ACP PARTICIPATION IN ARM AEROSOL IOP

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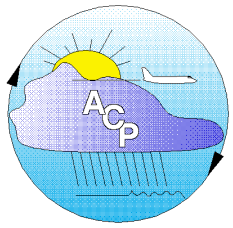

Prepared for presentation at

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BACKGROUND

- Importance of aerosols on local and global radiation budget.
- ARM will be conducting IOP (Intensive Operations Period) in May, 2003, focusing on aerosol influences on radiation components.
- Centerpiece of this IOP will be a series of ***closure experiments*** testing theory relating vertical dependence of several radiation components to vertical structure of aerosol optical properties, using aircraft measurements.
- Aerosol optical properties will be measured continuously at the surface as well as on aircraft during flights.
- These surface measurements provides opportunity for a complementary set of closure experiments testing ability to relate aerosol optical properties to composition and microphysics.
- Similar set of closure experiments relating CCN spectrum to composition and microphysics.

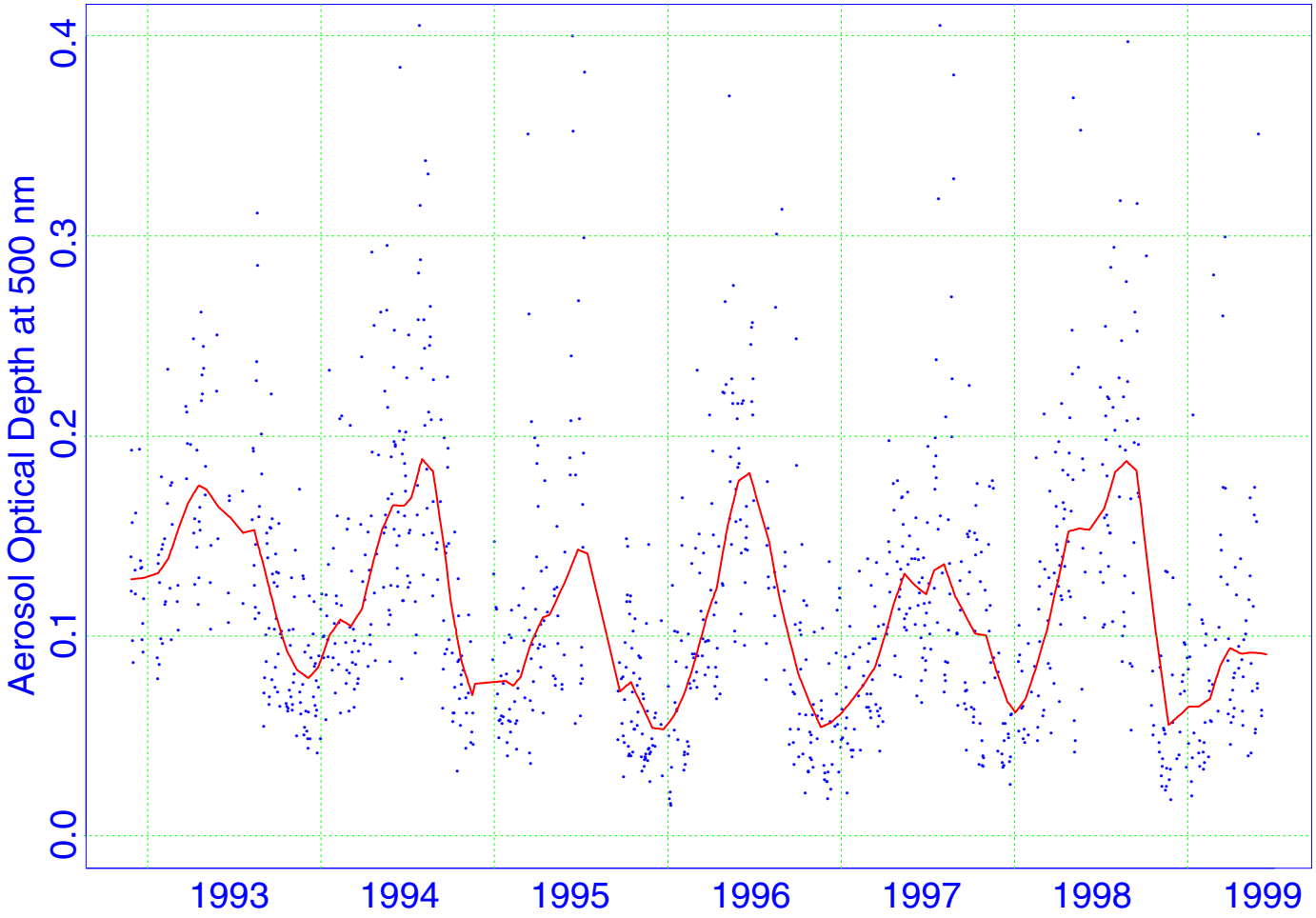
IMPORTANCE OF AEROSOLS TO ARM

- Aerosol influences on shortwave radiation are substantial locally and globally, ***directly*** (clear air) and ***indirectly*** (affecting cloud properties).
- An aerosol optical thickness of 0.1 results in an instantaneous decrease in direct normal surface irradiance of ca 100 W m^{-2}, and (depending on particle size and single scattering albedo) a top of atmosphere forcing of ca 30 W m^{-2}.
- Aerosol optical depths at SGP are commonly 0.1 and often more.
- Aerosol influence on the vertical distribution of atmospheric heating, depends sensitively on the aerosol single scattering albedo.
- ARM CART has been systematically measuring aerosol properties at the surface, by LIDAR, and regularly but intermittently by light aircraft.
- Knowledge of pertinent aerosol properties is required to accurately represent aerosol forcing in models.

AEROSOL OPTICAL DEPTH

Determined by Sunphotometry

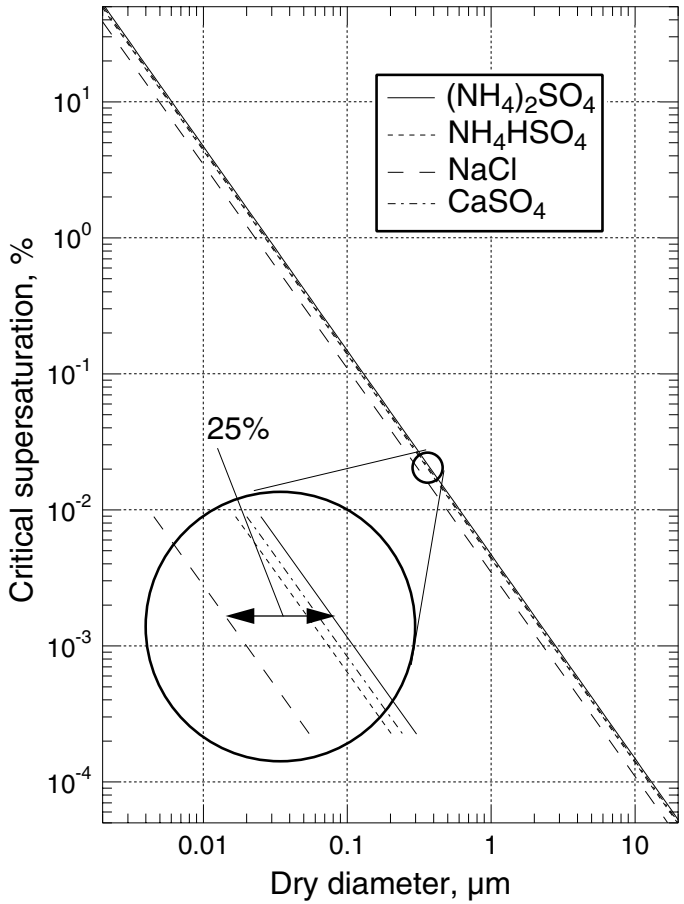
North Central Oklahoma



J. Michalsky et al., JGR, 2001

DEPENDENCE OF CRITICAL SUPERSATURATION ON PARTICLE SIZE AND COMPOSITION

$$S_c - 1 = \left(\frac{32}{27}\right)^{1/2} \left(\frac{MW_w}{\rho_w}\right) \left(\frac{MW_s}{i\rho_s}\right)^{1/2} \left(\frac{\sigma_{w/a}}{RT}\right)^{3/2} a^{-3/2}$$



For diameter = 0.1 µm, $S_c - 1 \approx 0.1\%$

AEROSOL OPTICAL PROPERTIES TO BE MEASURED DURING IOP

- Scattering coefficient (450, 550, 700 nm)
  - Total (7-170˚) and backscatter (90-170˚)
  - Dry (RH < 40%) and *f*(RH) (40 - 90%)
  - Aerodynamic diameter < 10 μm and < 1 μm
- Aerosol absorption coefficient (PSAP, 550 nm)
- Optical particle counter PCASP-X, 0.1 - 10 μm, 31 channels, RH < 40%
- CNC (total count, diameter > *ca* 10 nm)
- **CCN spectrum 0.1 - 1% supersaturation (Hudson)**
- **Aerosol extinction (Cavity ringdown; Moosmüller, Arnott; Strawa)**
- **Aerosol absorption (Photoacoustic; Moosmüller, Arnott)**
- RH
- Ozone

IMPORTANT AEROSOL CHEMICAL AND MICROPHYSICAL PROPERTIES

- Major inorganic ions
- Organic carbon
- Inorganic carbon
- Speciated organics
- Particle size distribution; dry and f(RH)
- Size-dependent composition (or at least some views of it)
- Morphological analysis (microscopy)

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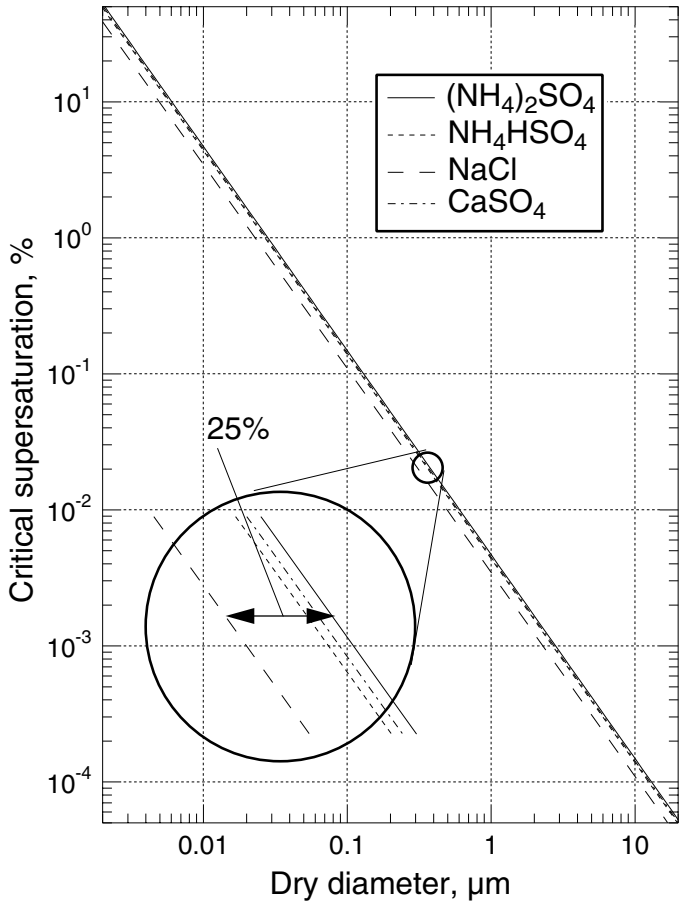

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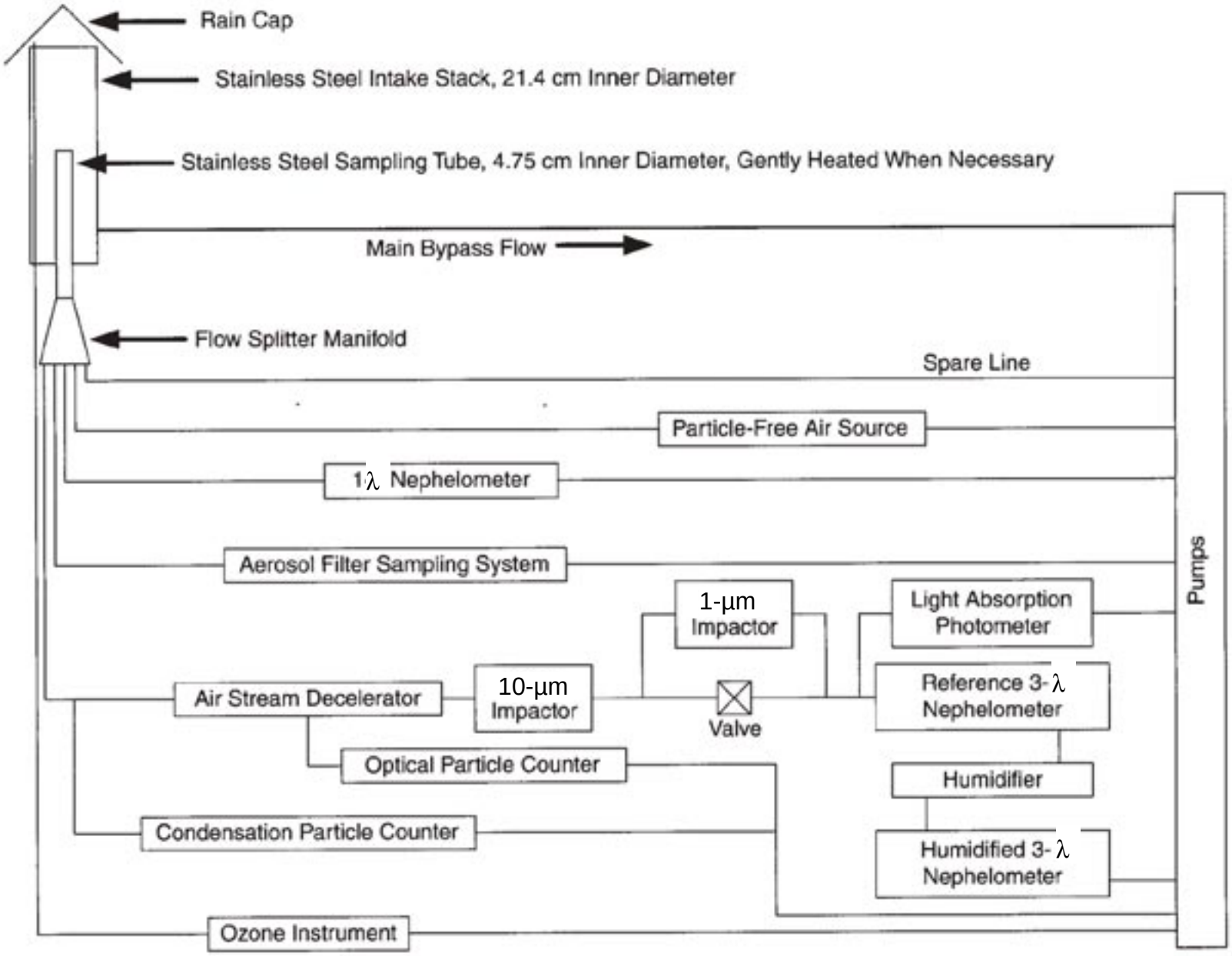
POTENTIAL CLOSURE EXPERIMENTS INVOLVING AEROSOL CHEMICAL AND MICROPHYSICAL PROPERTIES

- Size-dependent composition --> scattering coefficient, absorption coefficient, backscatter fraction, Ångström exponent, ...
- Size-dependent composition --> RH growth of diameter, optical properties
- Size-dependent composition --> CCN spectrum

AEROSOL SAMPLING SYSTEM AT SGP SITE



Sheridan, Delene & Ogren, JGR, 2001

IF YOU ARE INTERESTED . . .

Please contact Marv Wesely or Steve Schwartz