[redacted] Twelve Campaigns for the New Mobile Aerosol Observing System(s)

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Summary

Three new AOS units, including the Mobile Aerosol Observing System (MAOS) with an extended instrument suite, are now operational as part of the ARM Climate Research Facility. A fourth unit is planned for long-term deployment to Alaska. These measurement platforms represent a new generation of instrumental capabilities for direct measurement of aerosols and trace gases.

History

The American Recovery and Reinvestment Act (ARRA) funded construction of the original three units beginning in March 2009. The basic platform is a 20' SeaTainer built to contain a mobile laboratory with interior walls, HVAC, lights, power distribution and safety railings while still retaining its seaworthiness certification. The basic units were delivered to Brookhaven National Laboratory in the summer of 2010 where they were integrated with instrumentation and infrastructure. Following qualification testing, the first unit was deployed in September 2010. The following units were delivered to measurement sites in 2011.

Availability

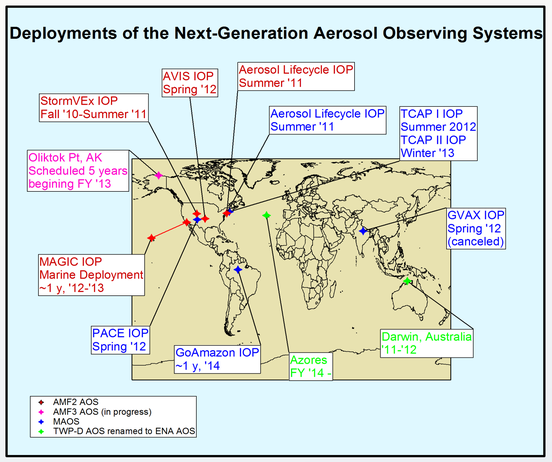
The AOS units not permanently attached to a site are available for user proposals through: http://www.arm.gov/campaigns/propose

Proposers are encouraged to work with the system Mentors.

Deployment

The AOS units can be deployed either individually or as part of a larger set of components. To date, there have been seven active deployments. When operating independently, the units are self-contained and require line power (50 or 60 Hz, 220 or 440 VAC) and internet connection. The basic units were designed for severe environments and have been successfully operated from -20 to +40 ^{o}C and winds up to 30 m/s (though 50 m/s should not pose problems) on mountain tops and merchant ships.

On-site staging is rapid. Two technicians can erect the sampling tower and railings and begin operations in 1-2 days (MAOS takes somewhat longer). Day to day operations take 2-3 h/day of a trained technician. (Operation of MAOS requires 1-1.5 FTE.)



Engineering

Two goals governed the design of the AOS units.

Goal 1: Reliable measurements, intercomparable with existing AOS units. Where possible, commercial instrumentation was adapted for installation. The hydrodynamic design of the existing aerosol inlet was also used.

Goal 2: Ease of all phases of operation to promote the highest possible duty cycle.

AMF2 AOS deployed on Christie Peak during StormVEx 2010-2011

Instrument Suites

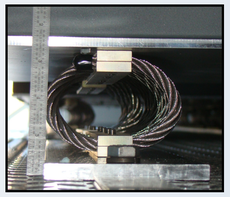
AMFII AOS	MAOS	TWP-D
Particle Counting		
CPC (>10 nm)	CPC (>10 nm)	CPC (>10 nm)
	UCPC (>2.5 nm)	
Size Distributions		
	UHSAS	
	SMPS	
	SP2	
Optical Absorbance		
PSAP	PSAP	PSAP
	Aethalometer	
	PASS-3	
Growth and Cloud Propensity		
HTDMA	HTDMA	HTDMA
Dual Nephelometer Hygrometer	Dual Nephelometer Hygrometer	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	

10-m Sampling Tower

Transported inside, the hinged base, lightweight irrigation pipe construction means the tower can be erected by two technicians and is guyed only to the structure. A single section can be used for marine platforms.

Instrument Mounting

Instruments are mounted in racks which are shock mounted with cable isolators at all eight corners. Each unit holds 3 or 4 72"(h) racks. The units are transported with all instruments wired and plumbed to greatly simplify staging/destaging.



Detail of isolator

Pump Vestibule

Pumps, dryers and blowers are contained in a ventilated ss cabinet in a rear vestibule. This isolates the cabin from noise, heat and vibration. In case of emergency conditions, the tower can be lowered and the SeaTainer doors shut in about 1 h.

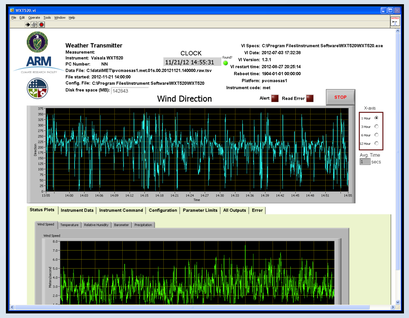
Computers

Instruments transfer their data to a small fanless computer with a standard Graphical User Interface that has a common look and feel for all instruments. Each computer can control 2-3 instruments. All computers are accessed by a single KVM unit to save space. Mentors can log onto all systems remotely to observe operations or update software. Each instrument computer can record 1-2 y of primary data (at 1 Hz).

A separate computer, the 'master,' controls individually-switched power outlets for all instruments. Thus the master can gently start up systems after power failures. Each outlet has current recording so the health of pumps can be monitored. Mentors can remotely turn systems on/off. The 'master' serves as redundant storage for all instrument computers. An NTP time server locks all systems to UTC.

A separate rack-mounted infrastructure computer is used for operator communications (e-mail, Skype, brower) and document storage. The AOS's are paperless, with the AOS SOP, all manufacturer's documents, inventory and export control documentation and MSDSs all stored electronically.

Acquired data is automatically transmitted to the ARM Data Management Facility (while at least two copies are maintained locally).

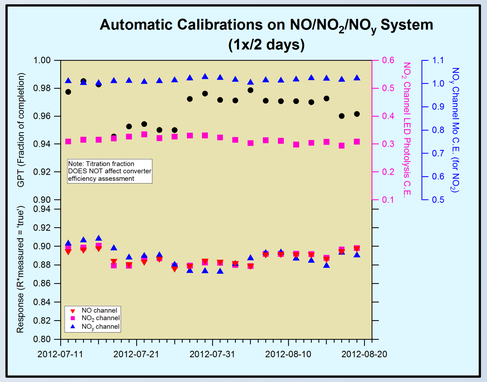


Typical GUI

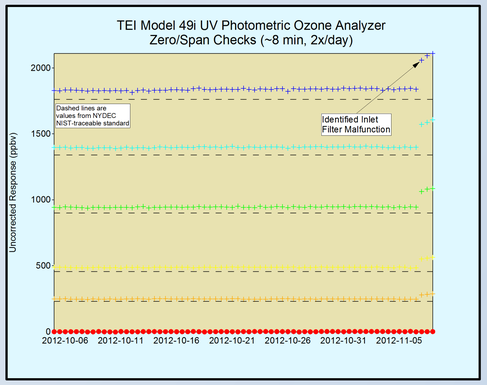
QA/QC

The data is monitored at multiple steps to assure quality.

- Instrument computers have red light/green light status indicators for parameter monitoring.
- Where appropriate, instruments perform automatic calibrations against standards



Typical performance chart for oxides of nitrogen detector



Typical performance chart for ozone detector

- Operators observe the real-time plots on a daily basis
- Mentors remotely log into systems to observe conditions or adjust parameters
- Uploaded data is inspected at the ARM Data Quality Office
- Mentors produce, review and approve the final product

Operations

While on site, Operators from Los Alamos and Argonne National Laboratories handle day-to-day tasks. Unusual behavior and failures usually require remote participation of Mentors. Special acknowledgment and appreciation are due Curt Dvonch (LANL), primary Operator of MAOS and Mike Ritsche and Nikki Hickmon (ANL), primary Operators of AMF2 AOS.