

University of New Hampshire Soluble Acidic Gases and Aerosol (UNH SAGA) Instrument Description

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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.

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-} , $\text{C}_2\text{O}_4^{2-}$, Na^+ , NH_4^+ , K^+ , Ca^+ , and Mg^+). 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. The interactions between aerosol and clouds are of particular interest during SEAC⁴RS. 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 SEAC⁴RS flights (e.g., SO_4^{2-} from industrial emissions of SO_2 , enhancements of $\text{C}_2\text{O}_4^{2-}$, K^+ , and NH_4^+ indicate encounters with biomass burning plumes, Na^+ , and Cl^- are tracers of seasalt, Mg^{2+} and Ca^{2+} are tracers of dust). Our system has two inlets, allowing collection of paired samples simultaneously. During SEAC⁴RS we will provide one set of filters to Dr. Rodney Weber (Ga Tech) who will quantify select organic compounds and characterize absorption by aerosol extracts (focused on "brown carbon").

The MC/IC system provides atmospheric distributions of nitric acid (HNO_3) and fine ($< 1 \mu\text{m}$) 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. Scavenging of HNO_3 in convective systems, production in convective outflow, and interaction with cirrus ice are SEAC⁴RS objectives these measurements will help to address.

Analyte	Temporal Resolution	Detection Limit
HNO ₃	1.5 min	1 pptv
Fine SO ₄ ⁼	1.5 min	5 pptv
Chloride	5 – 15 min	25 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

Twin Mist Chamber / Ion Chromatograph used aboard the NASA DC-8 for TC4

