

# ARM In-situ Aerosol Profiling (IAP)



- **Objectives**

- obtain aerosol climatology aloft
- determine relevance of surface climatology to vertical column

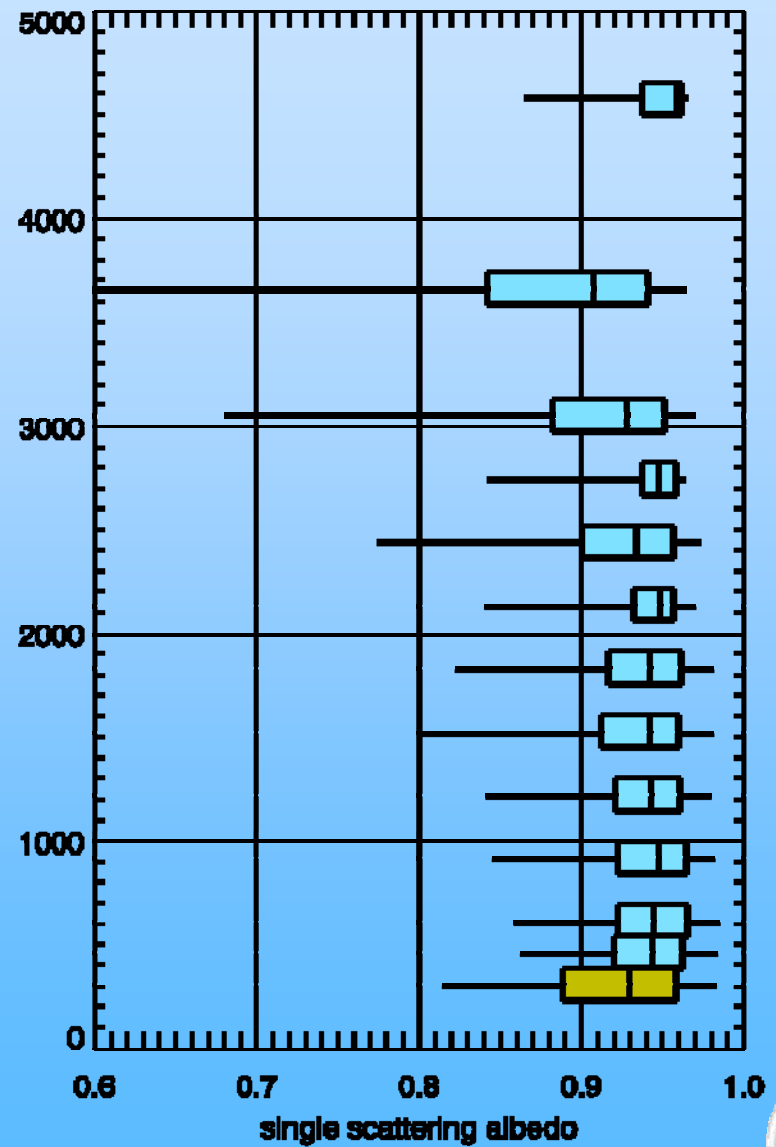
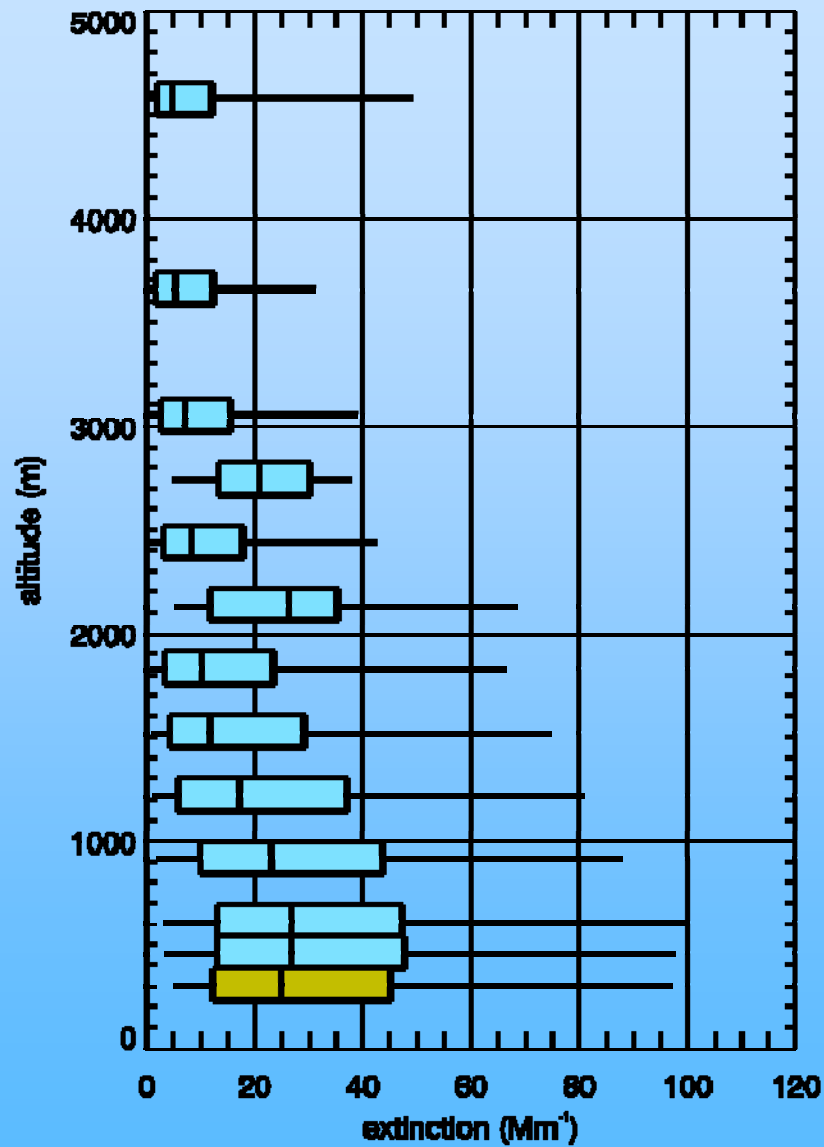
- **Measurements**

- Light absorption, scattering, and hemispheric backscattering
- RH-dependence of scattering
- Temperature and RH
- Flask samples for trace gases (CO<sub>2</sub>)

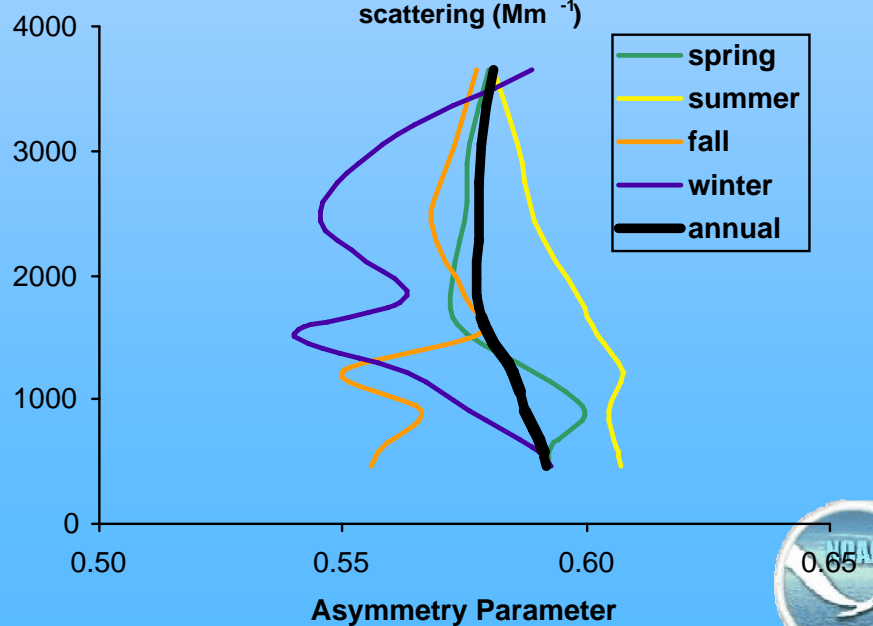
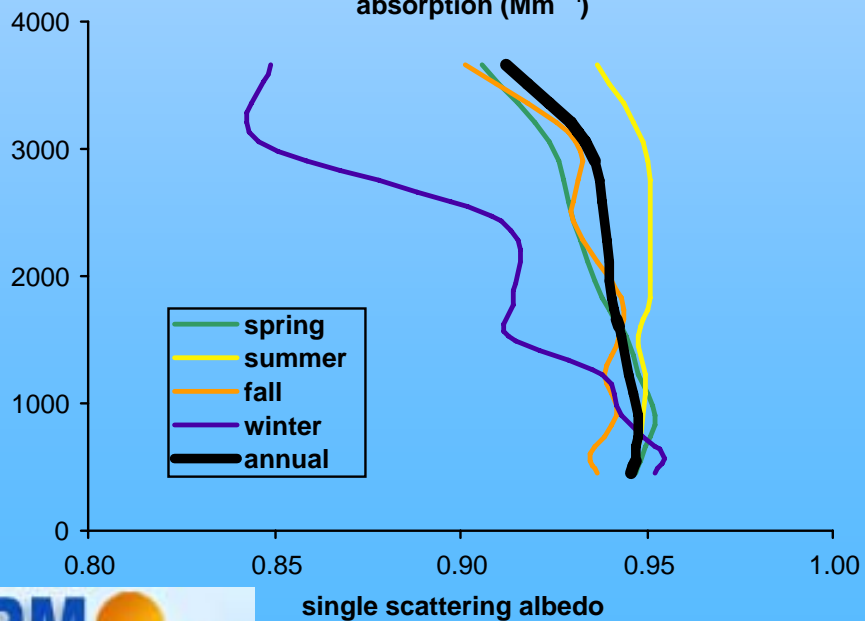
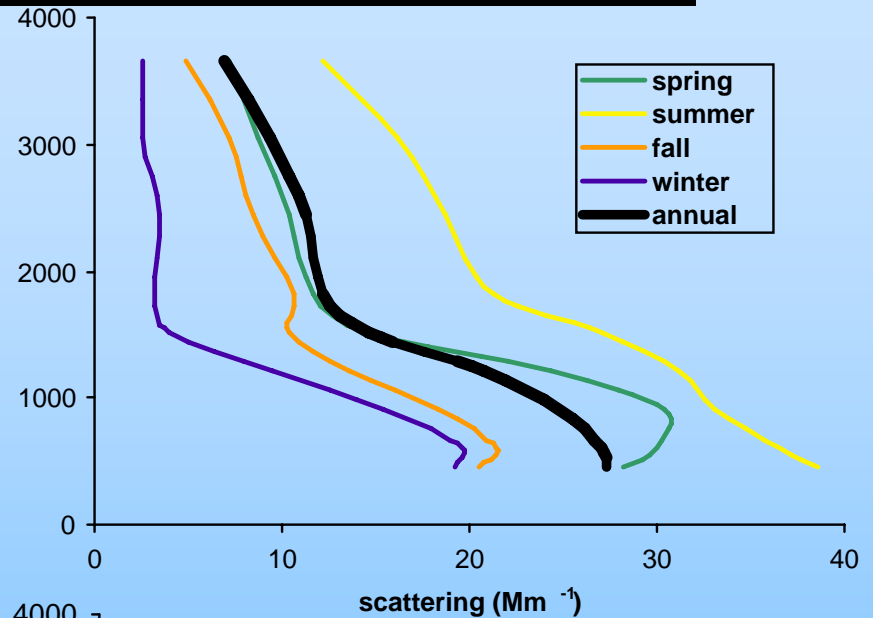
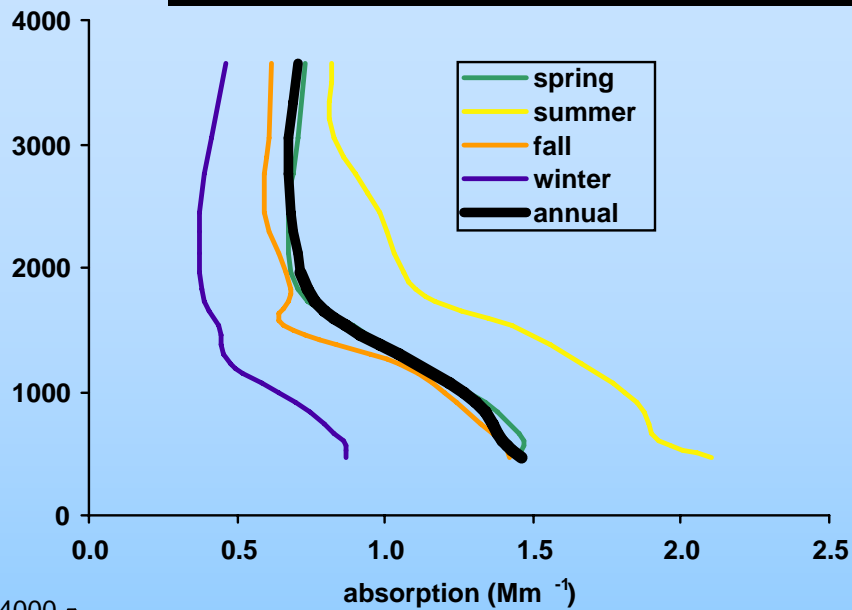
- **Flights**

- 9 levels, 0.5-3.7 km asl (172XP)
- 12 levels, 0.5-4.6 km asl (206)
- Temperature and RH
- 690 flights over 7 years

# IAP Summary Statistics 2000-2006



# IAP Seasonal Variations 2000-2006



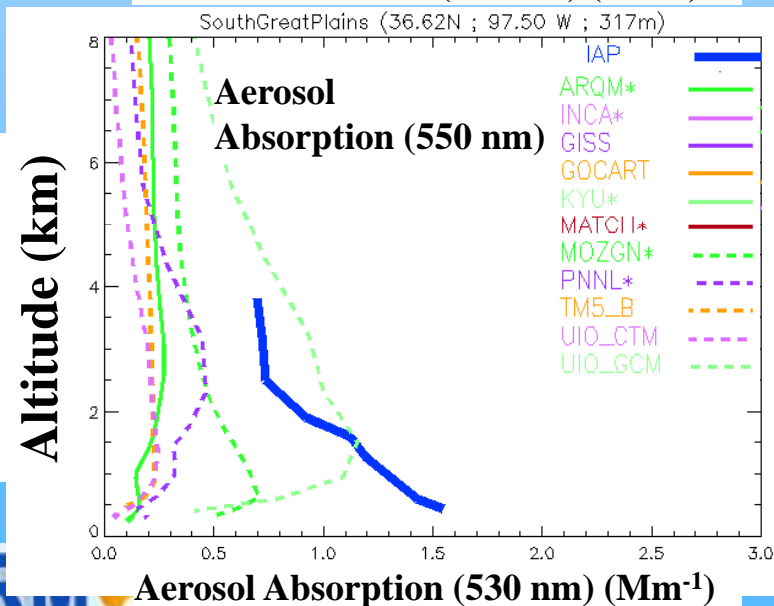
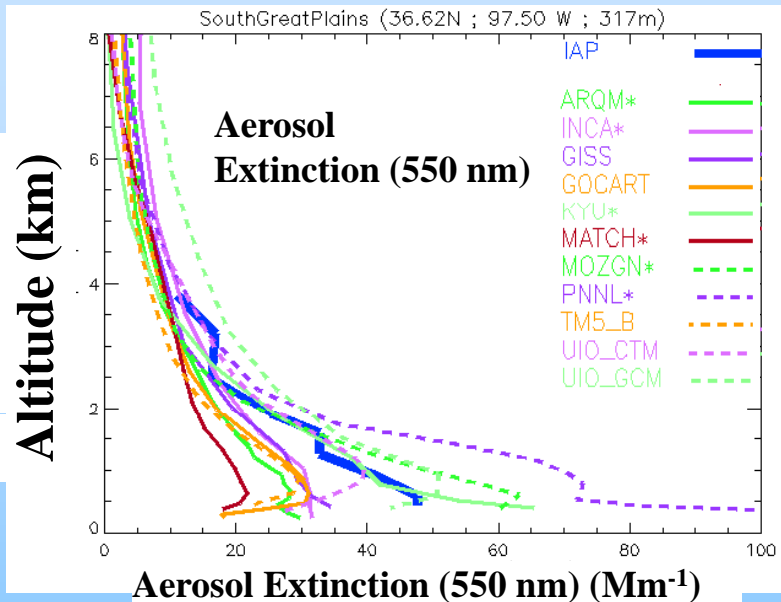
single scattering albedo

Asymmetry Parameter

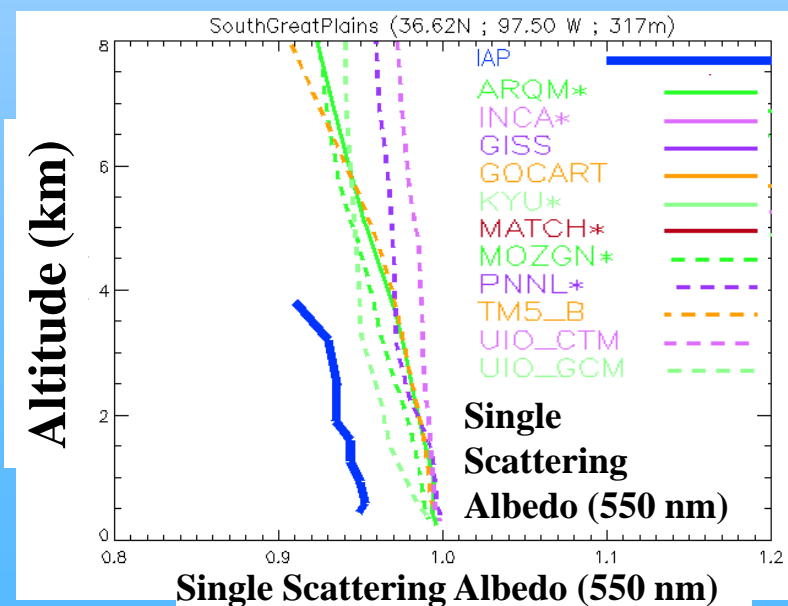
J. Ogren 4/12/2007



# Model Comparisons (Rich Ferrare)



- Daytime measurements 2-3 times/week
  - Aerosol scattering ( $3 \lambda$ ) (dry)
  - Aerosol absorption ( $1 \lambda$ ) (dry)
- Derived Parameters
  - Aerosol single scatter albedo
  - Aerosol optical thickness
- AEROCOM profile comparisons
  - General agreement in extinction
  - Models generally show smaller absorption



## Status of IAP instruments

- **High offset in high RH neph**
  - work with manufacturer to log raw data to troubleshoot problem in lab
  - Dry out neph after each flight
  - start periodic CO<sub>2</sub> span checks of neph calibration
- **Adding multifilter radiometer (MFR)**
  - Add wingtip extenders for mounting MFR
- **Replace the current 3-wavelength PSAP with a redesigned mini-PSAP**

## Citations to Papers That Have Used IAP Data

- Andrews, E., Sheridan, P.J., Fiebig, M., McComiskey, M., Ogren, J. A., Arnott, P., Covert, D., Elleman, R., Gasparini, R., Collins, D., Jonsson, H., Schmid, B., Wang, J., "Comparison of methods for deriving aerosol asymmetry parameter," *J. Geophys. Res.*, Vol. 111, No. D5, D05S04, doi:10.1029/2004JD005734 2006.
- Andrews, E., Ogren, J.A., Sheridan, P.J., Ferrare, R., "In situ aerosol profiles over the Southern Great Plains cloud and radiation test bed site: 1. Aerosol optical properties " *J. Geophys. Res.*, 109 (D6): Art. No. D06208, doi: 10.1029/2003JD004025,2004.
- Delle Monache L., Perry K.D., Cederwall R.T., Ogren J.A., "In situ aerosol profiles over the Southern Great Plains cloud and radiation test bed site: 2. Effects of mixing height on aerosol properties," *J. Geophys. Res.*, 109 (D6): D06209, doi:10.1029/2003JD004024, 2004.
- Ferrare, R., Turner, D., Clayton, M., Schmid, B., Redemann, J., Covert, D., Elleman, R., Ogren, J., Andrews, E., Goldsmith, J., Jonsson, H., "Raman Lidar measurements of aerosol and water vapor over the Southern Great Plains during the May 2003 Aerosol IOP," *J. Geophys. Res.*, Vol. 111, (D5), D05S08,10.1029/2005JD005836, 2006.
- Hallar, A. G., Strawa, A.W., Schmid, B., Andrews, E., Ogren, J., Sheridan, P., Ferrare, R., Covert, D., Elleman, R., Jonsson, H., Bokarius, K., Luu, A., "ARM Aerosol Intensive Operating Period: Comparison of aerosol scattering during coordinated flights " *J. Geophys. Res.*, Vol. 111, doi:10.1029/2005JD006250, 2006.
- Izioman, M.G., Lohmann, U., "Characteristics and direct radiative effect of mid-latitude continental aerosols: the ARM case," *Atmos. Chem. Phys.*, 3, 1903-1917, 2003.
- Jeong, M-J, Li, Z., Andrews, E., and Tsay, S-C., "Effect of Aerosol Humidification on the Column Aerosol Optical Thickness over the ARM Southern Great Plains Site," *J. Geophys. Res.*, in review.
- Ricchiazzi, P., Gautier, C., Ogren, J.A., Schmid, B., " A comparison of aerosol optical properties obtained from in situ measurements and retrieved from Sun and sky radiance observations during the May 2003 ARM Aerosol Intensive Observation Period," *J. Geophys. Res.*, 111 (D5): Art. No. D05S06, doi:10.1029/2005JD005863, 2006.
- Strawa A., Elleman, R., Hallar, A., Covert, D., Ricci, K., Provencal, R., Owano, T.W., Jonsson, H.H., Schmid, B., Luu, A.P., Bukarius, K., Andrews, E., "Comparison of in situ extinction and scattering coefficient measurements made during the Aerosol Intensive Operating Period," *J. Geophys. Res.*, Vol. 111, doi:10.1029/2005JD006056, 2006

# Future Directions for IAP Program

- **ACRF requires renewal proposal FY2008**
- **Managed as part of ARM Aerial Vehicle Program**
- **What should we change?**
  - Continue or cancel?
  - Scientific objectives?
  - Instrument payload?
  - Flight patterns?
  - Sampling site?

# NOAA Airborne Aerosol Observatory

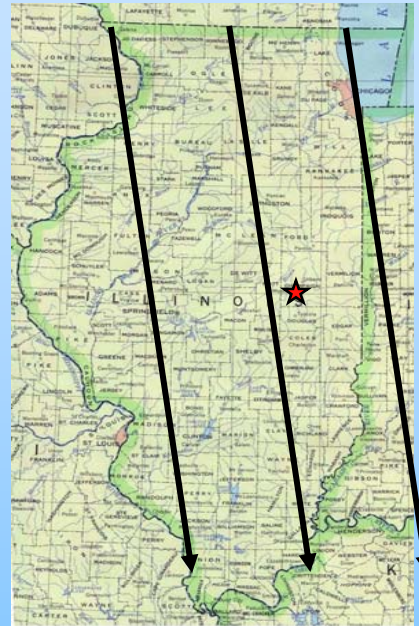


- Based at Champaign, IL
- Routine vertical profiles, 10 levels, 1.5-15kft
- Aerosol *chemical*, *microphysical*, optical, and hygroscopic growth measurements
- Trace gas (flask) and ozone (continuous) measurements
- Much more information at <http://www.cmdl.noaa.gov/aero/net/aao/index.html>



# NOAA AAO Objectives

- Obtain a statistically-significant data set of the vertical distribution of aerosol climate-forcing properties.
- Determine uncertainty in estimating aerosol radiative forcing from surface measurements.
- Evaluate performance of chemical transport models in predicting aerosol chemical, microphysical, and optical properties.
- Evaluate satellite aerosol remote sensing data and retrieval algorithms, including those onboard the “A-Train” Aqua and Calipso and the Terra satellites.



A-Train satellite overpass tracks in the vicinity of the AAO base of operations. Overpasses along each track occur approx. twice per month.

# Discussion Topics

- **Continue or cancel?**
  - Original science objectives have been met
- **Scientific objectives**
  - Column closure on AOD
  - Support for BBHRP
  - Spatial variability (aerosols, surface albedo)
  - Model and satellite evaluation
  - Vertical profiles of CCN and size distribution
  - Test retrievals of cloud microphysical properties
- **Instrument payload**
- **Flight patterns**
- **Choice of aircraft**
- **Choice of sampling site**