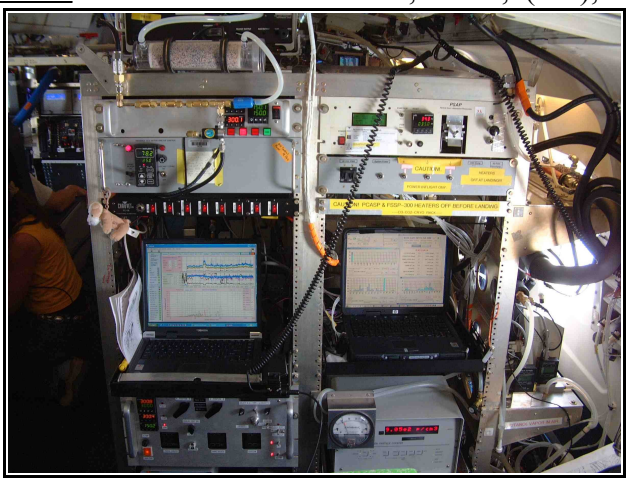
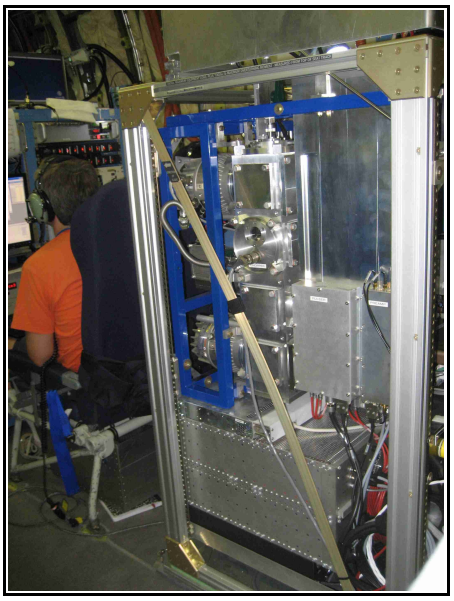
ARCTAS P3b
Instrumentation for HiGEAR research group A. Clarke (University of Hawaii)
http://www.soest.hawaii.edu/HIGEAR/

Objective: We propose to evaluate size-resolved aerosol physiochemistry and its links to aerosol optical properties during ARCTAS and will operate/co-ordinate our University of Hawaii' instrument package in conjunction with those of NASA Ames (Phil Russell et al.). We employ aerosol sizing instruments equipped able to identify volatile and refractory sizes. The latter is related to the soluble and insoluble components of the aerosol, including Black Carbon (BC), that are linked to their optical properties. The mass distribution of BC will be determined and full dry size distribution from 0.007 to 10.0 μm will also be characterized. Light scattering and light absorption coefficients will also be measured.

Above: HiGEAR rack with OPC, PSAP, f(RH),



TTDMA, UltrafineCN, CN, etc. on DC-8.
Right: HiGEAR ToF-AMS etc. on NCAR C-130.



1) Time of Flight Aerosol Mass Spectrometer (ToF-AMS)
Total and single particle characterization of volatile aerosol ionic and organic components (50-700nm). Uncertainty depends on species and concentration.

2) Single Particle Soot Photometer (SP2)
Single particle measure of BC (soot) mass in particles and determination of mixed particle size and non-BC coating using laser scattering and incandescence. 70-700nm. Single particle counting up to 10,000 per sec.

3) A size-resolved thermo-optic aerosol discriminator (30 s avg.):
Aerosol size distribution from 0.12 up to 7.0 μm, often where most aerosol mass, surface area and optical effects are dominant. Uses a modified Laser Optical Particle Counter (OPC) and computer controlled thermal conditioning system is used upstream (airstream dilution dried). Characterizes aerosol components volatile at 150, 300 and 400C and refractory aerosol at 400C (sea salt, dust and soot/flyash). (Clarke, 1991, Clarke et al., 2004). Uncertianty about 15%

4) Condensation Nuclei - heated and unheated (available at 1Hz)

Two butanol based condensation nuclei (CN) counter (TSI 3010) have been modified for aircraft use and count all particles between 0.01-3.0 um. We obtain total CN, refractory CN (those remaining at 300C after sulfate is removed) and volatile CN (by difference) as a continuous readout as a fundamental air mass indicator (Clarke et al. 1996). Uncertainty ~ 5%.

3) Aerodynamic Particle Sizer – (APS-TSI3320) – (<5min/scan)

To further characterize larger "dry" particles, including dust, we will operate an APS which sizes particles aerodynamically from 0.8 to 20 μm into 50 channels. Uncertainty~10%.

4) Differential Mobility Analyzer with thermal conditioning – (<3 min/scan)

Volatility tandem thermal differential mobility analyzer (VTTDMA) with thermal analysis (see discussion for OPC above) that provide size information (mass, surface area, number distributions) and their state of mixing over the 0.01 to 0.3μm size range (Clarke et al., 1998, 2007) for sampling times of about 1-3 minutes. Uncertainty ~10%

5) Nephelometer (10^{-7} m^{-1} detection for 60s avg., recorded every 1 sec.)

We plan to use a 3 wavelength nephelometer (450, 550, 700nm) for total scattering and submicrometer scattering values using a Radiance Research single wavelength nephelometer (and thereby coarse dust scattering by difference).

6) Two Particle Soot Absorption Photometers (PSAP-Radiance Research; detection <0.1μg m^{-3} for 5 min. avg.)

The PSAP will be used to quantify the spectral light absorption coefficient of the total and submicron aerosol (eg. soot, BC) at three wavelengths (450, 550, 660nm).

7) Humidity Dependent Light-Scattering (10^{-6} m^{-1} detection for 60s avg.; recorded every 1 s): Two additional Radiance Research single-wavelength nephelometers will be operated at two humidities (high/low) to establish the humidity dependence of light scattering, f(RH).

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