ARM Aerosol Measurement Plan Progress

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Introduction

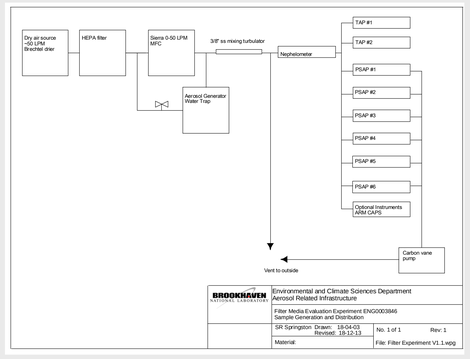
In May 2018, Mather, Springston and Flynn released the ARM Aerosol Measurement Plan, DOE/SC-ARM-TR-213. This plan addresses operational challenges, measurement complexity and alignment of aerosol measurements with active research. Specific needs are identified and consensus action items are put forth. The goal is to enhance the scientific impact of aerosol measurements with a set of near-term tasks. High-priority items were called out:

1. Add O_3 instrument to SGP (Done)
2. Analysis of ENA Supplemental site data (Done)
3. Inlet drying prior to impactor (Done at SGP)
4. Full-range size distribution at CACTI (Done by guest installation of APS)
5. Develop comparable size distribution representation across instruments (in progress)
6. Determine PSAP/TAP filter successor (Done)
7. Implement quantitative QA/QC in ACSM data products (Analysis complete – See Watson poster)

Optical Properties – ENG0003846 Select Replacement Media for PSAP

Four candidate filter media were tested for mechanical and optical performance against the Pall E70 media which is no longer produced. Emfab filters were selected for future ARM use based on agreement with the E70 in mechanical behavior, compositional similarity and measurement results. Detailed differences for ambient aerosols will be studied in a proposed side-to-side comparison over 6-12 months at SGP. ARM has an opportunity to participate in a major European intercomparison of absorbance techniques for FY '20.

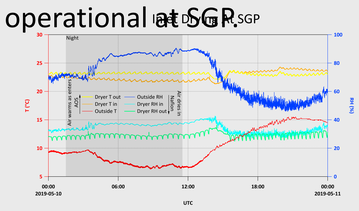
Rollout of new filters will commence beginning in FY '20 for fixed sites and, starting with next IOP, at mobile sites.



System Configuration – ENG0003571 Implement Inlet Drying at SGP

To have a meaningful 1/10-µm diameter cutoff with the impactor that precedes optical property instruments (scattering, absorbance and extinction), the sample must be dried to a consistent value (goal of ~35% RH). Three large Nafion tubes dry sample prior to the impactor. The first unit is operational at SGP.

Inlet Drying at SGP



The system works to date with summer operations remaining to be verified. Will roll out to all AOSes as allowed.

Instrument Change Highlights

- MAOS A/C reconfigured to AMF1 AOS01 (and MAOS on loan to Puerto Rico). Add APS (guest) for CACTI
- AMF2 AOS02 upgrades for MOSAiC: CCN-200 (new), µCPC (new), SP2 (guest), TOF-ACSM (guest), SMPS (loaner)
- SGP AOS07 additions: O_3 Analyzer, inlet drying, next-gen f(RH)

AOS Instrument Complement
Last Revised: V1.11, 05/24/2019

Instrument	AMF1 AOS [*1]	AMF2 AOS	AMF3 AOS	ENA AOS	SGPF13 AOS
ACSM/Q - Aerosol Chemical Speciation Monitor - Quadrapole					
ACSM/TOF - Aerosol Chemical Speciation Monitor-Time of Flight		Guest for MOSAiC			
Aethalometer					
APS - Aerodynamic Particle Sizer					
CAPS - Cavity Attenuated Phase Shift Monitor					
CO - Carbon Monoxide/Nitrous Oxide/Water Vapor					
CCN - Cloud Condensation Nuclei	CCN-200	CCN-200	CCN-200 non winter	CCN-100	CCN-200
CPC - Condensation Particle Counter					
µCPC - Ultra-Fine Condensation Particle Counter					
GHG - Green House Gases (CO2, CH4))					
HTDMA - Humidified Tandem Differential Mobility Analyzer	removed for CACTI		non winter		
1- 10-µm Impactor					
n-SMPS - Nano Scanning Mobilty Particle Sizer					
Neph, Amb - Nephelometer, Ambient					
Neph, Dry - Nephelometer, Dry RH Scanned		Broken			
NOx - 3 Channel: NO, NO2, NOy					
O3 - Ozone					
PASS-3 - 3 Wavelength Photo Acoustic Soot Spectrometer *2	sunset				sunset
PILS - Particle Into Liquid Sampler					
PSAP - Particle Soot Absorption Photometer					
PTRMS - Proton Transfer Reaction Mass Spectrometer					
SMPS - Scanning Mobility Particle Sizer		Guest for MOSAiC			
SO2 - Sulfur Dioxide					
SP2 - Single Particle Soot Photometer		Guest for MOSAiC			
TAP - Tricolor Absorption Photometer					
UHSAS - Ultra High Sensitivity Aerosol Spectrometer					
WXT520 – Weather Sensor					

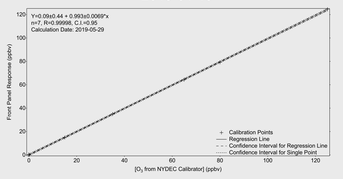
Legend	
Part of System	
Not part of System	
Part of System, not yet Delivered	
At site but not installed in AOS	
Currently needs replaced	

Notes
*1 Original AMF1 AOS was mothballed as of 12/1/2015. It is formally replaced by MAOS-A.
*2 The PASS-3 was sunset on 10/1/2015.

O_3 Analyzer Standardization

Mentor calibrated four ARM instruments and an O_3 source at the NY Department of Environmental Conservation against a NIST traceable standard. ARM now has a 'spare' O_3 analyzer which will be rotated through deployed AOS systems. Vendor calibration of new instruments was within ~1% of the NIST standard. Experience this year identified switching valves as a consumable and spares were provided to all sites.

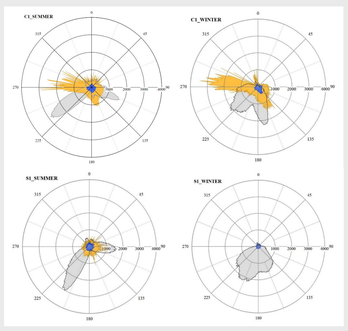
TEI Model 49i, SN 1181370005/WD 85205 (Floater)
2019-01-19



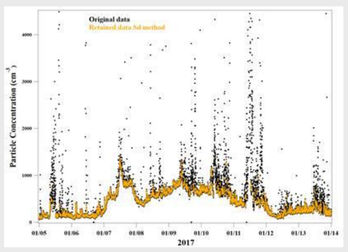
Deployment Strategies– ENG0003248 and ENG0003875 ENA Supplemental Site Report (Aiken, Gallo, Uin et al.,)

Local sources impacting the the Central Facility were identified by comparison with measurements at the S1 site.

Local pollutant spikes can be removed from regionally representative background through mathematical algorithms. Standard deviation method using AOS CPC data is applied in the report. Moving the C1 site IS NOT justified since impacts are ubiquitous.



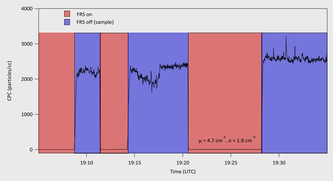
CPC – orange, UHSAS – blue, wind - grey



System Configuration – ENG0004003 AMF2 AOS For MOSAiC

The AOS02 was refurbished at BNL prior to deployment. Multiple instruments were added. To deal with stack-exhaust contamination while aboard the iced-in *Polarstern*, Mentors designed and implemented a system to automatically purge the aerosol sampling inlet with filtered air based on a threshold value of [CO]. Scrubbing efficiency for fine particles > ~99.9%

Flow Reversal System Demonstration



Upcoming/Ongoing Efforts (partial list)

- (ENG0003794) Inlet Characterization for D_p > 1 µm – Experiment at SGP in FY '19-'20. This is follow on to the characterization from 10 nm > D_p > 1 µm as described in DOE-SC-ARM-TR-191
- Replacement of AMF1 AOS01 structure prior to TRACER
- (ENG0003133) Validation of X-Ray Neutralizers for Long-Term Use – Study is dependent on future IOP deployment plans to a location not allowing radioactive neutralizers
- Uniform reporting of size distributions (n-SMPS, SMPS, UHSAS, APS)
- Moving selective instruments from AMF3 AOS03 to NSA (Barrow)