New Aerosol Observing System (E13) at SGP Opens the Door for Advanced Instrumentation

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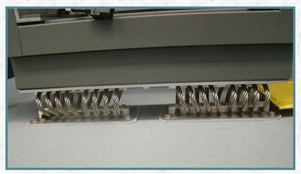
Introduction

The new Aerosol Observing System (AOS) at the Southern Great Plains site, E13, is the most recent addition to ARM capabilities. This system, deployed and brought on line in November 2016, has enhancements in engineering, computing and instrumentation.

Engineering for Ease of Use



The new AOS design accommodates 5 full-height instrument racks (1 more than the previous generation) each independently suspended by cable shock isolators. Instruments in the new AOSes are easily accessible on slide out shelves. A 'clean' installation minimizes removal of instruments for maintenance and repair, lessening data disruptions and instrument downtime.

A walk-up stair, deck and railing improves safety for Operators.

The APS is located directly under it's inlet to avoid bends in the sample path to mitigate losses of the super micron particles. This configuration also makes maintenance easier. The next gen blower enclosure, first introduced in the AMF3 AOS, makes pump servicing and replacement less troublesome. The pumps plug into a quad outlet box, all of the plumbing connects to bulkhead Swagelok fittings, and the blower is wired to a receptacle. These changes make the blower enclosure completely modular. Most connections are made using the connection panel seen below. Only the housekeeping sensors have cables that pass through a conduit to a connection panel inside. ENG-0003252 covers implementing these changes in AOS01, AOS02 and AOS06. These 3 systems will be retrofitted with a smaller enclosure, with the same functionality, but with the air dryer located outside of the enclosure. These new dryers, Puregas P5000PM, are environmentally hardened and are designed to be outside.

The new AOS is installed with a "prairie" entryway fashioned after the AMF3 Olitok site. This configuration helps to mitigate the temperature variations that the AOSes experience when Operators enter or leave. The entryway also serves as the sheltered home for the blower enclosure holding the pumps and other mechanical systems servicing the AOS instruments. Since the entryway is also climate controlled it provides extra workspace for the SGP Operators.

Each structure has it's own HVAC system that operates independently. This has led to an increase in the stability of the temperatures in the AOS. The addition of a single, large Uninterruptible Power Supply, 10KVA, buffers all instruments from power surges AND makes short interruptions inconsequential. This has led to less operator intervention, fewer hard instrument shutdowns and more complete datasets. The prairie entryway has electrical service and opening for the expansion of a future mobile lab. This is the second AOS, AMF3 was first, to replace many instrument computers with a virtual computing system. This system allows for centralized updates, synchronized backups and a more robust computing architecture.

The SGP Instrument Suite is:

Aerodynamic Particle Sizer (APS) – Particle size distribution from 0.5 – 20 μm

Aerosol Chemical Speciation Monitor (ACSM) – Non-refractory aerosol ionic and organic composition

Cavity Attenuated Phase Shift (CAPS) – 3 wavelength measurement of σ_{ext}

Cloud Condensation Counter (CCN-200) – 2 channel instrument with one channel scanning in supersaturation

Condensation Particle Counter (CPC) – Number concentration D_p > 10 nm

Ultra-Fine Condensation Particle Counter (u-CPC) - Number concentration D_p > 2.5 nm

Hygroscopic Tandem Differential Mobility Analyzer (HTDMA) – Measuring physical growth factor with RH (to be installed upon delivery in Spring 2017)

Meterological Sensor (WXT-520) – To measure local conditions at point of sampling

Impactor – Brechtel unit to selectively cut off aerosol < 1 and < 10 μm prior to the optical properties measurements (CAPS, Nephs, PSAP and TAP,)

Nephelometer (Neph) - 3 wavelength measurement of $\sigma_{scat\ (total)}$ and $\sigma_{scat\ (back)}$. A second nephelometer will be added with the f(RH) system (to be installed Spring 2017) to measure scattering changes with RH

Particle Soot Absorption Photometer (PSAP) – 3 wavelength, filter-based measurement of σ_{abs}

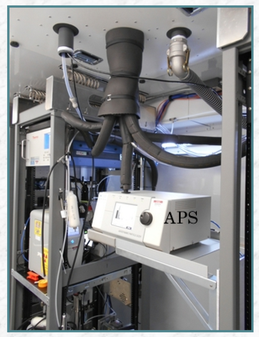
Scanning Mobility Particle Sizer (SMPS) – Particle size distribution from 10 – 500 nm

nano-Scanning Mobility Particle Sizer (n-SMPS) – Particle size distribution from 2 – 150 nm

Sulfur Dioxide Monitor (SO_2) – Trace gas involved in new particle formation

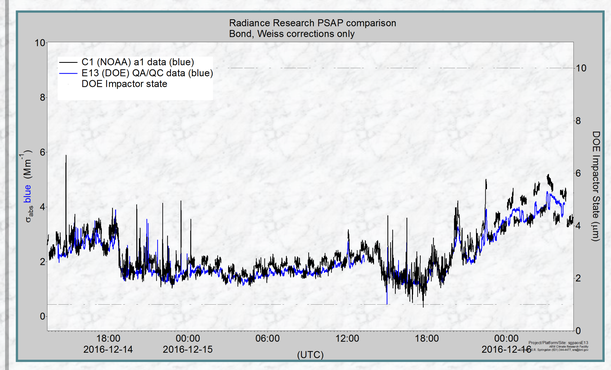
Ultra-High Sensitivity Aerosol Spectrometer (UHSAS) – Particle size distribution from 60 nm – 1 μm

There are 4 new instrument systems in this AOS. The n-SMPS and the APS provide extended size distributions. With the addition of these two instruments to the AOS core suite, particle size distributions (diameter) are measured over a 4 orders of magnitude range. Also new is the TAP being evaluated as a successor to the venerable PSAP. In late Spring 2017, a new humidigraph, with active feedback control of humidity and a redesigned, 4-way switching valve will come on line to deliver deliquescence and effluorescence scans from 30 – 80% RH.

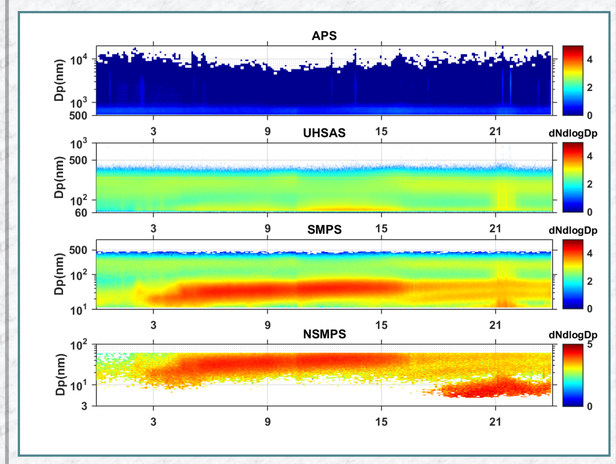


Preliminary Tests

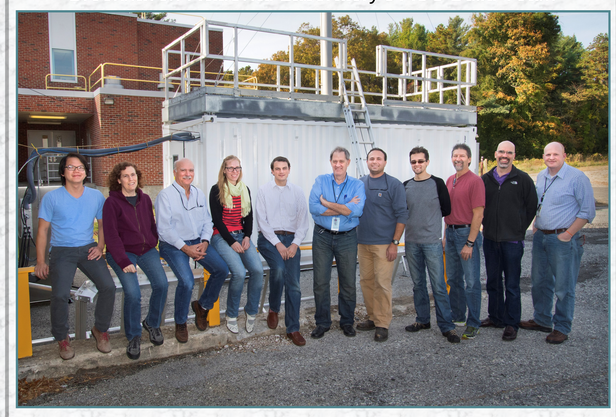
Inter AOS sampling – Comparison of PSAPs excellent



November 19, 2016 – Size distribution from 3 nm to ~20 μm



Brookhaven National Laboratory's AOS Build Team



Our special thanks to Nicki Hickmon and Mike Ritsche for their support and encouragement throughout the project. Our thanks also to Kenny Teske, SGP Operator, who has been there to do whatever has been needed to install and operate the new Aerosol Observing System.