AEROSOL OBSERVING SYSTEM (AOS)

AMF Shouxian, China 2008

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Aerosol Observing Systems

In-situ surface measurements of aerosol optical, chemical, size, hygroscopic and cloud-forming properties

- SGP
  - ARM central facility Lamont, OK
- AMF
  - Pt Reyes, CA 3/2005 - 9/2005
  - Niamey, Niger 12/2005-1/2007
  - Murg Valley, Germany 4/2007 -1/2008
  - Shouxian China 5/2008 - 12/2008
  - Graciosa Island, Azores 4/2009
- BRW/NSA
  - Barrow Alaska

Changes to the AOS systems/Status

SGP

- interface AOS CCN and HTDMA for daily salt calibrations of the CCN supersaturations.
- add Photoacoustic Spectrometer *(Dubey)*
- add Particle Sizer *(Collins)*
- suspend inorganic filter measurements

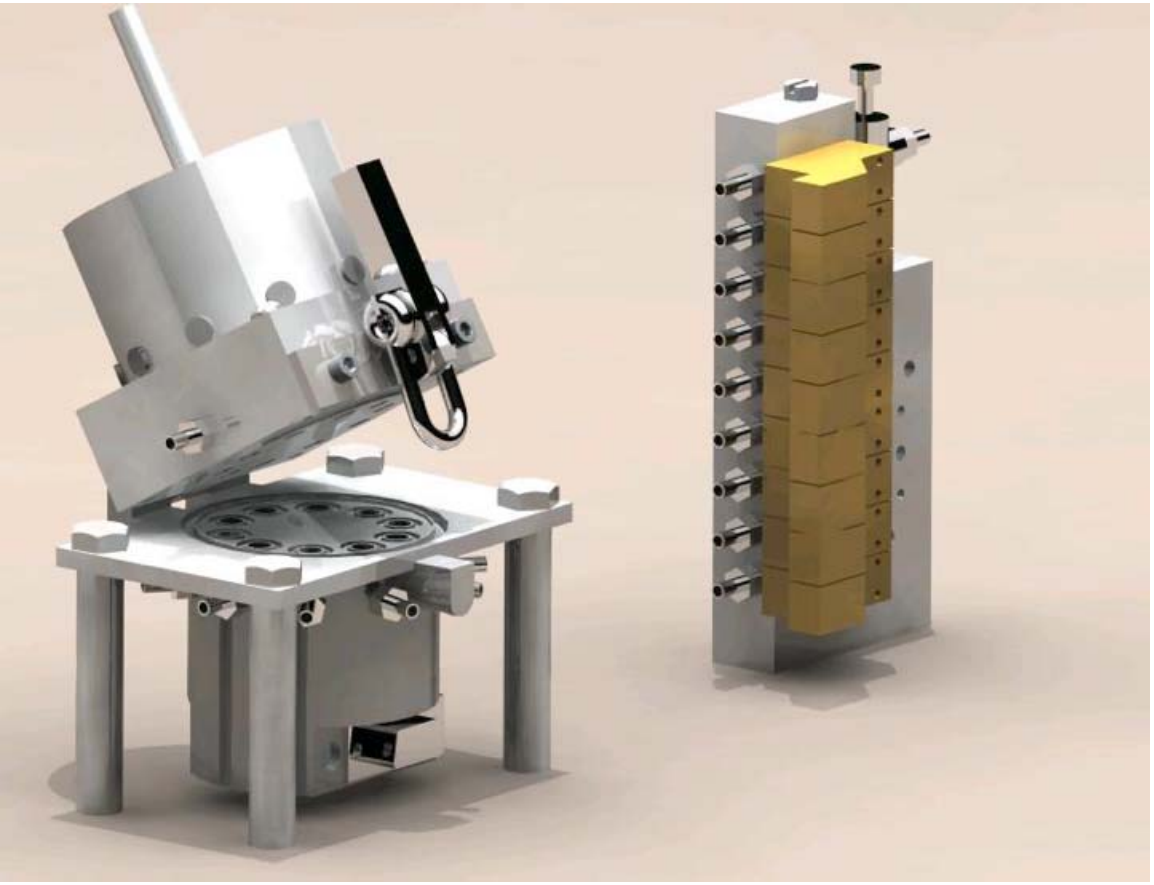
BRW/NSA

- 2007- add a CCN and a SMPS
- 2008 add filter measurements of EC/OC (*Russell*, *Scripps)*
- 2008 suspend fRH until system redesign
- 2009 suspend inorganic filter measurements (?)

AMF

- 2008 add a dilution/dryer system to prolong instrument performance

NOAA Multi-filter Light Absorption Instrument



9 sampling sites on each filter for remote and polluted sites

Small size can mount on neph

Transparent data acquisition

Higher sensitivity, lower S/N

Variable integration time on each wavelength

Design and software are OPEN SOURCE

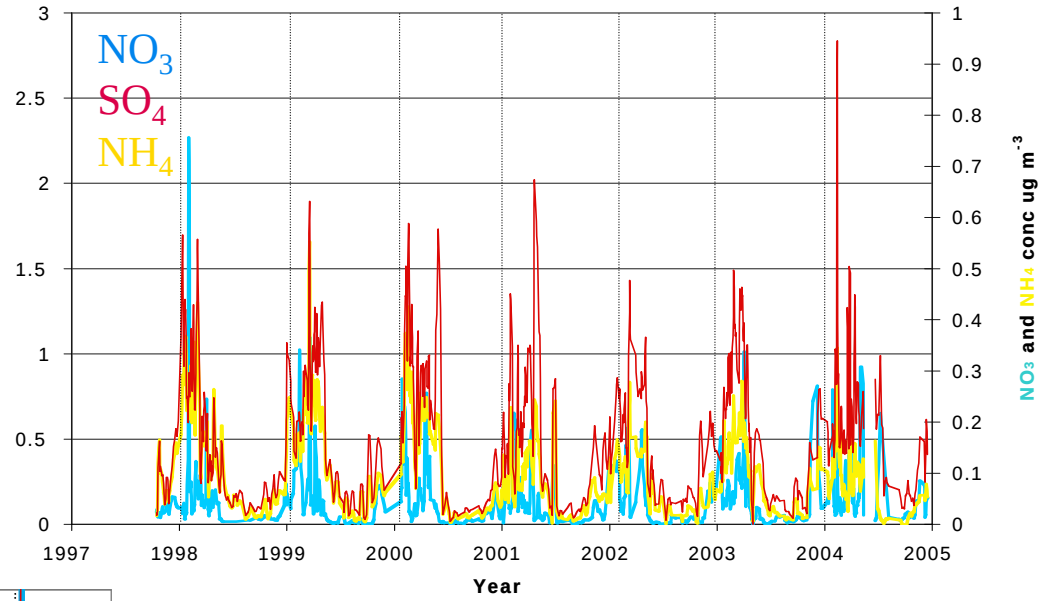
Low cost ~ $6000

Heated optics block and sample inlet for RH control

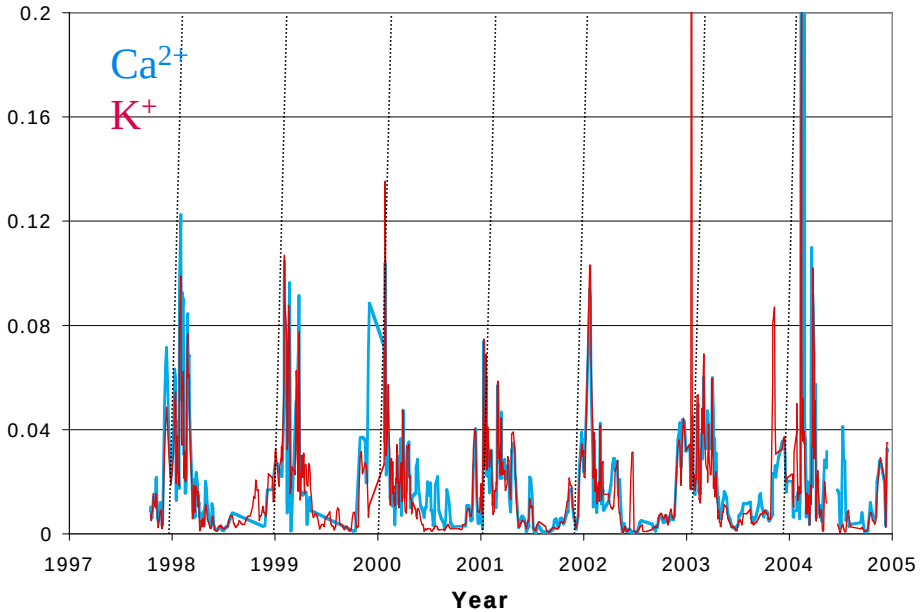
Ability to calibrate wavelength, detector response and filter reflectance

Filter measurements of inorganic ions at BRW/NSA

Patricia Quinn *NOAA/PMEL*
BRW data: 1997-2004
saga.pmel.noaa.gov/data/stations
Quinn et al. Tellus, 59B, 2007



NSA dust and smoke aerosol

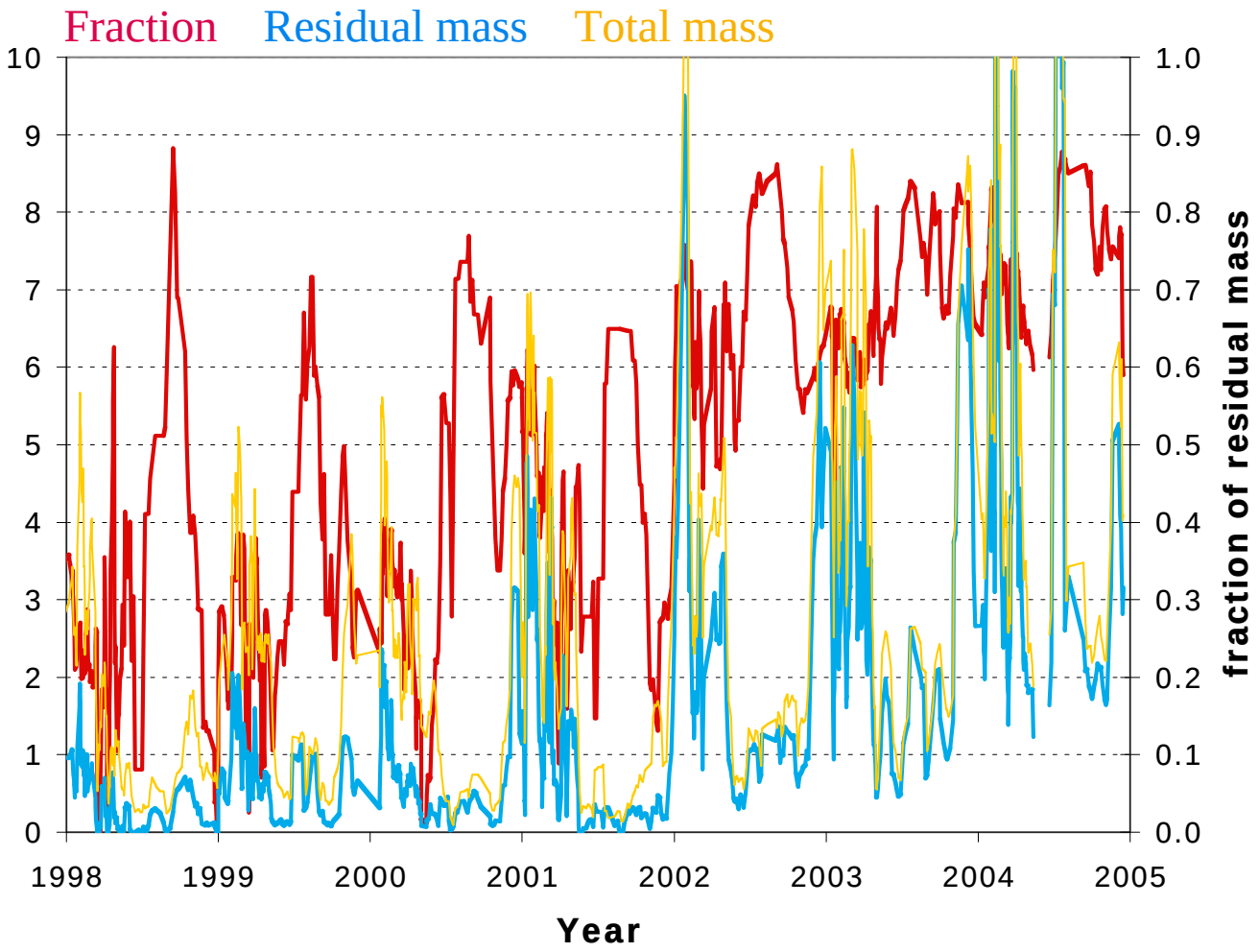


NO_3 , SO_4, NH_4 show seasonal cycle with high in Spring with no apparent annual cycle.

Sources of smoke and dust are unclear as these aerosol are present in the winter as well as the spring. Transport in the winter is often via the Arctic vortex.

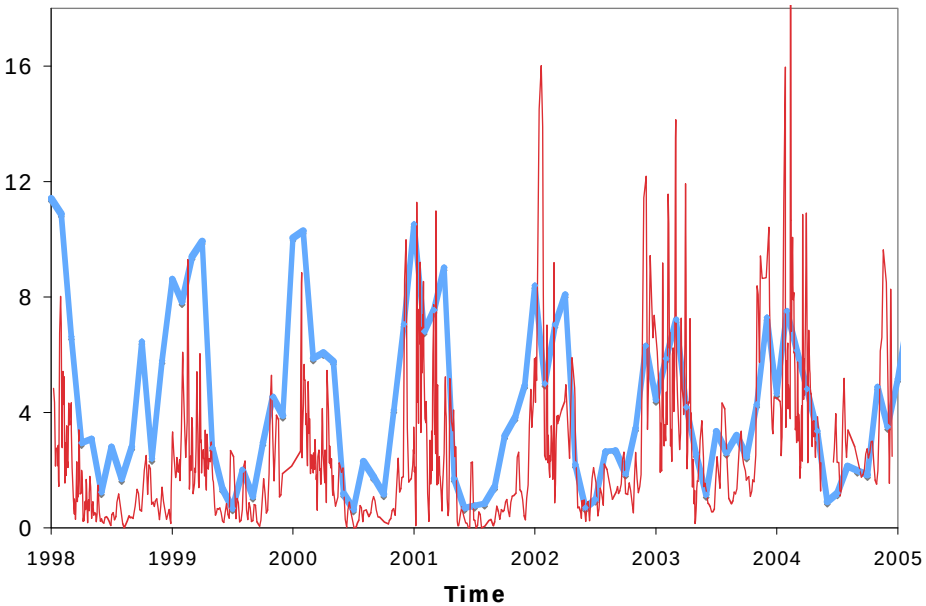
Submicron inorganic ion composition Daily March-May Every 4 days June-Feb.

NSA Residual(organic + H_2O?) mass is high in the Spring and shows a pronounced increase in baseline levels since 2002. All ion measurements are conducted at 33% RH. Residual fraction is higher in the summer perhaps from biogenic emissions. Road construction to the site was finished in 2000. Even though the road and NSA building are out of the sampling wind sector, there could be contamination from car traffic as well as off shore drilling.

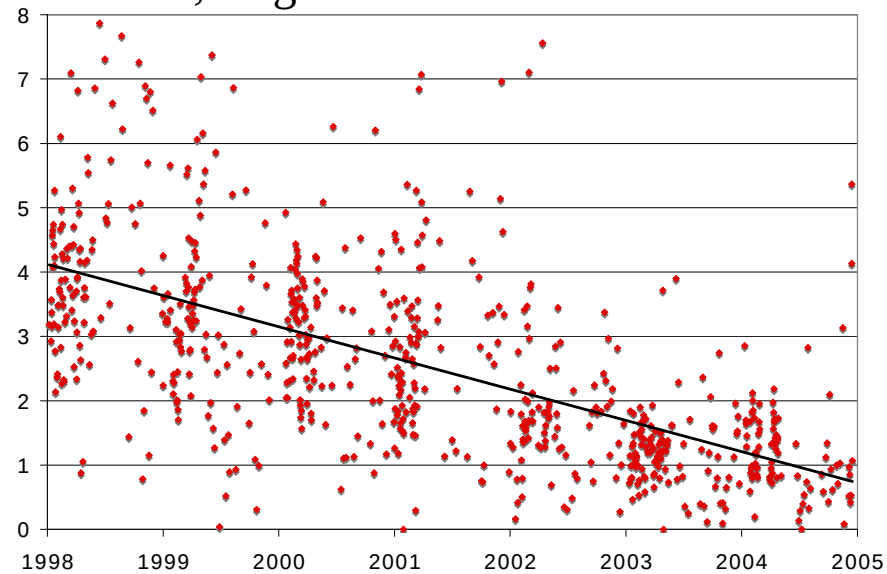


Trends in the Barrow chemical and optical data

Sub*um* scattering coefficient @ 550 nm Mm^{-1}
Sub*um* aerosol mass concentration *ug*m^{-3}

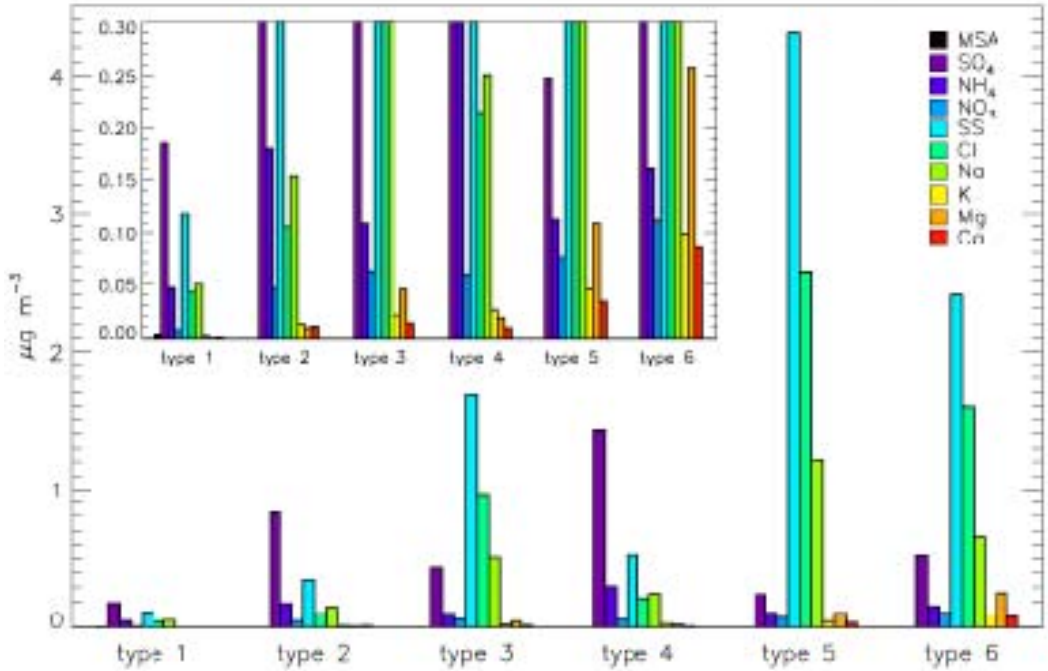


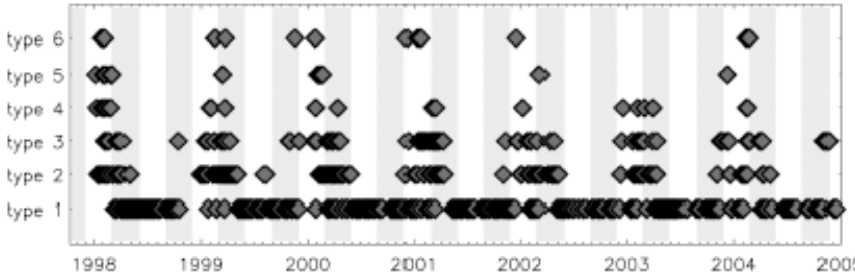
sub*um* mass scattering efficiency
550 nm, m^2gm^{-1}



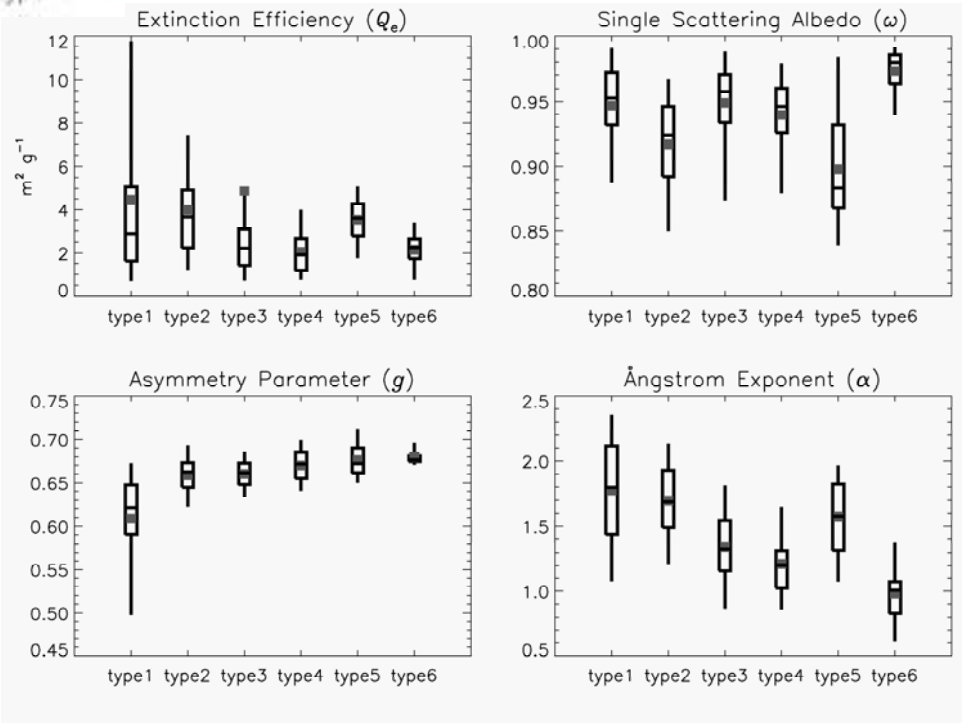
The increase in the aerosol mass and slight decline in the aerosol scattering coefficient indicates a decline in the aerosol mass scattering efficiency over the 1998-2005 measurement period.

K-means Cluster Analysis of NSA aerosol chemistry and optical properties





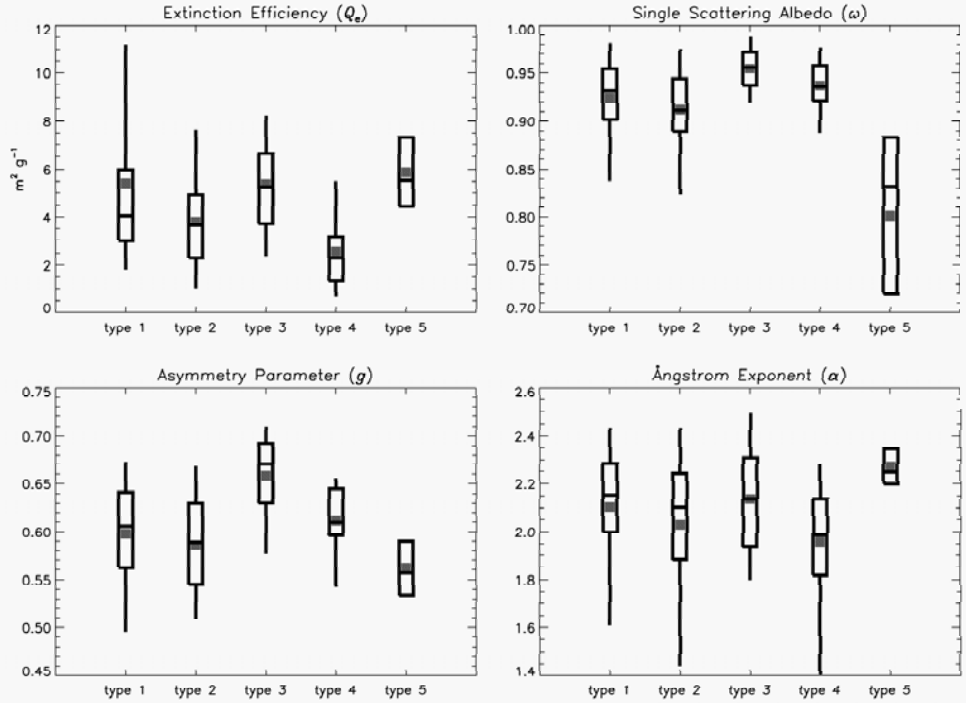
1	2	3	4	5	6
Clean	p-clean	p-SS	sulfate	SS-smoke	SS-dust-smoke

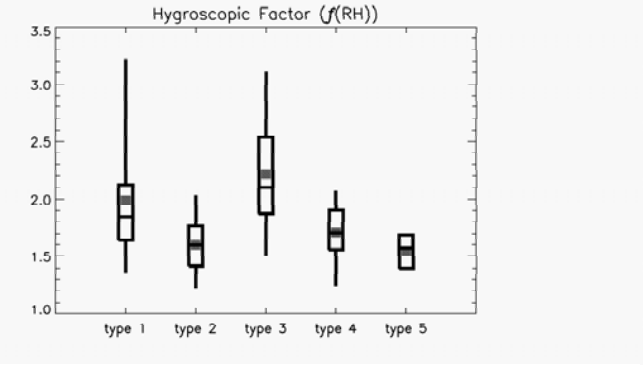


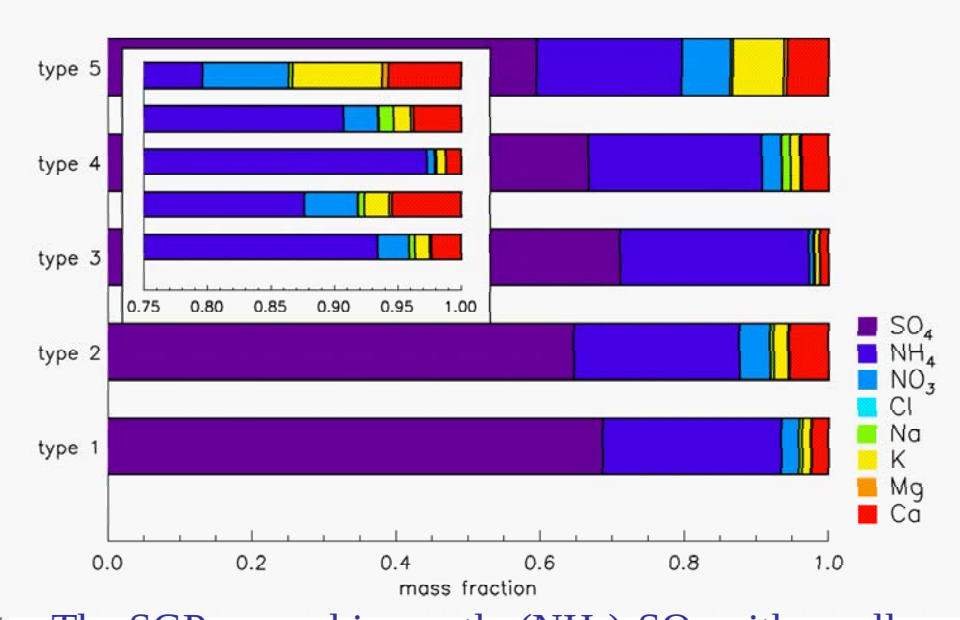
Trajectory analysis of the aerosol types shows no clear source direction for any one type. Sea salt is the dominant component with secondary contributions from sulfate, dust and smoke. Type 1 dominates throughout the year with large contributions from types 2,3 and 4 during the Spring.

Allison McComiskey

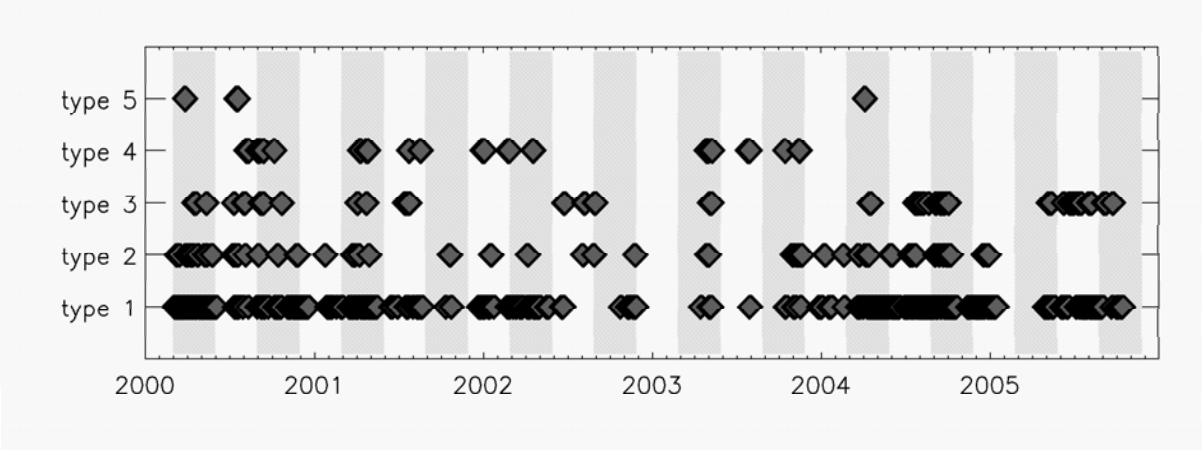
SGP Cluster Analysis



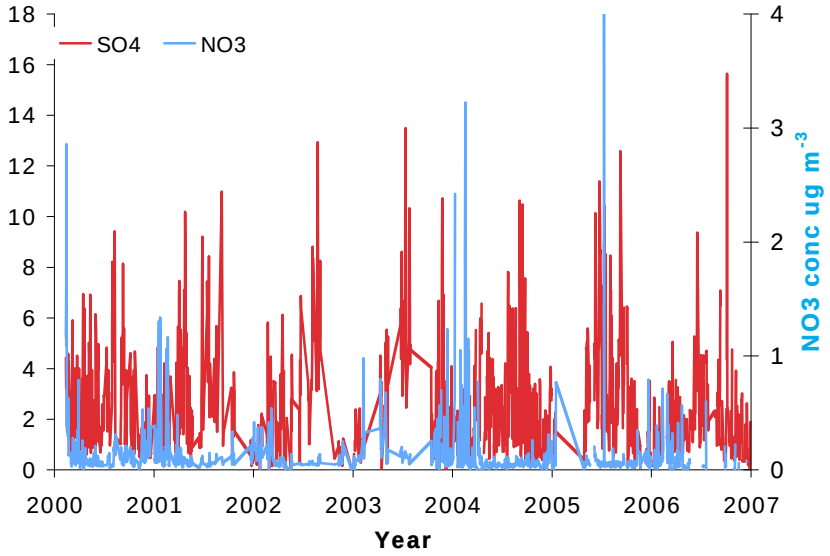


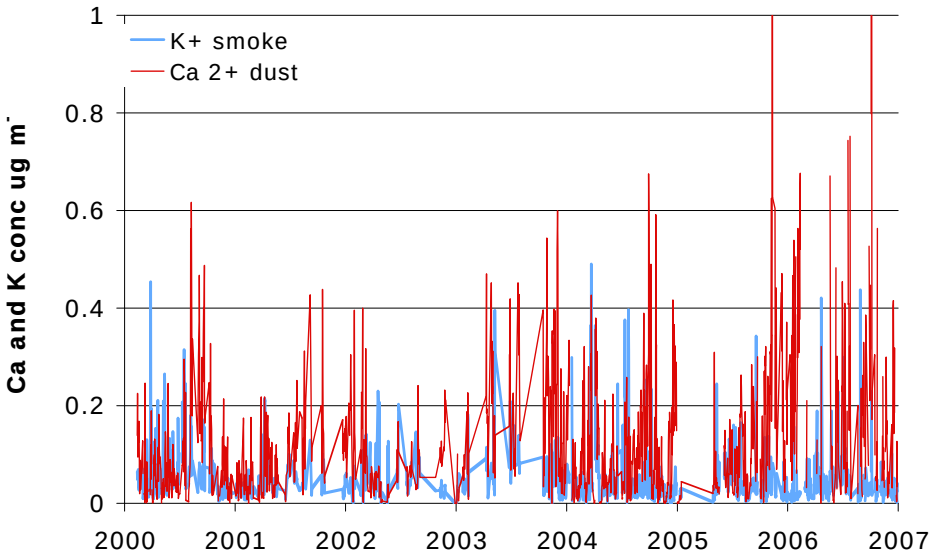


The SGP aerosol is mostly $(NH_4)_2SO_4$ with small contributions from other ions.



SGP Inorganic aerosol ion concentrations





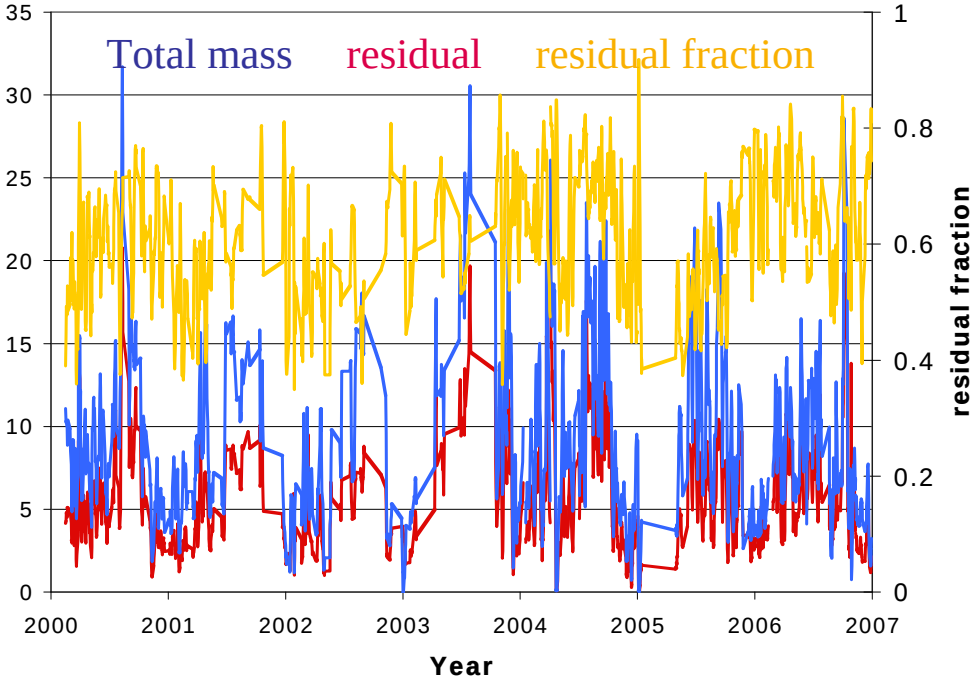
Sulfate is the dominant component

Higher mass loading in the Fall

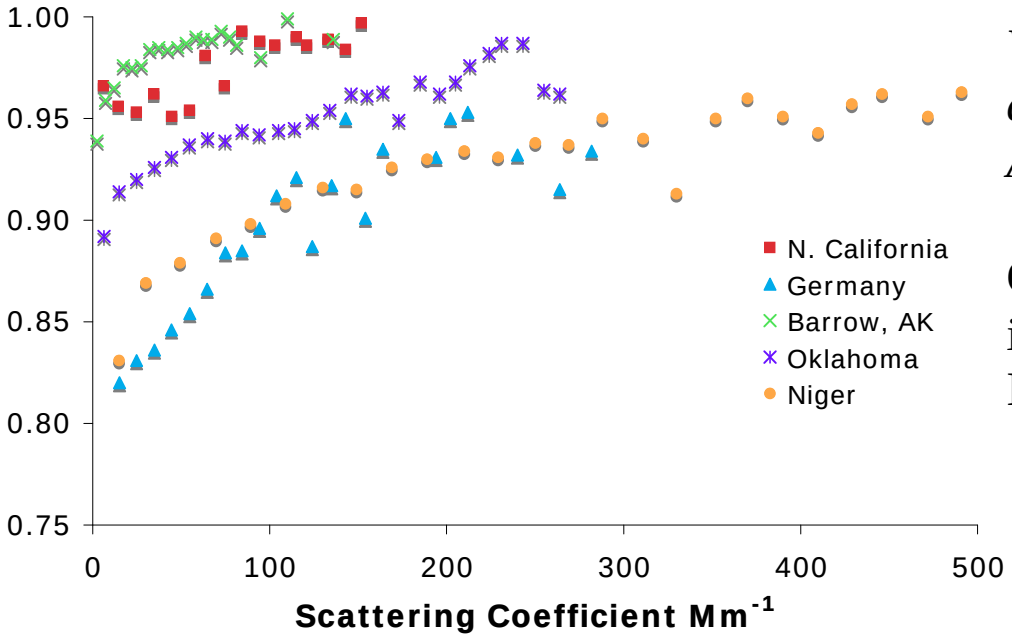
No annual trends

As much as ~50% of Ca and NO_3 are in the supermicron size range

The 5 aerosol types of the cluster analysis exhibited no distinct source regions

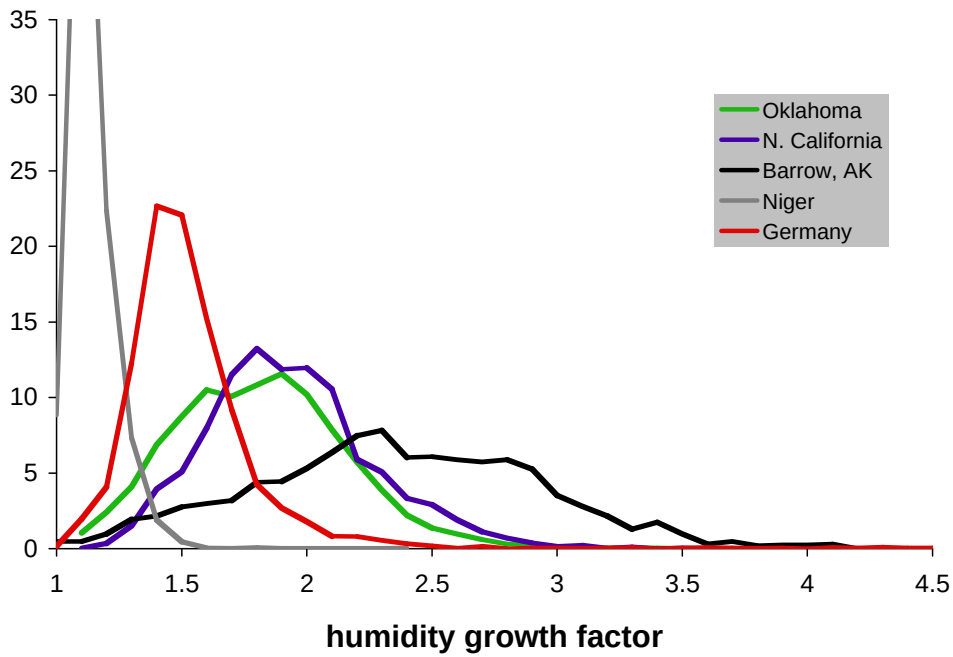


Trends in Aerosol Optical Properties



Variation in the single scattering albedo at 550 nm with aerosol loading at the ARM sites

General trend at most all sites that SSA increases with aerosol loading (except Indian Ocean)



Frequency distribution of hygroscopic growth factors at the ARM sites

Temporarily suspend NSA measurements to redesign system to look at upper portion of hysteresis using a dehumidification rather than humidification

Summary

Install a new multi-filter PSAP at SGP next year

New APS and PAS instruments at SGP

~75% of the aerosol mass at NSA and ~65% of the aerosol mass at SGP is residual or mostly organic and H_2O composition.

There was little variation in the SGP inorganic ion composition at SGP or in the optical properties associated with changes in inorganic composition.

NSA residual (organic) composition has increased since 2000.