

Update on ARM Aerosol Observing Systems

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ARM Aerosol Observing Systems

In-situ measurements of aerosol optical, chemical, microphysical, hygroscopic and cloud forming properties

- **SGP**
 - ARM central facility Lamont, OK
 - **IAP**: In-situ aerosol profiling over SGP site
- **NSA/BRW**
 - In-situ aerosol measurements made by NOAA
- **AMF**
 - Pt Reyes, CA 3/2005 - 9/2005
 - Niamey, Niger 12/2005-1/2007
 - Murg Valley, Germany 4/2007 -1/2008
 - Taihu (Lake Tai), China 3/2008 - 2009



Comparison of AOS Installations

Measurement	SGP	AMF	NSA	IAP
Scattering, low RH	3- λ	3- λ	3- λ	3- λ
Scattering, f(RH)	3- λ	3- λ	3- λ	1- λ , 40,65,85%
Absorption, low RH	3- λ	3- λ	3- λ	3- λ
CN	Y	Y	Y	N
CCN	Y	Y	Y	N
Size distribution	Y	N	Y	N
Chemical comp.	Y	N	Y	N

2007 additions listed in RED

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**
 - add Aerodynamic Particle Sizer (APS, 0.5-20 μm diameter)

SGP AOS repackaging

- **Similar design and data acquisition as NSA, AMF and IAP systems**
- **Easy to update and compatible data acquisition and processing**
- **Upgrade humidifier for better %RH control, wider range of % RH and more safety features**
- **remote access and control of instruments**
- **compact instrument package**
 - shorter sample lines
 - less aerosol loss
 - better temperature and RH control
- **Open and accessible design for ease of maintenance and repair**
- **Spare parts and electronics are identical for all AOS systems and swapable with mentor stock of spares**

SGP repackaging

- Humidified nephelometer
- CCN measurements

NEW!!

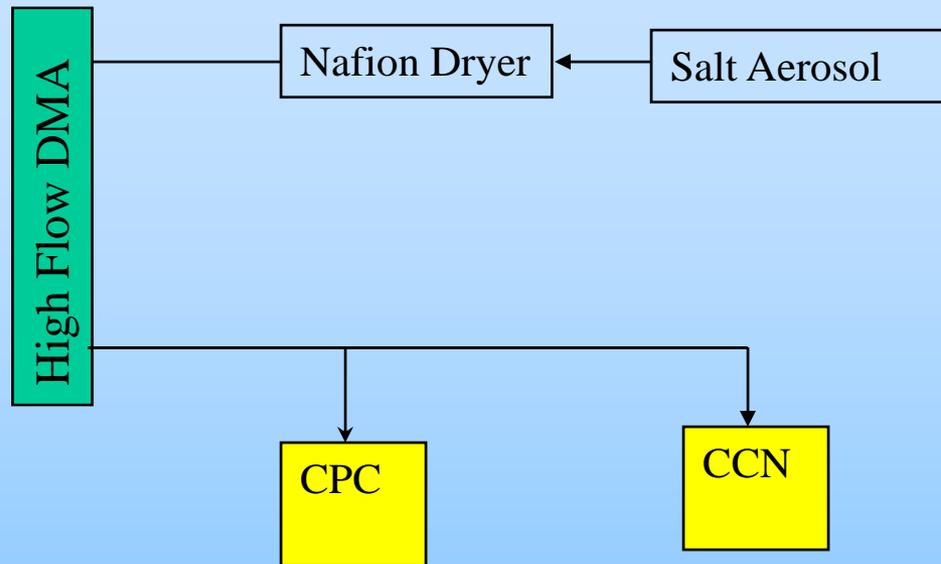


2001 10 5

OLD



2008: HTDMA - CCN coupling for daily calibration



Daily Calibration of CCN with NaCl aerosol

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.

Status of AMF AOS



- all instruments are currently working well
- Moved AOS system to front of trailer to make room for AERI
- AOS Hygroscopic Growth Factor Intercomparison with Swiss group from Paul Scherrer Institute, Aug. 2007
- New pump box for Germany
- New aerosol inlet tower for China
- Sample air dilution/dryer for China

AMF pump box



- Import regulations prohibit shipping of old wooden pump box
- New box is fiberglass marine dock box
- Fan and filters minimize heating and keep out rain and dust
- Unistrut platform elevates off ground and allows fork lift moving.

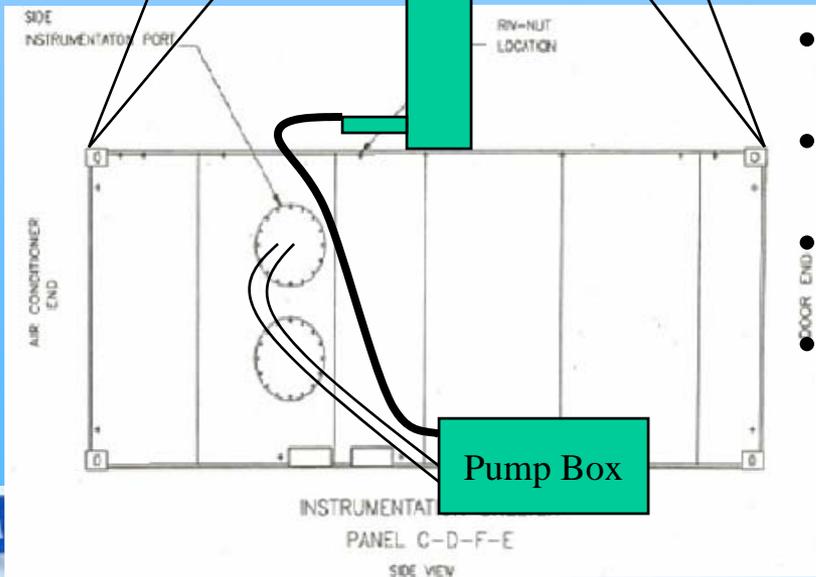
Current AMF sample inlet stack



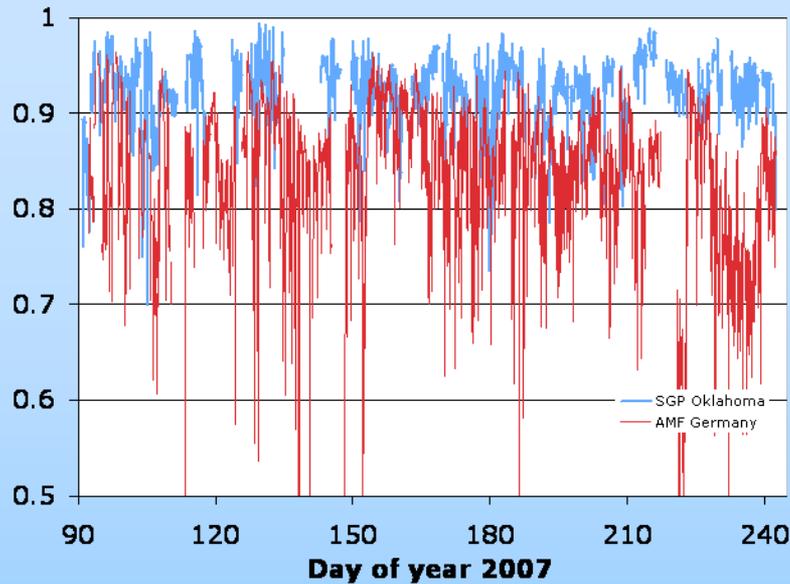
- Stack and inlet are 40 ft high to be above the tree height at Pt Reyes
- Side port entrance to trailer
- Tower requires crane to lift in place
- Several guy points on the ground and on other trailers
- Outer stack is heavy schedule 40 PVC pipe

New AMF Stack Design

- Light weight Aluminum pipe
- 2 - 10 ft lengths, sits ~30 ft above the ground
- Guy wires connected to weld joints on pipe
- Guys to 4 corners of trailer
- Enters center port on top of trailer
- No longer uses support stack
- Aerosol splitter is recessed ~10" inside outer pipe
- easy installation without use of crane
- No need to guy to ground or other trailers
- Sample inlet is closer to instruments



Sub 10 micron single scattering albedo at 550 nm



Aerosol in Germany vs. SGP

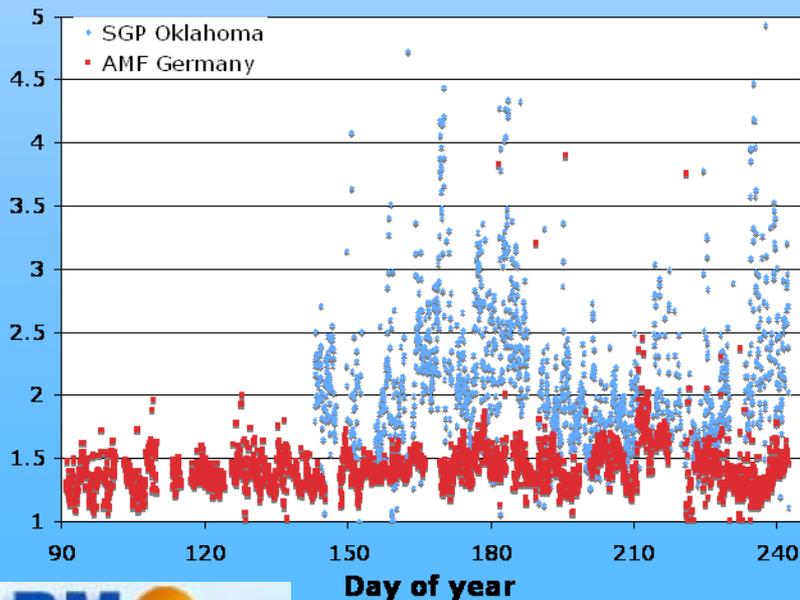
Average (stdev) from 4/1 to 8/31

	$f(RH)$	ϖ
AMF	1.42(0.18)	0.84(0.08)
SGP	2.12(0.55)	0.92(0.04)

Lower $f(RH)$ and ϖ in Germany may be a result of extensive wet scavenging and deposition.

High variability in $f(RH)$ at SGP could be from presence of multiple aerosol types: road dust, smoke from crop burning and sulfate.

Sub 10 micron Hygroscopic Growth Factor at 550 nm



IAP Status

721 flights since March, 2000 (as of Sept 14, 2007)

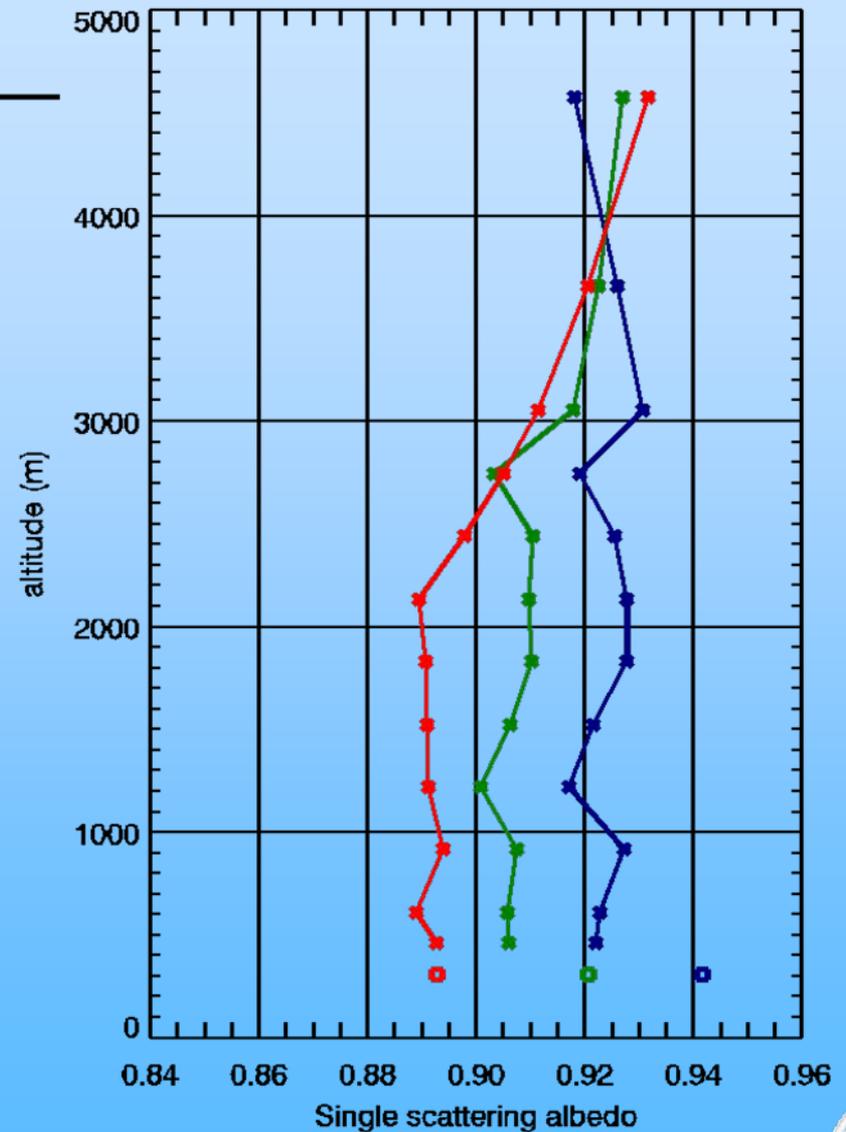
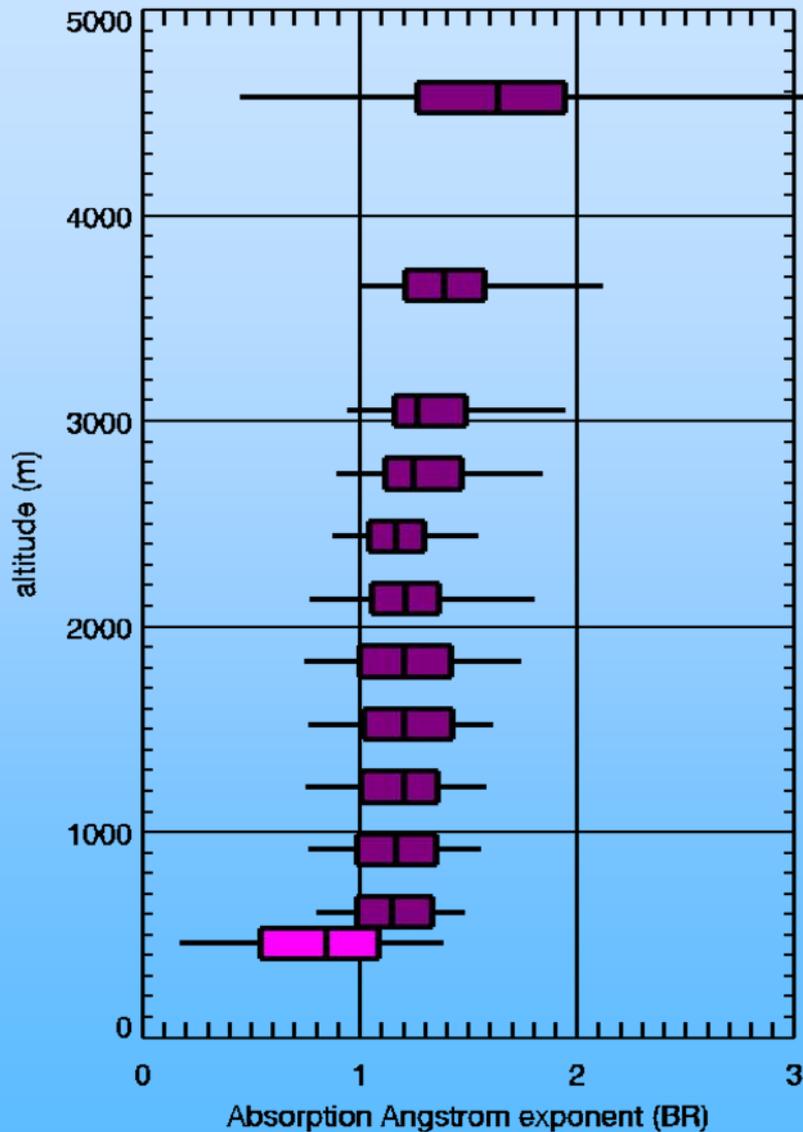
New since last year -

- Humidograph behavior is better understood and controlled
- Wingtip extensions installed and MFR deployed
- Added capability to do span checks on nephelometers
 - instrument reliability check
- CHAPS campaign provided opportunity for instrument intercomparison
 - IAP instruments compared well with other similar instruments

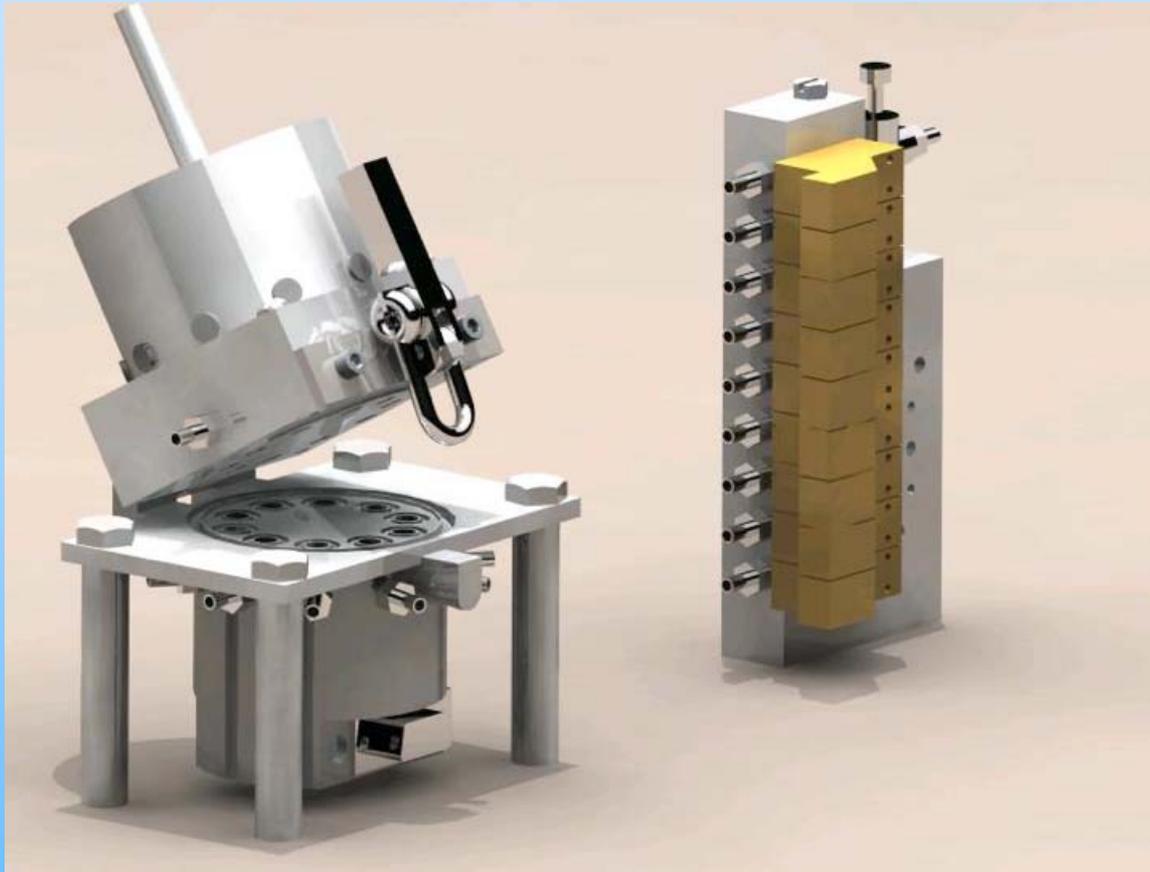
Future plans –

- Replacement of large, rack-mounted PSAP with redesigned PSAP head
- Reprocessing of data set based on better understanding of humidograph system
- CCN+CPC addition?

Vertical Profiles of Spectral Light Absorption at SGP



NOAA Multi-filter Light Absorption Instrument



NEWS FLASH! NOAA comparisons between PSAP and PAS in urban air indicate possible positive artifact from liquid organic species.



IAP Renewal Proposal

- **Submitted Aug 1, 2007**
- **Undergoing review by ARM**
- **Available on ARM Wiki**
http://wiki.arm.gov/bin/view/AerosolWG/IAP_Proposal
- **Proposes 3-yr continuation of IAP flights**
- **Proposed enhancements include**
 - Add CN and CCN counters
 - Add extended horizontal transects in BL
 - Conduct vertical profiles under A-Train
- **Consider relocating plane to other sites for limited periods (AMF, IOP's)**



Original IAP Objectives (2000-2007)

- **Obtain a statistically-significant data set of the vertical distribution of aerosol properties for characterizing the radiative properties of aerosols for evaluation of climate forcing**
- **Relate these properties to those measured by similar or identical instruments at the surface to determine under what conditions surface measurements may be used to estimate column properties**

Objectives of Enhanced IAP Data

- **test the ability of radiative transfer models to calculate surface radiative fluxes for a statistically-significant number of cases (“closure” experiments)**
- **calibrate and validate aerosol remote sensing data and retrieval algorithms, from both ground-based and satellite sensors**
- **evaluate the extent to which ground-based CCN measurements (in-situ and remotely-sensed) represent CCN aloft, where clouds form**
- **evaluate the extent to which the temporal variability of aerosol radiative properties at a point represent their horizontal variability, on the spatial scale of a GCM grid cell (~100 km)**