Aerosol Observing Systems (AOS), New Capabilities for ASR Researchers

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Summary

Three new AOS units, including the Mobile Aerosol Observing System (MAOS) with an extended instrument suite, are coming on line as part of the ARM Climate Research Facility. These units represent a new generation of instrumental capabilities for aerosols and trace gases. The labs are independent and designed for rapid deployment, harsh environments, more autonomous operation and uniform data output across diverse instruments. Data are redundantly stored twice within each AOS, again at the Site Collector Computer and at the ARM Data Management Facility. A system of remote access over the internet allows mentors complete control over AOS infrastructure components, instrument computers and direct control of most instruments. Mentors can view outputs in real time and communicate with on-site technicians. The units are also designed to accommodate limited guest instruments in addition to the standard suite. Development of the data flow stream for all AOS units and the extended components of MAOS is ongoing.

Success

AMFII AOS was integrated at BNL and deployed to Christie Peak at Steamboat Springs, CO in October '10 and has been operating continuously as part of StormVEx. Data from core instruments and two guest instruments are being recorded. Core measurements are transmitted to the ARM DMF. Guest instrument data are accessed directly by mentors. Instrument down time has been minimal (99+% duty cycle) and problems have been quickly addressed with direct cooperation between mentors and operating technical staff. Temperature minimums of ~-15 C have not posed significant problems nor has 8000' elevation.

Data Quality Problem Report and Data Quality Report system now accepts AOS instrument issues.

User Interface/Data Format

- Data recorded at 1-Hz
- Data record uploaded to site and then to DMF hourly (local copies maintained)
- Full mentor control of instruments with remote capabilities
- Full mentor control of acquisition computers (fanless CPUs with 145 GB capacity)
- Local control of all AOS CPUs via 16-port KVM (minimizes space to 1 keyboard/monitor
- Remote "viewing only" privileges for program participants

Some Current Integration Tasks

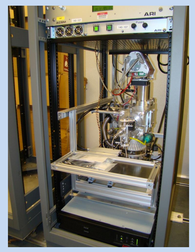
Testing, installation of 3 HTDMAs (Units 2&3 scheduled for late March delivery)

Add f(RH) and HTDMA driers to pump box

Shock mount PTRMS for MAOS

Shock mount PILS for MAOS. CO instrument to go at top (author for size reference)

f(RH) Unit #1 in rack. Two more to go!



ACSM Unit #2 modified for rack mounting in TWP-D. Unit #1 operating at SGP, Unit #3 to go in MAOS

Character

- Flexible
  - Inlet and instrument comparability with other AOS units
  - Fast setup (2-h to erect railing, sampling mast and instrument turn on)
  - Tolerance for heat/cold, wind
  - 'Turtle' mode in ~2 h
  - Enclosure provides laboratory environment for instruments (land/marine)
  - Space available for guest instruments (power, rack space, sampling, computer)
  - Tradeoff between available bandwidth vs. operating technician demands
- Self Contained
  - Requires only power and internet
  - Safety railing and inlet transported internally
  - Instruments transported in shock-mounted racks plumbed and wired
  - Pumps pre-installed in ventilated vestibule
  - Internal, redundant data storage
- Smart Control
  - 'Master' computer can switch on/off all subsystems allowing both remote and autonomous restart and shutdown of unit in graded steps
  - Local and remote control of multiple individual computer systems (2 independent access paths)
  - View-only mode available for involved parties
- Common user interface and data output format for most systems
  - LabView GUI with standard look and feel reduces training
  - Behind the scenes processing and status reporting (red light/green light)
  - Flat ASCII format with common structure and uniform time base (all systems linked to site NTP server for time synchronization)

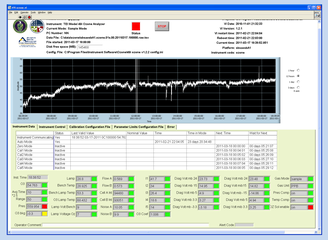
Operations/Communications

Prior to deployment, or on site, instrument mentors train site operators in system safety and day-to-day instrument procedures. Because of the wide variety of instruments, especially in MAOS, it is impossible to train site operators for detailed processing or quality assessments. These are the responsibility of instrument mentors who depend on real-time electronic access to the AOS units. Site operators work closely with mentors when instruments require service or repair.

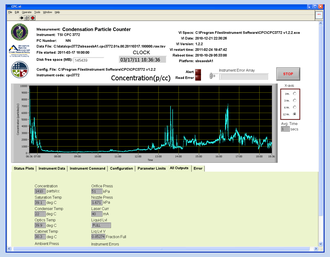
Check lists for daily and scheduled maintenance are available in hard copy and on the AOS infrastructure computer. Instrument manuals, safety information, contact information are also available on this unit. The infrastructure computer provides essential communications between the AOS, mentors and, when necessary, vendors or other web resources. Daily reports are filed with the AOS mentor through Skype.

During the initial four months of StormVEx, several instrument issues were quickly identified and solved with minimal downtime and without additional on-site visits by mentors.

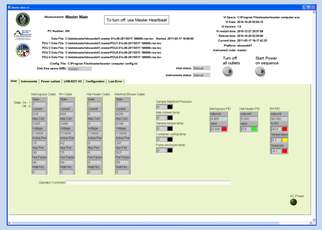
Typical Interfaces , LabView GUI (on-site and remote access)



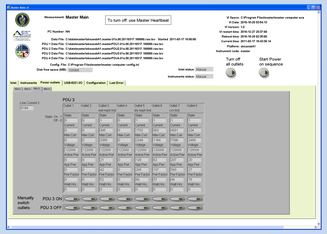
Ozone Analyzer



CPC



Master (Inlet control tab)



Master (PDU #3 Tab)

Instrument Suites

AMFII AOS	MAOS	TWP-D
Particle Counting		
CPC (>10 nm)	CPC (>10 nm)	CPC (>10 nm)
	UCPC (>2.5 nm)	
Size Distributions		
	UHSAS	
	SMPS	
	SP2 (~5 GB/h!!)	
Optical Absorbance		
PSAP	PSAP	PSAP
	Aethalometer	
	PASS-3	
Growth and Cloud Propensity		
HTDMA	HTDMA	HTDMA
Dual Nephelometer Hygrometer	Dual Nephelometer Hygrometer	Dual Nephelometer Hygrometer
CCN-100 (single column)	CCN-200 (dual column)	CCN-100 (single column)
Aerosol Composition		
	PILS	
	ACSM	ACSM
Trace Gases		
	PTRMS	
	Carbon Monoxide	
Ozone	Ozone	Ozone
	Sulfur Dioxide	
	Speciated Odd Nitrogen (NO, NO_2, NO_y)	
State Parameters and Remote Sensing		
Local meteorology	Local Meteorology	Local meteorology
	SODAR	
	Radar Wind Profiler	

Schedule

AMFII AOS	MAOS	TWP-D
Fall '10 – Complete integration	Spring '11 – Complete integration	Winter '11 – Complete integration
Fall '10 to Spring '11 – Storm Peak Lab Cloud Property Validation Experiment, Steamboat Springs, CO	Summer '11 - Aerosol Life Cycle IOP, NY	Spring '11 – Depart for Australia
Summer '11 - Aerosol Life Cycle IOP, NY	Spring '12 – Ganges Valley Aerosol Experiment IOP, Lucknow, INDIA	TBD – Site selection, AOS on line
Fall '11 – Available (?)	Summer '12 to Summer '13 – Two Column Aerosol Project IOP, Cape Cod, MA	
	Spring '14 – Amazon Basin IOP, Manaus, BRAZIL	

BNL Assembly Team
Top Row: Larry Milian, Scott Smith, Stephen Springston, Art Sedlacek
Bottom Row: Yin-Nan Lee, Cindy Salwen, Nancy Warren, Judy Williams, Lisa Morello, Bill Behrens, Gunnar Senum
Not Shown: Gabe Vignato, Jian Wang