Measuring *in situ* Aerosol Size Distributions for Satellite Validation

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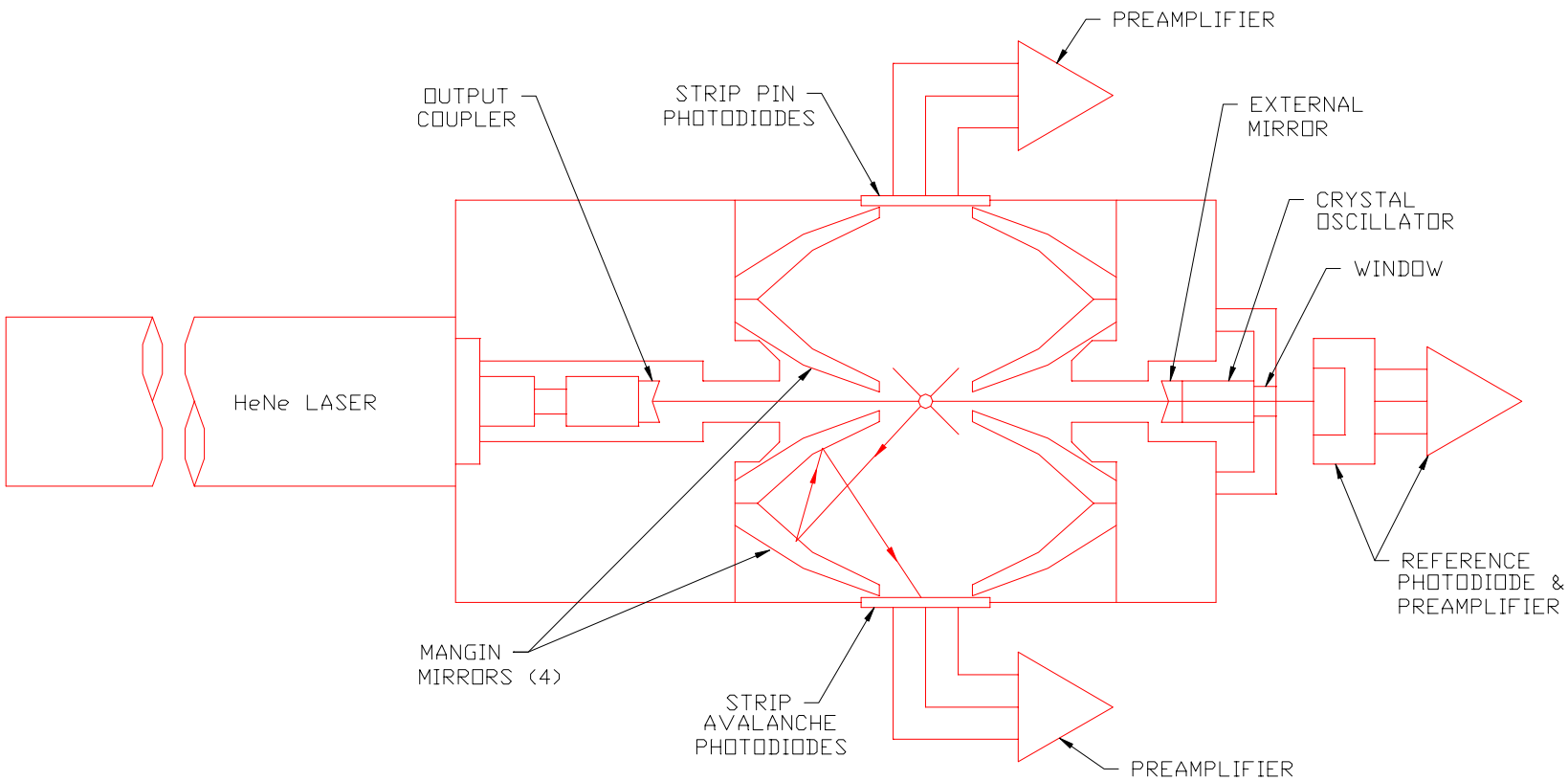
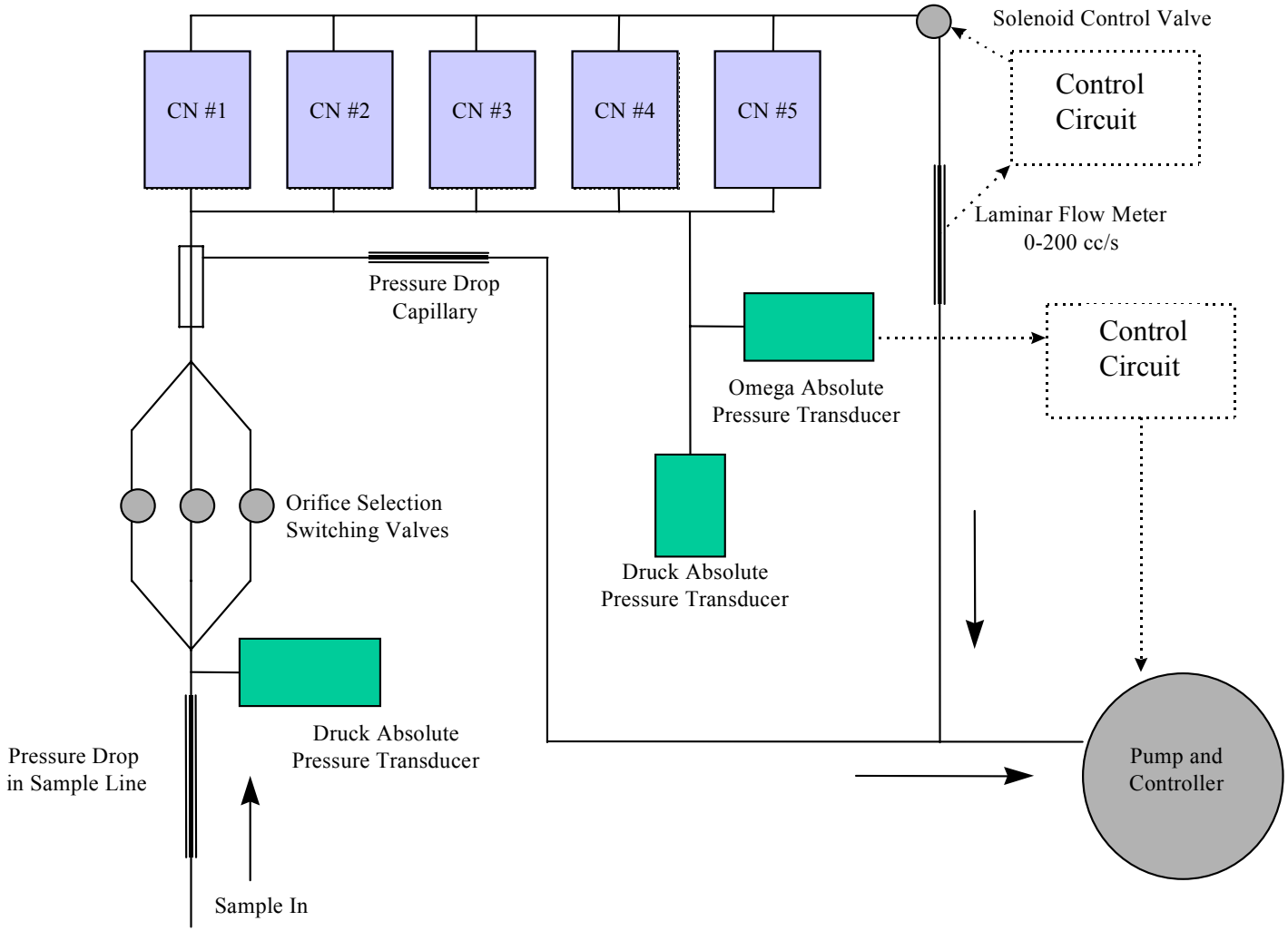
Focused Cavity Aerosol Spectrometer (FCAS II)



Nucleation-Mode Aerosol Size Spectrometer (N-MASS)



Fun Facts

FCAS II

- Long history of calibration for number and size.
- Flown on ER-2, WB-57F, DC-8, P-3.
- Output is differential size distribution.
- Inversion includes instrument response and corrections for anisokinetic sampling, evaporation of water.
- 1 Hz acquisition (stratosphere: 30 s average, typically).
- Size range: 90 to 2000 nm diameter.

N-MASS

- Flown on ER-2, WB-57F, DC-8, P-3, Electra, Falcon.
- Channel 50% cut points at 4, 8, 15, 33, 60 nm.
- Output is cumulative size distribution.
- Inversion includes channel responses and small corrections for diffusion loss.
- 10 Hz acquisition.
- Size range: 4 to 100 nm diameter.

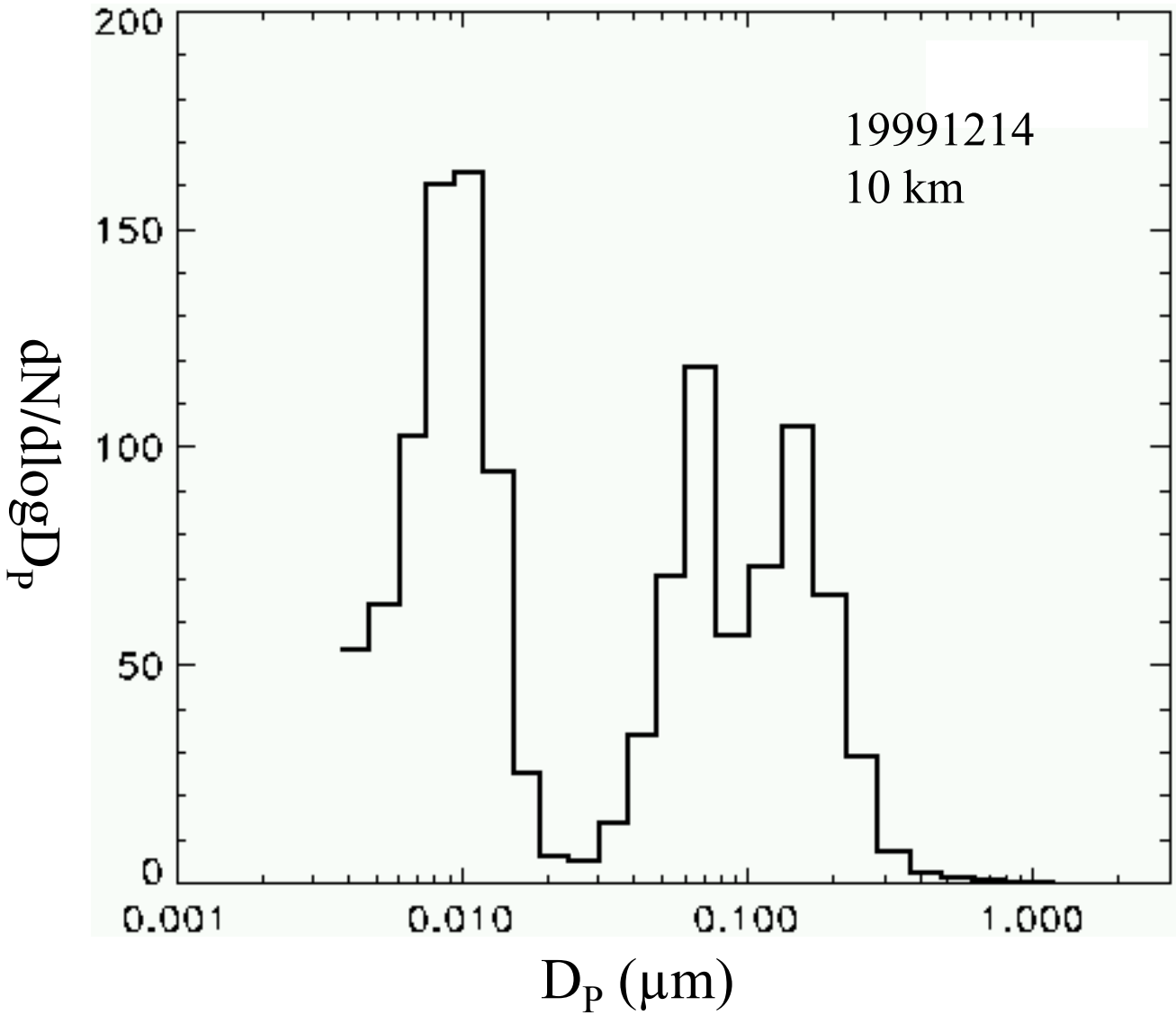
Data Analysis & Science

- Obtain 4 to 2000 nm diameter differential size distributions from combined data using modified Twomey inversion.
- Calculate aerosol total surface, volume densities.

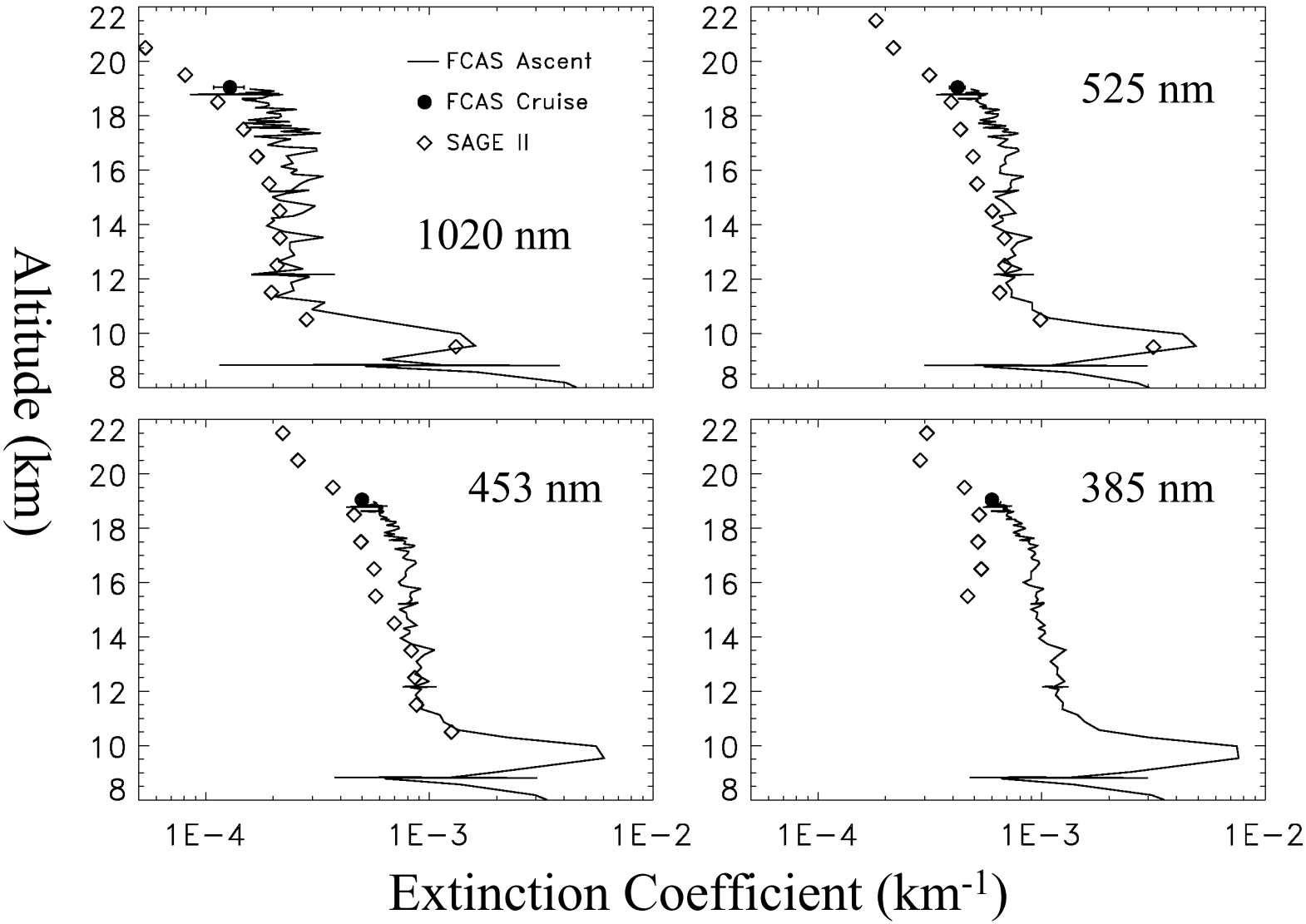
Where coincident with SAGE III or POAM III:

- Calculate aerosol extinction coefficients using Mie scattering theory.
- Compare extinction and surface area with satellite products (& volume if available).

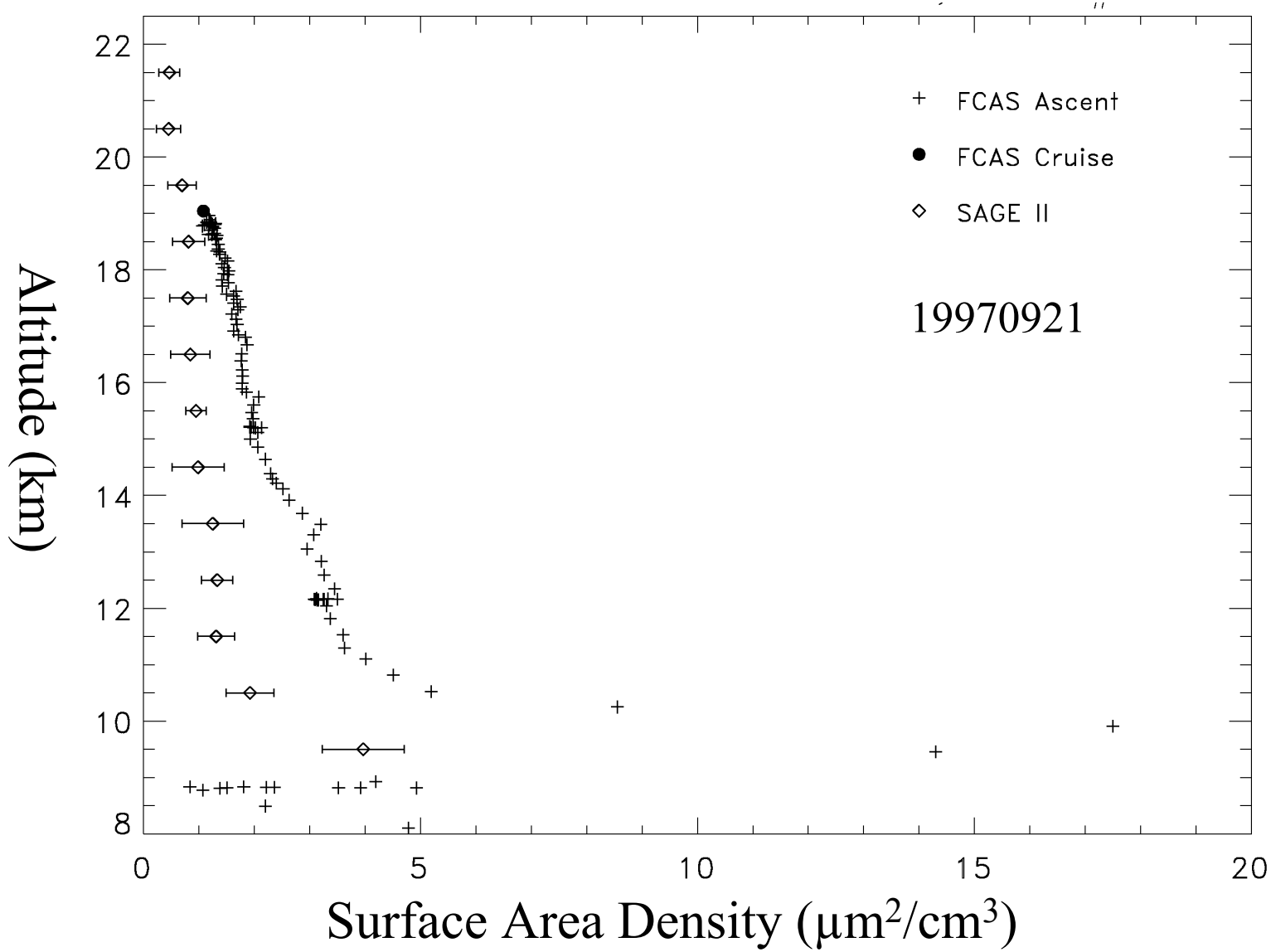
FCAS II + N-MASS sample size distribution from SOLVE

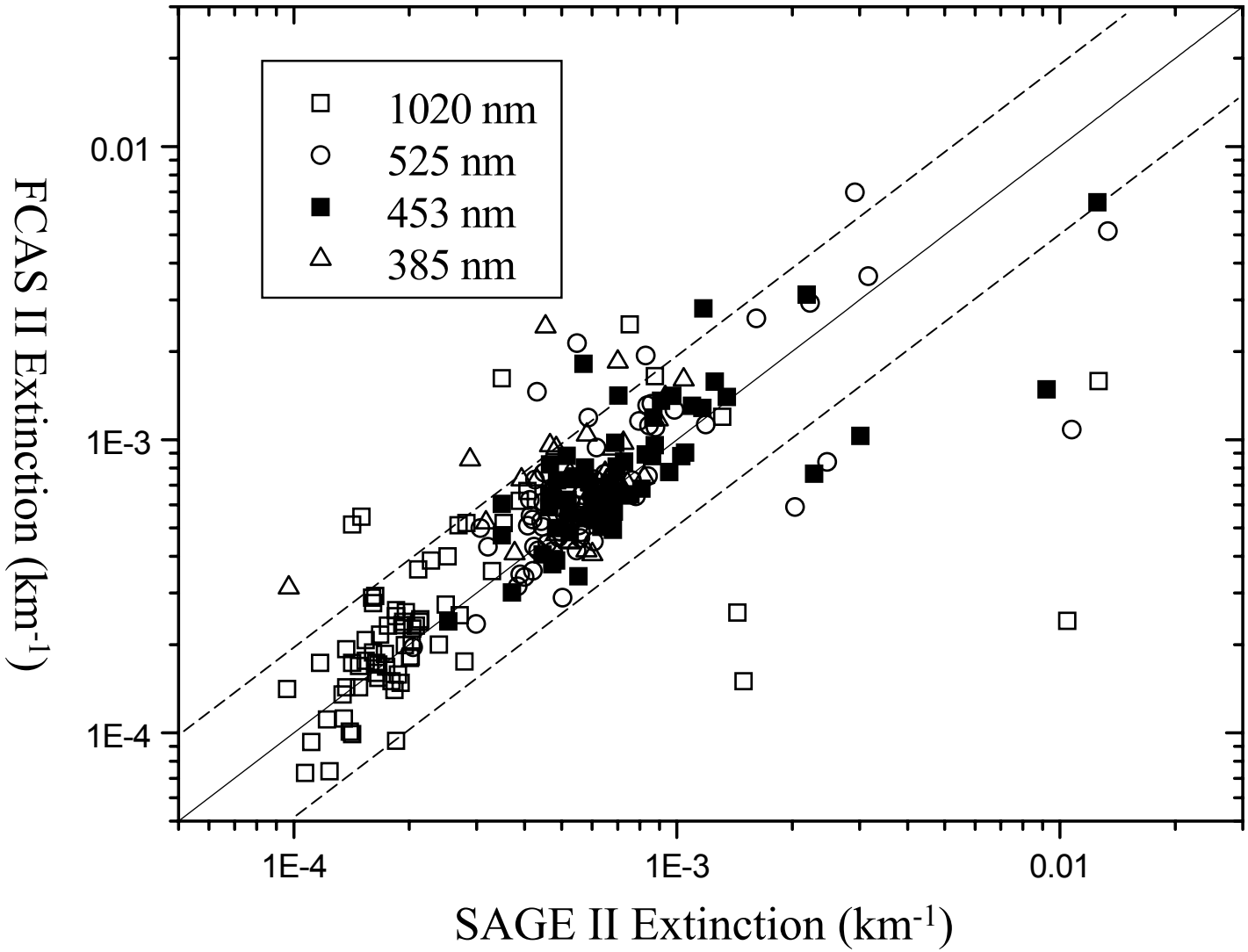


FCAS II & SAGE II Profiles from POLARIS, 19970921



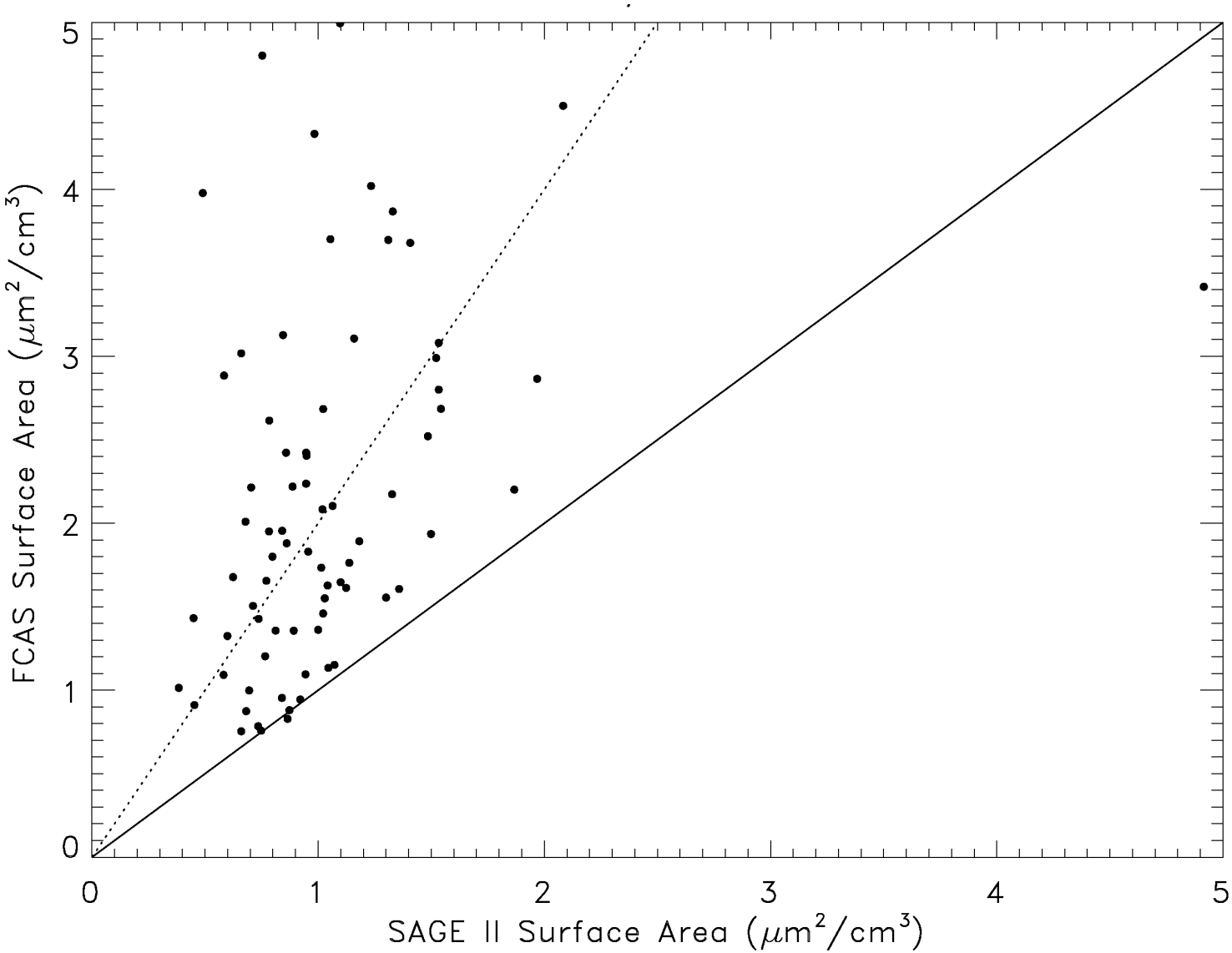
FCAS II & SAGE II surface area profiles from POLARIS





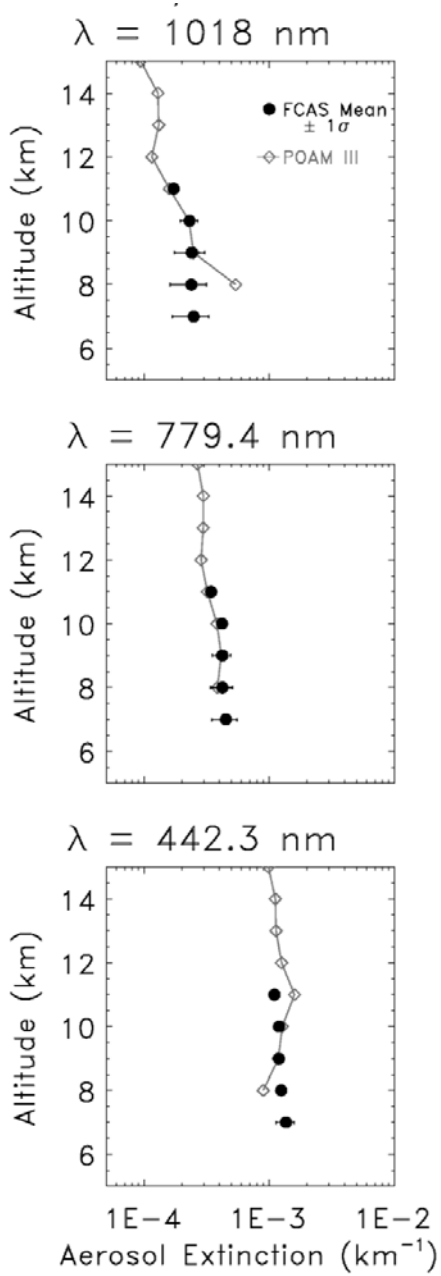
Median absolute difference = 26% @ 1020 nm, < 20% for others

FCAS II, SAGE II Surface Area Density



When we know it's the same airmass:

FCAS II and POAM III extinction from SOLVE DC-8 rendezvous, 19991214



Summary

- SAGE III will report aerosol extinction from 0 – 40 km. Validation of SAGE III is a primary mission goal, and is especially important at lower altitudes where satellite retrievals are most difficult.

- SAGE total aerosol surface area density (SAD) is widely used as model input, and current PCA method underestimates below 20 km. The aircraft and balloon instruments in SOLVE II provide an excellent opportunity to validate, and possibly improve, SAGE total SAD derivation.

- Models don't agree on O_3 variations. Correct SAD values are an important ingredient. Understanding O_3 loss and recovery is a fundamental goal of both SOLVE II and ESE.