

Progress toward Aerosol Measurements Implementation Plan (May 2018, DOE/SC-ARM- TR-213)

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Aerosol Breakout Session ARM STM 190610

Strategic Plan action items
Deployed instrument array
Hygroscopicity (Uin)
Other activities
Upcoming work



Priority Activities from Strategic Plan

1. Complete Instrument Set at SGP (Done 3/18/19)
 - Develop protocol for rotating calibrated O₃ instrument
 - Test bed for procedures, new instrumentation, system characterization (CAPS, inlet drying, next-gen f(RH), HTDMA)
 - SGP AOS07 is FULL – Room for adjoining AOS expansion
2. ENA Site Characterization
 - Local sources and influences studied by G-1 fly overs, winter/summer measurements at supplemental site
 - Report on characterization in review

Priority Activities from Strategic Plan

3. Inlet drying system
 - Motivation
 - Design
 - Implementation (Done)
 - Evaluation (Ongoing)
 - Roll out to humid sites
4. 2nd Full range set of size characterization (Done)
 - SGP AOS07 goes from ~ 3 nm - > 10 μ m (n-SMPS, SMPS, UHSAS, APS)
 - APS used in AMF1 AOS01 CACTI* (SMPS, UHSAS, APS)
 - SMPS available for AMF2 AOS02 MOSAiC
5. Comparable size distribution representation (Ongoing)

Priority Activities from Strategic Plan

6. Filter Migration (Done)

- Study at BNL selected Pall Emfab (Complete)
- Extended comparison at SGP
- Potential ARM participation in European absorbing aerosol study at Paul Scherrer Institute (2020)
- Ongoing evaluation of the TAP (vs. PSAP)

7. ACSM Quality Assessment

- $$C_s = \left[\left(\frac{1}{CE * T_{m/z} * RIEs * RF_{NO_3}} \right) \sum_{all\ i} IC_{s,i} \right] * \left(\frac{AB_{ref}}{AB_{meas}} \right)$$
- Instrument stable
- Calibration protocol established and followed
- CE = f(season and composition) bounding uncertainties
- Bottom line – need to bound with independent volume, i.e., UHSAS
- Report in final stage

Instrument Array



AOS Instrument Complement

Last Revised: V1.12, 06/09/2019

Instrument	AMF1 AOS01 ^{*1}	AMF2 AOS02	AMF3 AOS03	ENA AOS06	SGPE13 AOS07
ACSM/Q - Aerosol Chemical Speciation Monitor - Quadrapole					
ACSM/TOF - Aerosol Chemical Speciation Monitor-Time of Flight		Guest for MOSAiC	removed 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 (CO ₂ , CH ₄)					
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, NO ₂ , NO _y					
O ₃ - 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			
SO ₂ - 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 AOS00 was mothballed as of 12/1/2015. It is formally replaced by AMF1 AOS01.

*2 The PASS-3 was sunset on 10/1/2015.

Instrument Array Consequences

Since 2009, Mentors, Translators and DMF have provided significant operational efficiencies allowing:

- New AOSes (AMF3 AOS03, SGP AOS07)
- New instruments (TOF-ACSM, APS, TAP, CAPS, Impactor, n-SMPS)
- Increased Count (~10) of existing instruments

Review and prioritization has led to downsizing (MAOS A/C reconfiguration, PILS, PTRMS, PASS3, NO_x)

Additional instruments/activities have to be balanced against resources in current flat environment (AMSG, UEC, Mentors, Pls, Use statistics Surveys . . .)

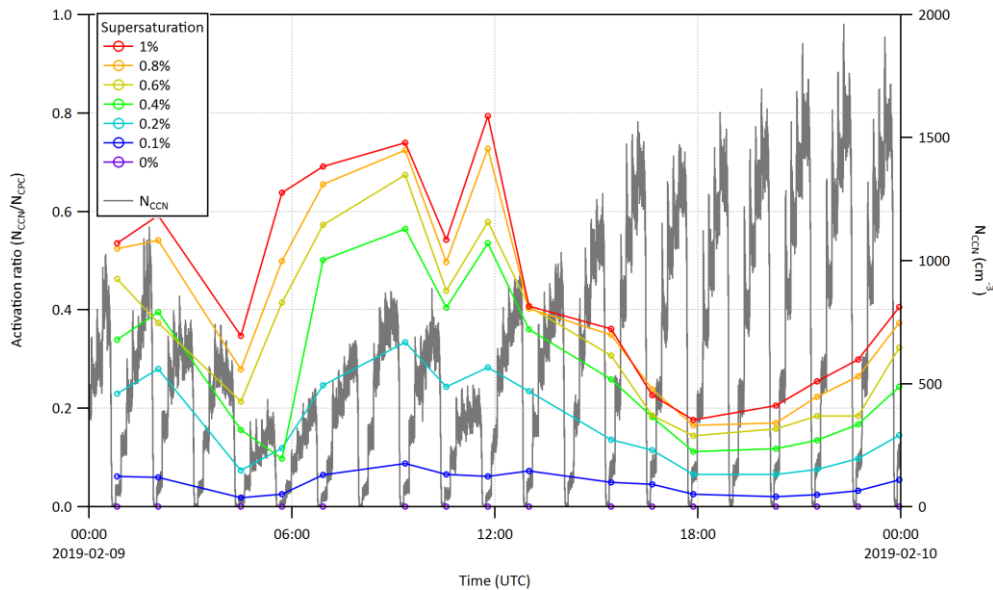
Some of those current activities include:

- SP2 Intercomparison/Harmonization leading to . . .
- 2-Spot aethalometer
- Absorbing aerosols
- ACSM Study leading to . . .
- Selective sampling (for MOSAiC)
- Hygroscopicity

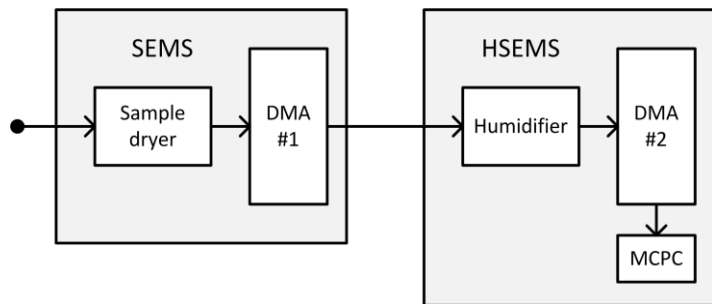
Cloud condensation nuclei – CCN

- ▶ **Number concentration of activated aerosol particles as a function of supersaturation**
- ▶ Two columns with one as a reference (at fixed SS%)
- ▶ Supersaturation scan cycle: 0, 0.1, 0.2, 0.4, 0.6, 0.8, 1.0%

- ▶ DMT CCN 200 (upgrade from CCN 100)

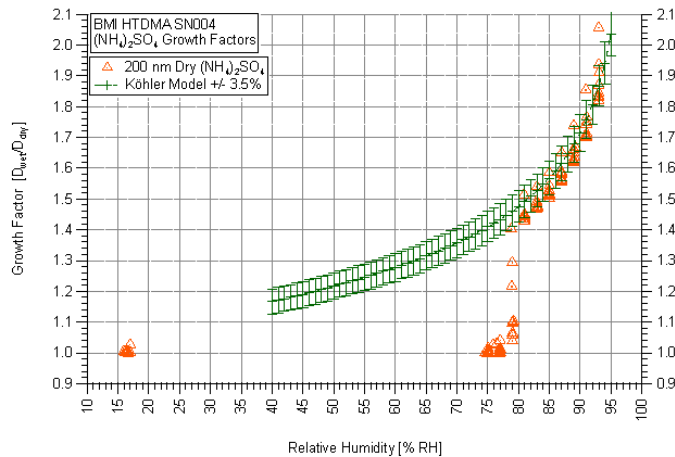
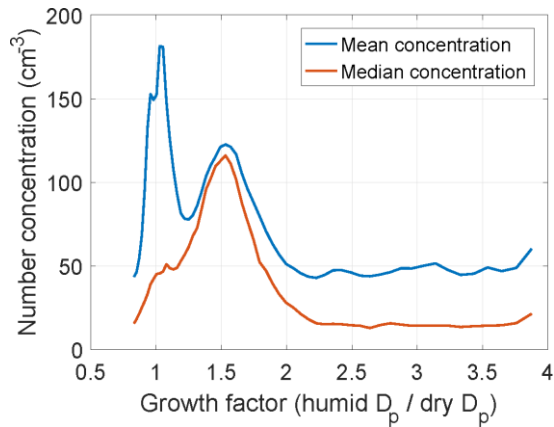


► Size-resolved particle growth factor



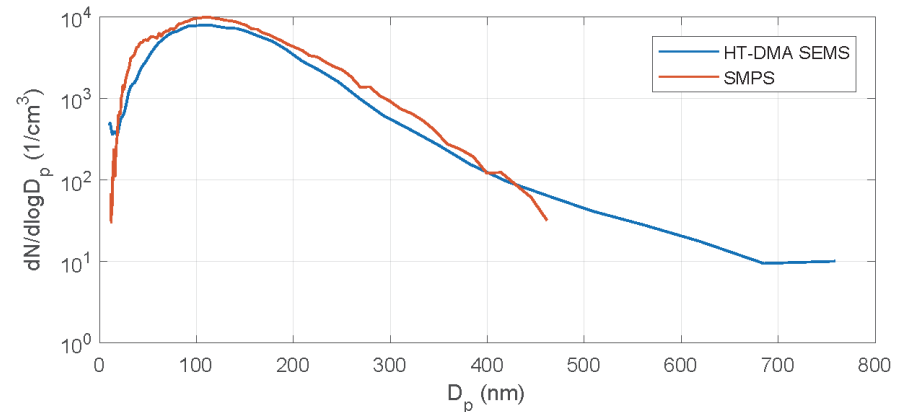
- 50, 100, 150, 200, 250 nm dry cut-sizes
- Fixed RH (can be stepped)





Expanding the measurements:

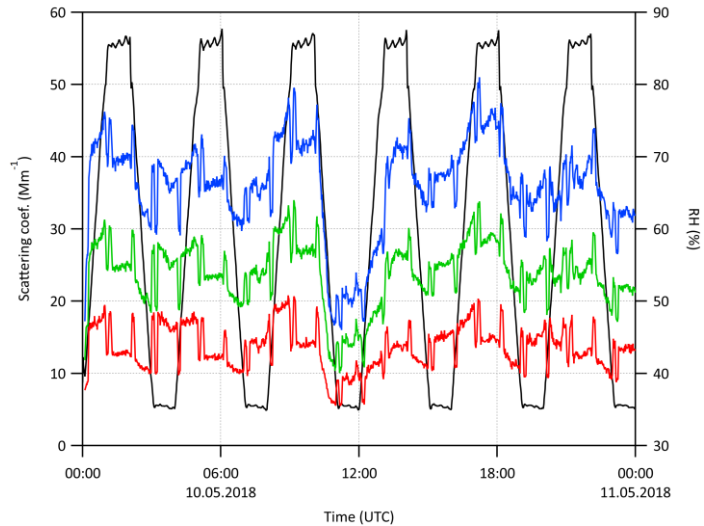
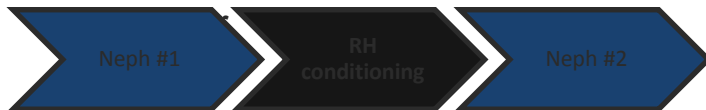
- ▶ Calculating the hygroscopicity parameter, K
- ▶ Extending the dry cut-size range
- ▶ Ambient size scans (“SMPS mode”)



Optical scattering – Humidigraph



- ▶ **Optical scattering as a function of RH**
- ▶ Deliquescence and efflorescence
- ▶ Synchronized with the AOS



Upcoming (watch this space)

Vertical profiles of aerosols

- Raman LIDAR/HSRL at SGP (upgrade of ARM HSRL) + MFRSR constrains retrieval
- UAS capabilities (Drones, TBS, tower(?))

Uniform Size Distribution Presentation

- Stitched distribution (n-SMPS, SMPS, UHSAS, APS) ???

Aerosol inlet characterization $> 1 \mu\text{m}$

Ground Measurement Platform Needs

- AMF1 AOS01 update (between COMBLE and TRACER)
- SGP AOS07 extension
- AMF3 AOS03 (partial) transfer of instruments to Barrow

X-ray neutralizer vs radioactive source (status pending)



Upcoming (watch this space)



Filter Measurements of Aerosols

- Addition of IMPROVE Network to SGP
- 4-season side-by-side PSAP filters at SGP
- Paul Scherrer Institute Absorbance Study Spring 2020 (incl. PTI, CAPS/SSA, filters)

