Langley In Situ Aerosols (LAERO)

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ABSTRACT

We will provide measurements of aerosol number density, volatility, size distribution and optical properties aboard the NASA DC-8 during INTEX. These measurements will be conducted in close collaboration with the University of Hawaii (Antony Clarke, PI) and will provide detailed information on ambient in-situ aerosol microphysical properties in conjunction with on-board real-time assessments of the underlying physio-chemical characteristics. This combination will provide size-resolved data that links aerosol atmospheric effects to the nature of aerosol emissions and composition. Measurements will include: 1) a set of three condensation nuclei counters to determine total aerosol number density, the number of particles between 0.003 and 0.01 μm (ultrafine CN) and the fractional volatility of aerosols > 0.01 μm (LaRC-UH); 2) a tandem differential mobility analyzer and optical particle counter to obtain total and nonvolatile aerosol size distribution over the size range from 0.010 to 7 μm (UH); 3) an Aerodynamic Particle Sizer (APS) for mass-dependent sizing of 0.5 to 10 μm diameter particles (LaRC); 4) a pair of wing-tip mounted aerosol scattering spectrometer probes to measure, in addition to cloud liquid water content, particle size distributions at ambient humidity over the 0.3 to 1550.0 μm size-diameter range(LaRC); 5) a pair of 3-wavelength, integrating nephelometers to measure total and submicron aerosol scattering coefficients (LaRC-UH); 6) two Particle Soot Absorption Photometers (PSAPs) to record total and submicron aerosol (i.e., black carbon) absorption coefficients (LaRC-UH) and (7) measurements of extinction vs. humidity [f(RH)] that quantifies the role of water uptake on the ambient scattering/extinction properties (UH), as detected by remote sensing. Sample air will be provided to the cabin-mounted instruments via the University of Hawaii shrouded inlet probe that was evaluated during the DC-8 Inlet Characterization Experiment (DICE) and found to efficiently transmit particles < 4 μm dry diameter over the entire performance envelope of the aircraft. The selected instruments were successfully deployed aboard the aircraft during DICE as well as previous missions and will yield aerosol physical property measurements

comparable to those being recorded aboard the NOAA P-3B and NRL Twin Otter aircraft and the NOAA ship, Ron Brown, that will be conducting coordinated missions with the DC-8 as part of the overall ICARTT program. The proposed effort will include careful pre- and post-mission calibration of the instrument payload; in-flight distribution of selected signals to the DC-8 data acquisition and distribution system (ICATS) for real-time display and use in flight planning; and generation of post-flight and post-mission data products. The effort will also include post-mission analyses aimed at 1) evaluating the consistency between the DC-8 aerosol measurements and data sets collected by other participating groups (e.g., NOAA P-3 aircraft and the ship, Ron Brown); 2) determining the advective flux of aerosol species off the U.S. east coast; 3) comparing modeled aerosol microphysical properties to those observed experimentally; and 4) establishing the relationships between aerosol microphysical and compositional properties and optical parameters that can be observed remotely by active and passive satellite sensors.

The specific data that will be archived by LaRC are shown in the table below.

Parameter	units	Resolution (seconds)	precision
Total aerosols > 0.003 μm	cm^{-3}	10	20%
Ultrafine Aerosols (0.003 to 0.01 μm)	"	10	20%
Mass-based Modal Diameter (> 5 μm)	μm	10	.1 μm
Dry Aerosol Mass (> 0.5 μm)	cm^{-3}	10	20%
Ambient Accumulation Mode Diameter	μm	10	.1 μm
Ambient Accumulation Mode Number Density	cm^{-3}	10	20%
Ambient Accumulation Mode Surface Area		10	40%
Ambient Accumulation Mode Volume	μm^{-2} cm^{-3}	10	50%
Ambient Coarse Mode Diameter	μm	10	0.2 μm
Ambient Coarse Mode Number Density	cm^{-3}	10	20%
Ambient Coarse Mode Surface Area	cm^{-3}	10	40%
Ambient Coarse Mode Volume	μm^{-2} cm^{-3}	10	50%
Mean Precipitation Mode Diameter	cm^{-3}	10	20%
Precipation Mode Number Density	m^{-3}	10	20%
Precipitation Mode Surface Area	μm^{-2} m^{-3}	10	40%
Precipitation Mode Volume (calculated)	μm^{-3} m^{-3}	10	50%
Liquid Water Content	mg m^{-3}	10	20%

Total Aerosol Surface Area	$\mu m^{-2}\ cm^{-3}$	10	50%
Total Aerosol Volume	$\mu m^{-3}\ cm^{-3}$	10	50%
Aerosol Phase (Ice or Water)	-	10	-
Aerosol Scattering Coefficient (450 nm)	m^{-1}	10	10%
Aerosol Scattering Coefficient (550 nm)	m^{-1}	10	10%
Aerosol Scattering Coefficient (700 nm)	m^{-1}	10	10%
Aerosol Backscatter Coefficient (450 nm)	m^{-1}	10	10%
Aerosol Backscatter Coefficient (550 nm)	m^{-1}	10	10%
Aerosol Backscatter Coefficient (700 nm)	m^{-1}	10	10%
Aerosol Absorption Coefficient (535 nm)	m^{-1}	60	10%
Angstrom Coefficients	-	10	10%
Single Scattering Albedo	-	60	2%
Black Carbon	$ng\ m^{-3}$	60	10%