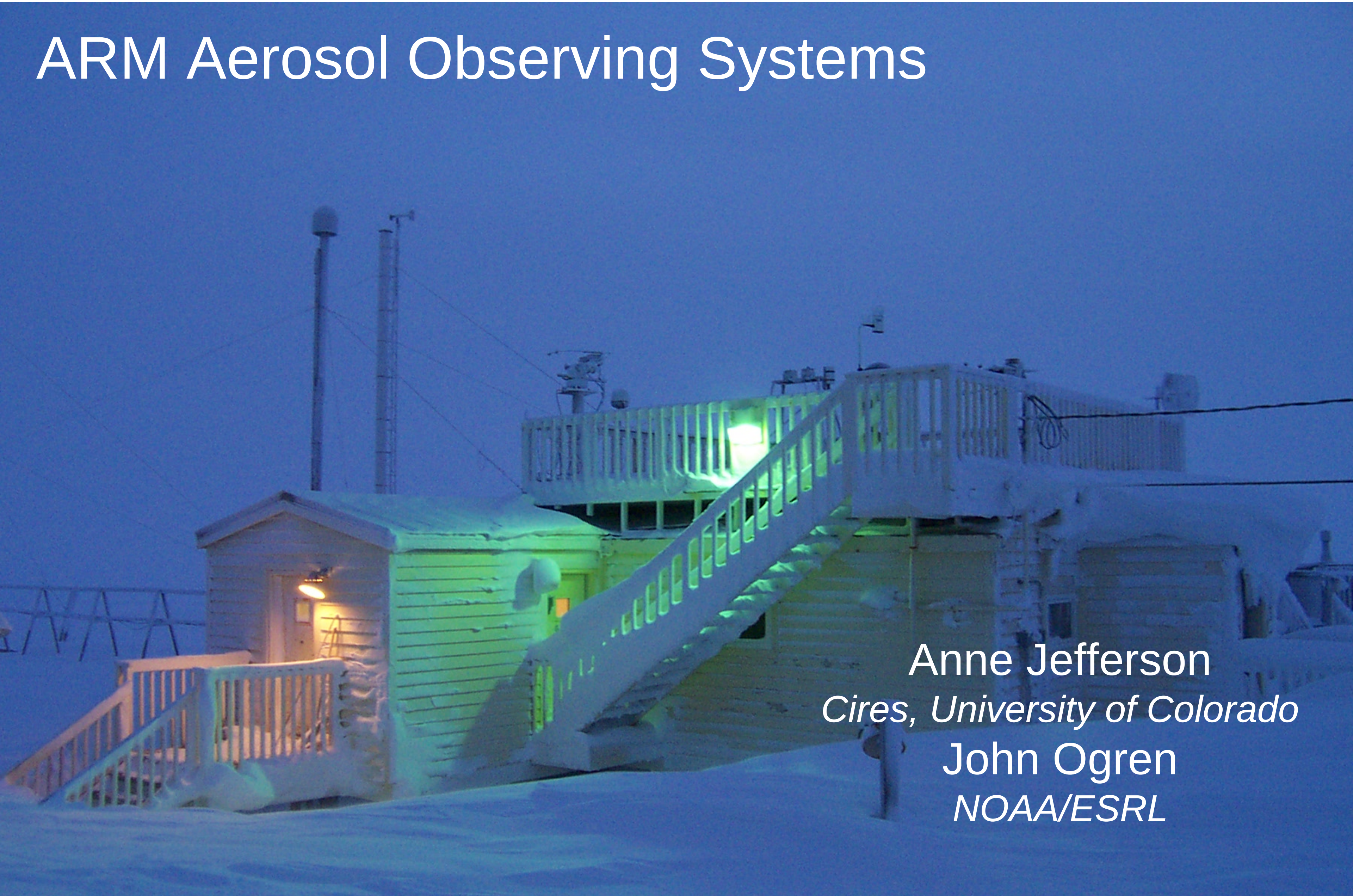
ARM Aerosol Observing Systems



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Aerosol Observing Systems

In-Situ surface and aircraft profile measurements of aerosol optical, chemical, size, hygroscopic and cloud-forming properties

- SGP
  - ARM central facility Lamont, OK
- AMF
  - Pt Reyes, CA 3/2005 - 9/2005
  - Niamey, Niger 12/2005-1/2007
  - Murg Valley, Germany 4/2007 -1/2008
  - Shouxian China 5/2008 - 2009
- BRW/NSA
  - Barrow Alaska

In-situ measurements of aerosol optical and cloud forming properties

Measured Parameters

Scattering coefficients: at 450, 550, 700 nm at sub 10 micron and sub micron size cuts as a function of RH

Backscattering coefficients under similar conditions

Absorption coefficients:at 467, 530 and 660 nm at sub 10 micron and sub micron size cuts

Particle number concentration

Cloud Condensation Nuclei concentrations: 7 supersaturations and 20 droplet size bins

Submicron Particle Size Distribution (NSA and SGP)

Submicron Inorganic Ion chemical composition (NSA and SGP)

Calculated Parameters

Single Scattering Albedo at 450 550 and 700 nm

Hygroscopic Growth Factor, fRH

Asymmetry Parameter, Backscatter Fraction

Ångström Exponent

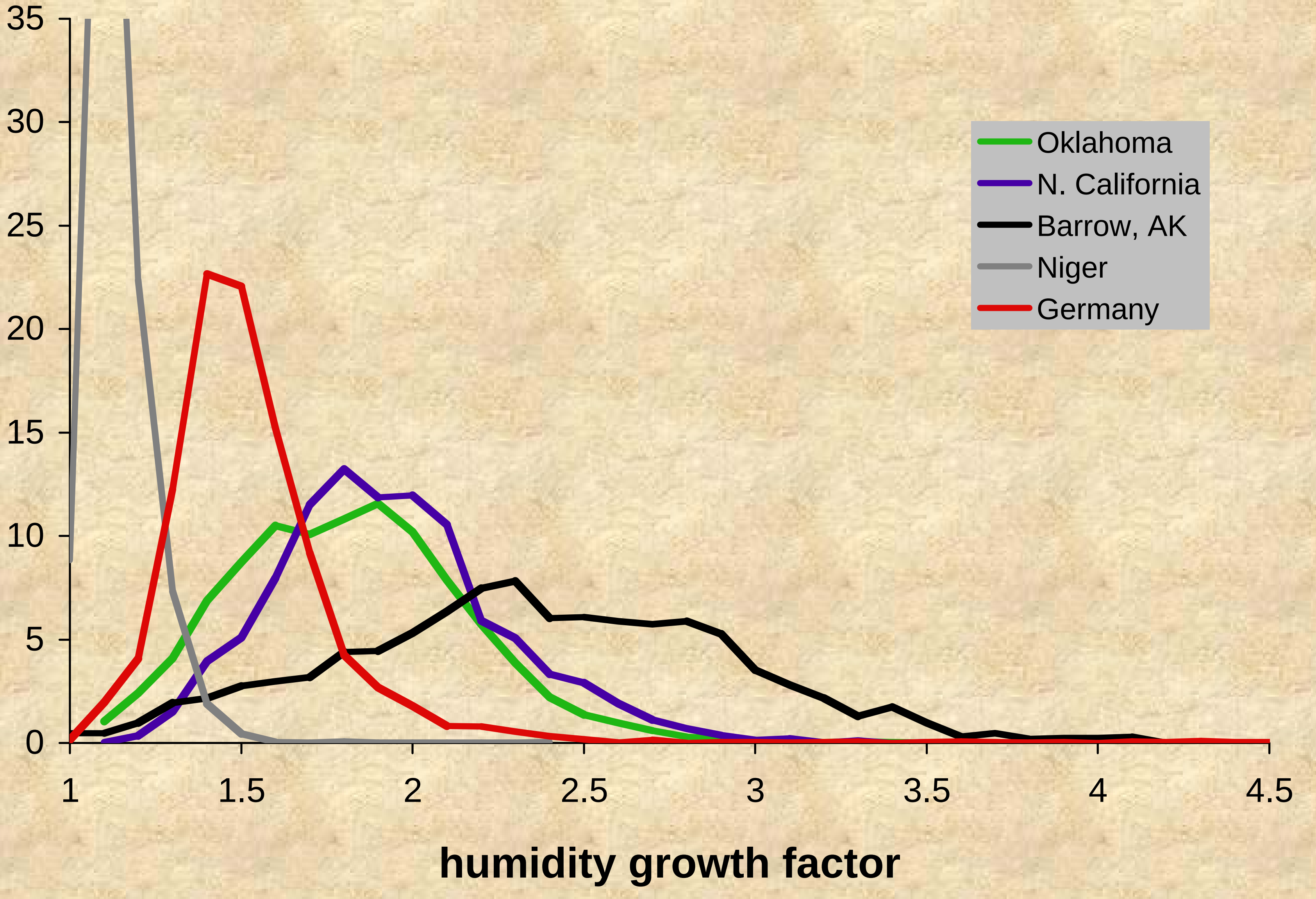
Sub micron scattering fraction

Radiative forcing efficiency

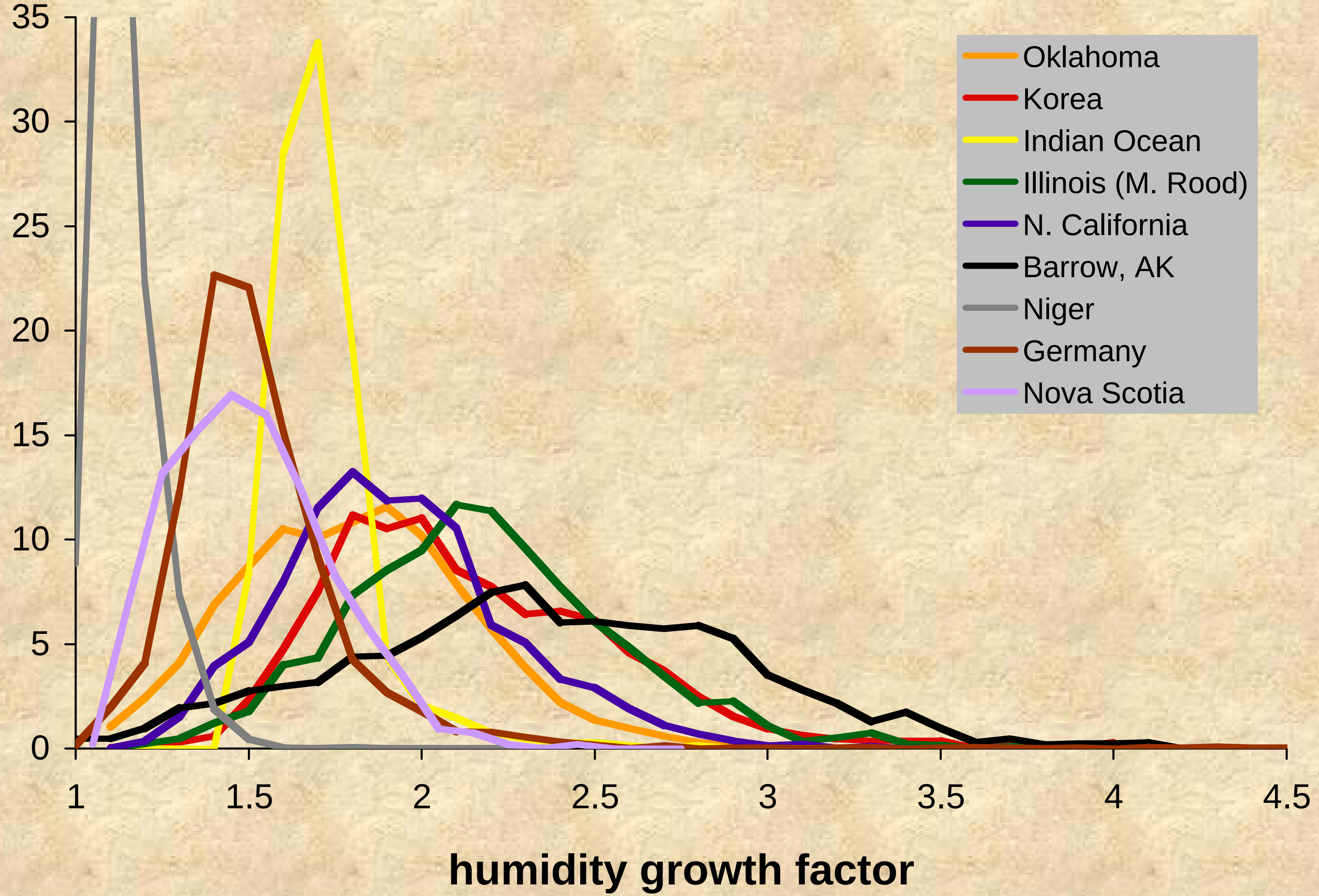
Fraction of particles that form CCN

Mass Scattering Efficiencies

Frequency distribution of hygroscopic growth factors at the ARM sites



Frequency distribution of hygroscopic growth factors at all NOAA-mentored sites



Changes for AMF AOS

Install new sample tower Nov. 2007
Sample inlet enters center top port of trailer

Move AOS Rack to center of trailer to make room for the AERI and MPL

In anticipation of high pollution and relative humidity in China we added a new dilution/dryer system to prolong instrument performance.

Installation of new AOS tower at AMF

New tower is 22 ft high from top of trailer
Made from light-weight, powder-coated aluminum
Guys directly to trailer no need for tower or base support
Not depend on trailer configuration or ground anchors
Easy installation, no need for crane

Upgrade of NSA/BRW system

- 2006 upgrade included the addition of CCN and humidified scattering coefficients as well as a new electronics rack to match SGP and AMF systems.
- Add SMPS to measure aerosol submicron size distribution
- UC Scripps added measurements of submicron aerosol EC and OC composition in addition to PMEL measurements of aerosol inorganic composition

April 2008 NOAA Aerosol, Radiation, and Cloud Processes affecting Arctic Climate (ARCPAC) -*aircraft and surface measurements over Alaskan Arctic*

Upgrades to SGP AOS

- 2005
  - 3 λ PSAP
  - HTDMA -Don Collins
  - build exterior pump box
- 2006
  - DMT Cloud Condensation Nuclei counter
- 2007
  - System reconfiguration
- 2008-2009
  - Photoacoustic Absorption Spectrometer-Dubey Manvendra
  - Aerodynamic Particles Sizer for 0.5 *u*m to 15 *u*m particles-Don Collins

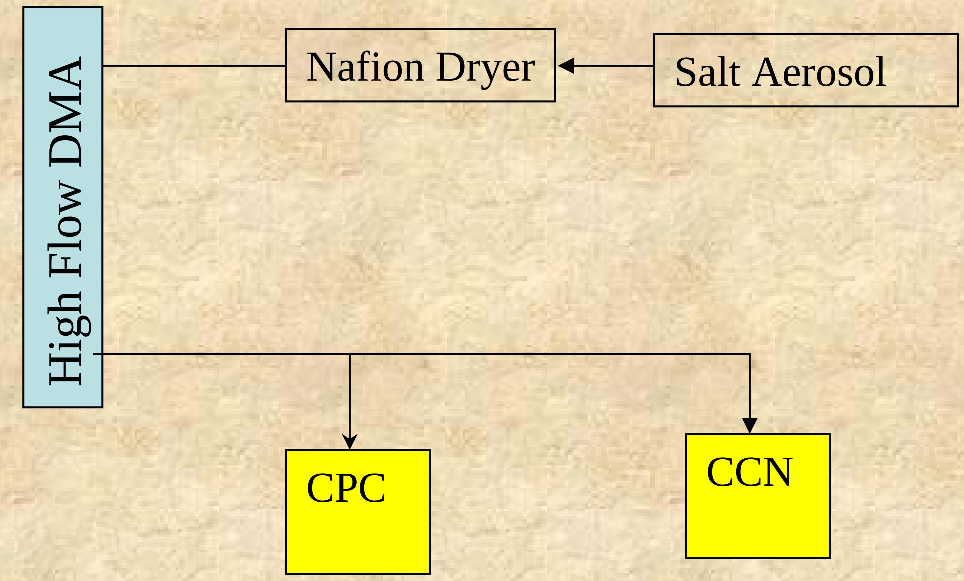
2008-09 Changes to the AOS SGP

• Interface AOS CCN and HTDMA for daily salt calibrations of the CCN supersaturations.

•Add a photoacoustic aerosol absorption spectrometer - Dubey Manvendra (LANL) Oct. 2008 Intercompare the photoacountic and PSAP under a variety of aerosol loading and types and RH to determine the conditions that each instrument operates best

•Add an Aerosol Particle Sizer (APS) to obtain coarse particle size distribution

Coupling of HTDMA and CCN for daily calibration



Daily Calibration of CCN with NaCl aerosol at 0 UTC

Test instrument % supersaturation to known critical supersaturation of salt aerosol of a specific size.

Modification will require addition of 3 way ball valves, plumbing and software changes so that two systems can communicate to one another as well as post-processing programming to merge data and calculate the Kohler growth curves.

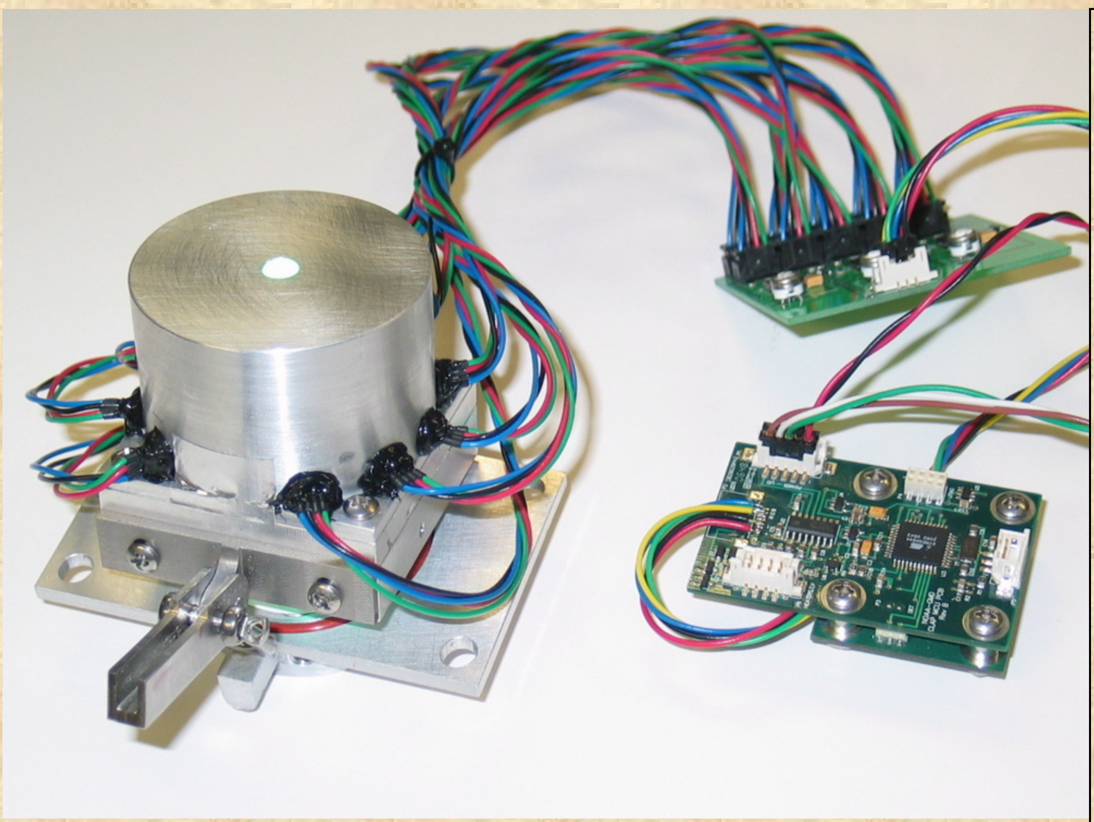
Uncertainties in aerosol absorption measurements

NOAA comparisons between PSAP and PAS in urban air indicate possible positive artifact from liquid organic species. D.Lack et al, submitted, 2008; Subramanian et al., *Aerosol Sci. and Tech., 2007*.

PSAP sensitivity declines with relative humidity and shows a bias with respect to RH in comparison to the PAS, O. Schmid et al., Atmos. Chem. Phys., 2006.

Field studies show the PSAP/PAS to differ by as much as 0.945 to 1.61 O. Schmid et al., Atmos. Chem. Phys., 2006, Arnott et al., *JGR, 2003*.

NOAA Multi-filter Light Absorption Instrument



- 10 sampling sites on each filter for remote and polluted sites
- Small size can mount on neph
- Transparent data acquisition
- Higher sensitivity, lower S/N
- Variable integration time on each wavelength
- Design and software are OPEN SOURCE
- Low cost ~ $5000
- Heated optics block and sample inlet for RH control
- Ability to calibrate wavelength, detector response and filter reflectance

Future direction of AOS measurements

Add short-term measurements of aerosol organic and elemental carbon to help complete our understanding of the absorption measurements (PILS, AMS or filter based EC/OC)

Evaluate need for current filter sampling of aerosol inorganic ion composition

Absorption and FRH IOP

- Deploy NOAA cavity ring down spectrometer (CRDS) to measure humidity dependence of the aerosol extinction

--CRDS can be a standard from which to compare the PAS and PSAP

--Compare fRH of AOS, CRDS and HTDMA

-- Evaluate humidity dependence of absorption