_3, which has been identified as a priority for validation of the TES, OMI, and HIRDLS sensors on the AURA platform. Correlations between HNO_3 and O_3 in the upper troposphere have proven to provide insight into stratosphere-troposphere-exchange (STE) on small spatial scales. This system will also measure "soluble bromide" (HOBr, HBr, plus fine particulate bromide) if present at mixing ratios greater than about 1 pptv. We expect soluble bromide will largely be restricted to boundary layer airmasses that are experiencing ozone depletion events, but will be very interested if enhanced bromide is observed in the Arctic free troposphere.

We use ion chromatography on aqueous extracts of the bulk aerosol samples collected on Teflon filters to quantify soluble ions (Cl^-, Br^-, NO_3^-, SO_4^{2-}, $C_2O_4^{2-}$, Na^+, NH_4^+, K^+, Ca^+, and Mg^+). The natural radionuclide tracers ^7Be and ^{210}Pb are determined by gamma and alpha spectrometry, respectively, on a separate, but simultaneously exposed, glass fiber filter. Filters are exposed on all level flight legs. Below 3 km exposure times are 5 minutes or less, increasing at higher altitudes to a maximum sample time of 15 minutes. Aerosols participate in heterogeneous chemistry, impact radiative transfer, and can be detected from space. Our measurements will help to validate and extend retrievals of aerosol distributions and properties by MODIS, MISR and CALIPSO. In addition, several of the particle-associated ions are tracers of sources of gas and aerosol pollutants that will be targeted during ARCTAS flights (e.g., SO_4^{2-} from industrial emissions of SO_2 in Eurasia is a major component of Arctic Haze, and enhancements of $C_2O_4^{2-}$, K^+, and NH_4^+ indicate encounters with biomass burning plumes). Lead-210 is another tracer of Arctic Haze, while ^7Be complements HNO_3 and O_3 as a tracer of STE.

Analyte	Temporal Resolution	Detection Limit
HNO_3	1.5 min	1 pptv
Fine $SO_4^=$	1.5 min	5 pptv
Soluble Bromide	1.5 min	1 pptv
Chloride	5 – 15 min	25 pptv
Bromide	5 – 15 min	3 pptv
Nitrate	5 – 15 min	3 pptv
Sulfate	5 – 15 min	3 pptv
Oxalate	5 – 15 min	5 pptv
Sodium	5 – 15 min	20 pptv
Ammonium	5 – 15 min	7 pptv
Potassium	5 – 15 min	10 pptv
Calcium	5 – 15 min	25 pptv
Magnesium	5 – 15 min	5 pptv