Aerosol Properties: In Situ Measurements and SAGE Retrievals

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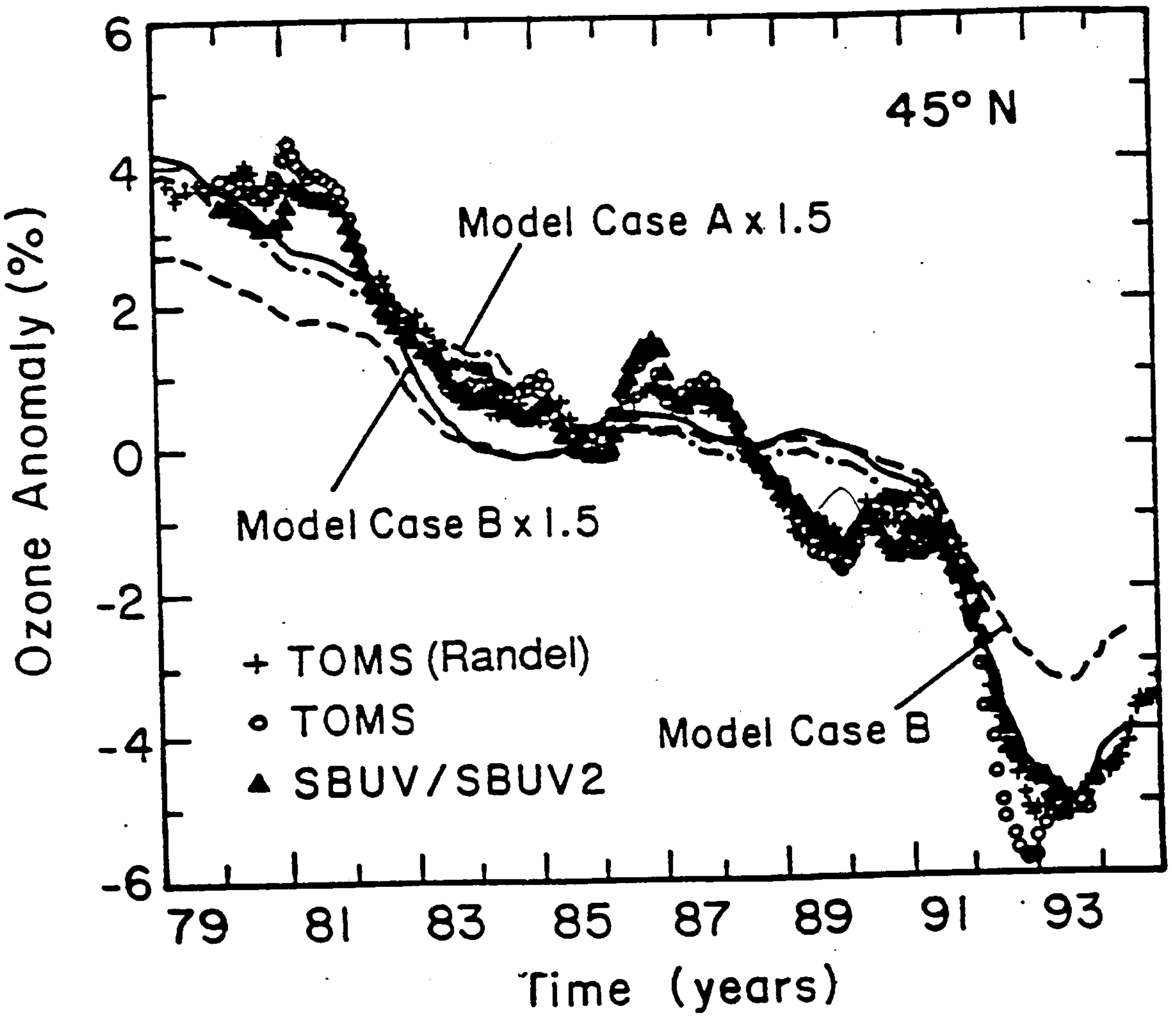
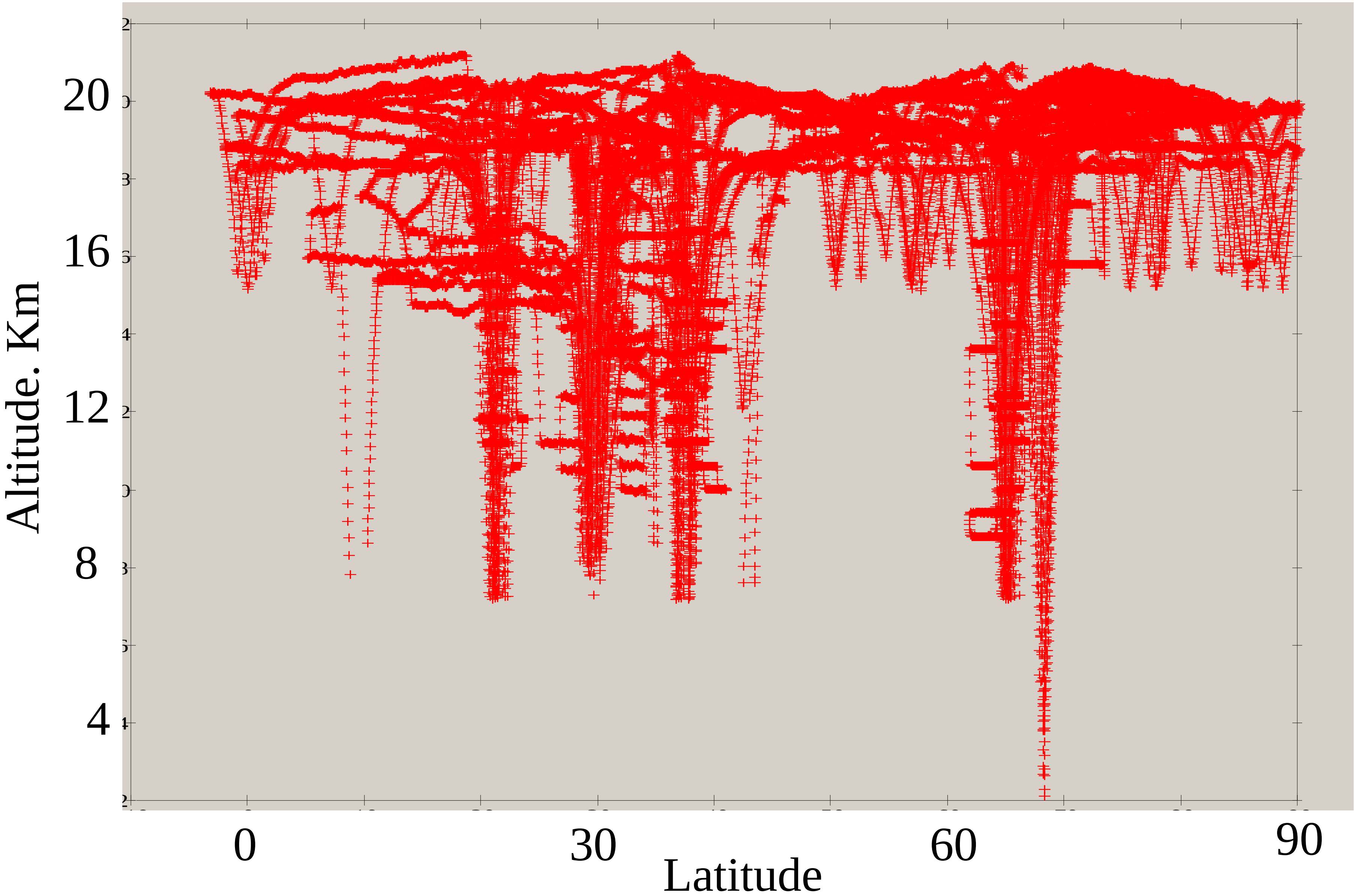
Chuck Wilson, Mike Reeves, Shan-Hu Lee
University of Denver Department of Engineering
SAGE and POAM Science Teams

Motivation

- The hydrolysis of N_2O_5 on the surface of sulfate aerosol particles directly effects the partitioning of the reactive nitrogen species and that partitioning, in turn, effects the partitioning of HOx and Clx families. Thus, aerosol surface area concentrations impact the major ozone loss mechanisms.
- Satellites provide global coverage. Accurate satellite retrievals of aerosol properties permit study of atmospheric chemistry and mechanisms controlling aerosol abundance.

Solomon et al., 1996





~50,000 ER-2 Measurements in the Non-Volcanic Atmosphere

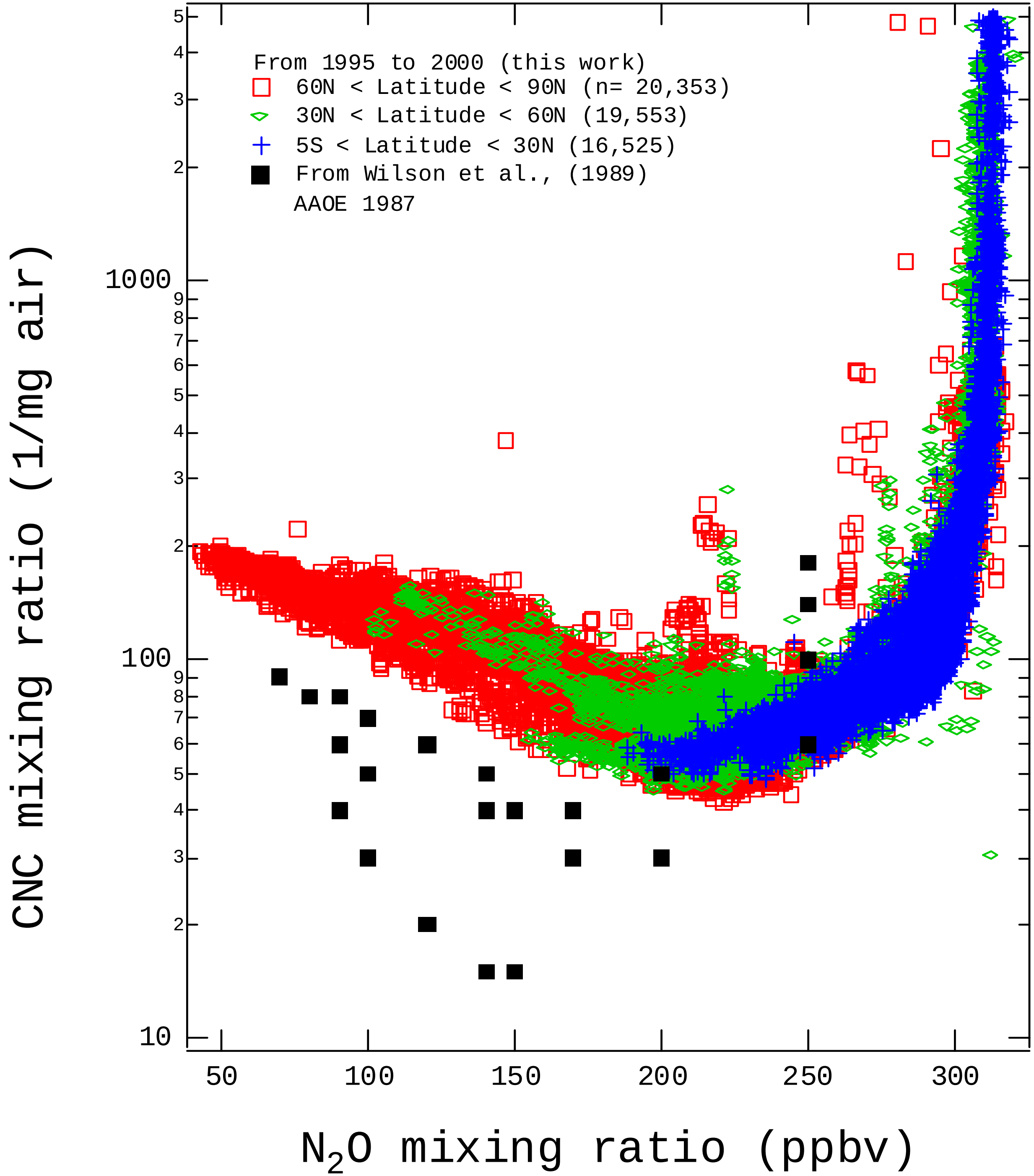
Measurements were also made from the DC-8 in SOLVE and SOLVE II.

Most were made at high latitudes.

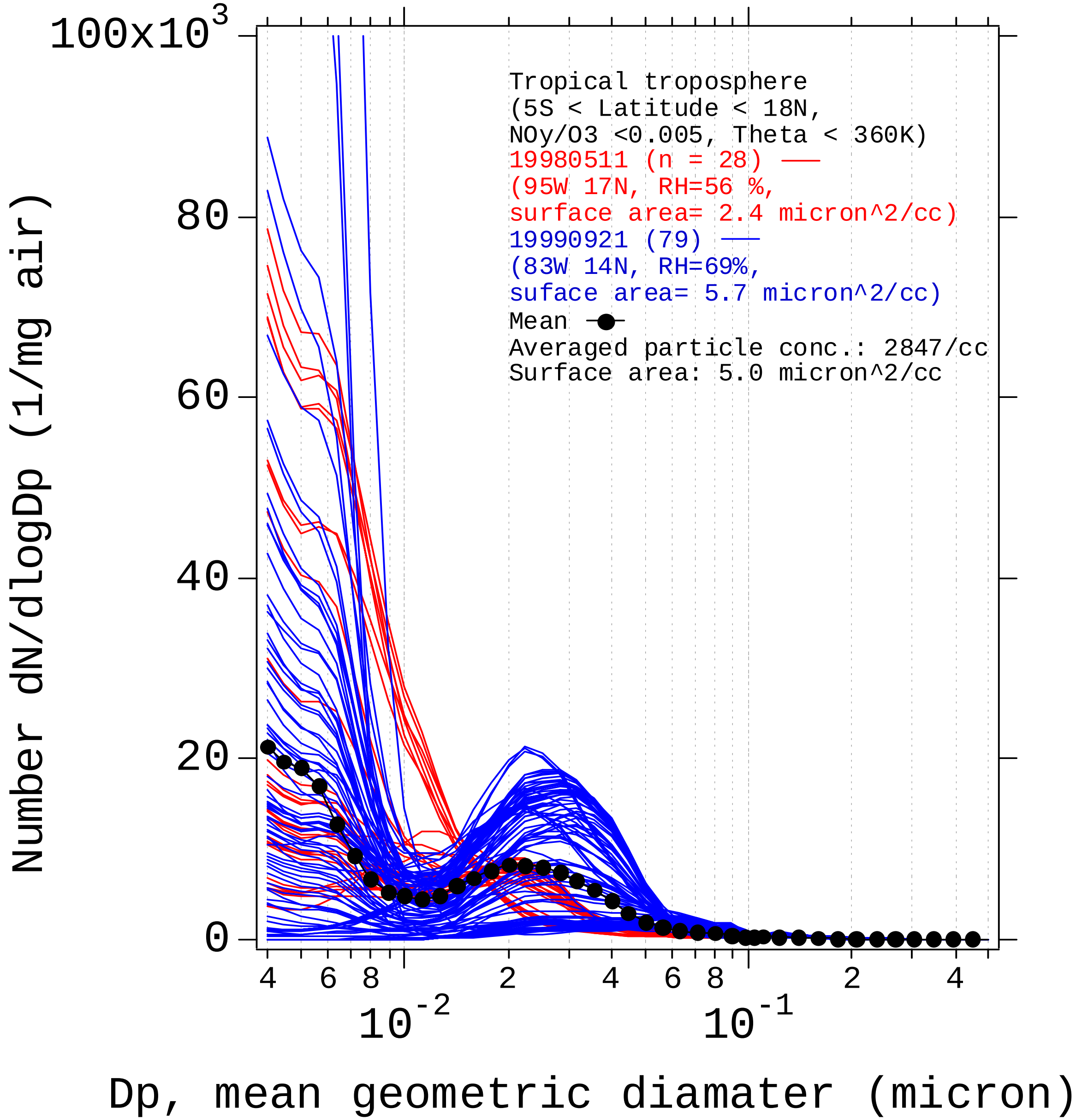
Observed Aerosol Properties

- Non-Volcanic Atmosphere
- Spatial Distributions
- Size Distributions
- Implications for Wavelength

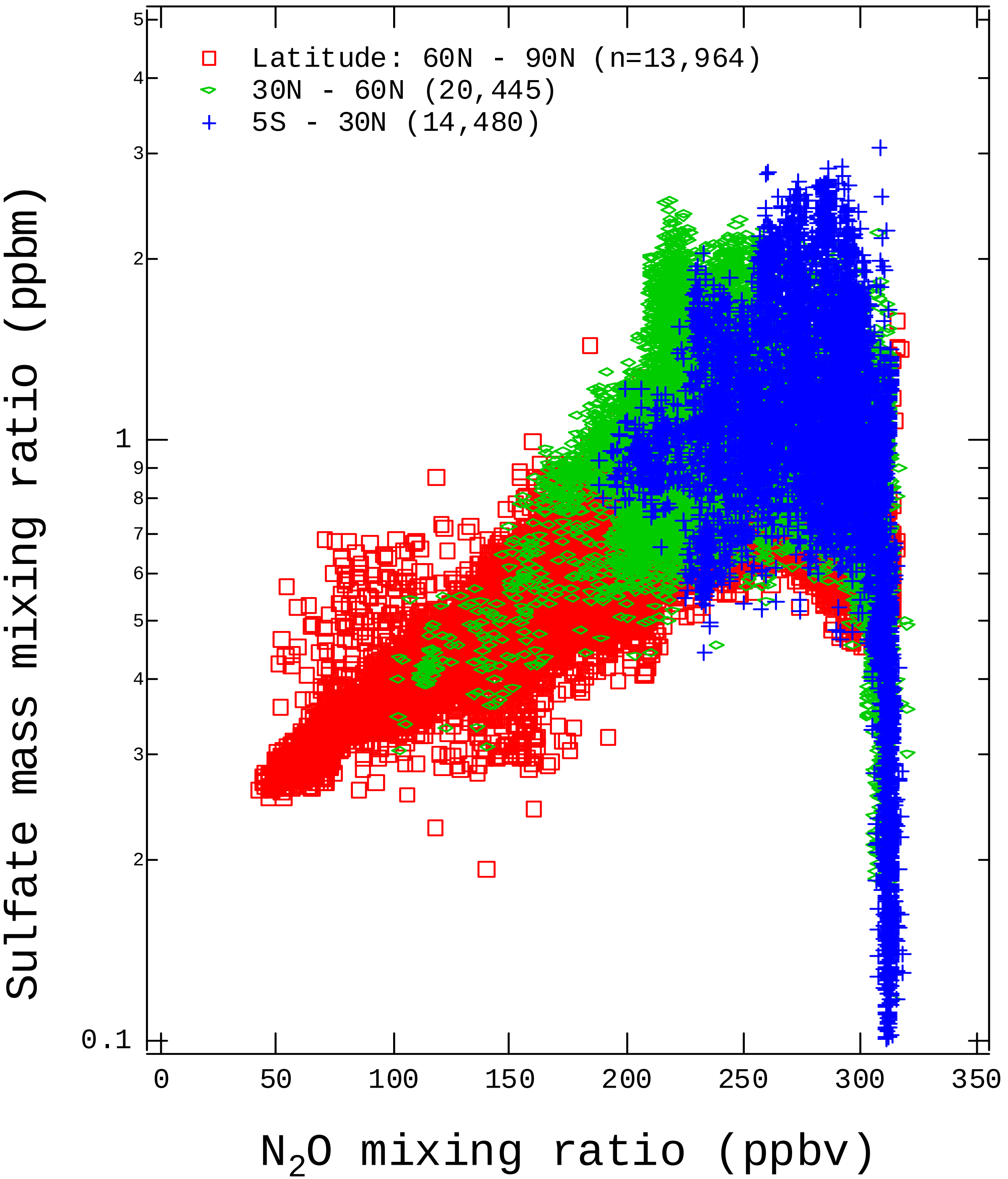
CNC mixing ratio in all altitudes as a function of N_2O. Antarctic measurements have also shown (Wilson et al. 1989). Aerosol mixing ratio increases as N_2O decreases from 200 to 50 ppbv in high latitude. More new particles are formed in air that descends the most.



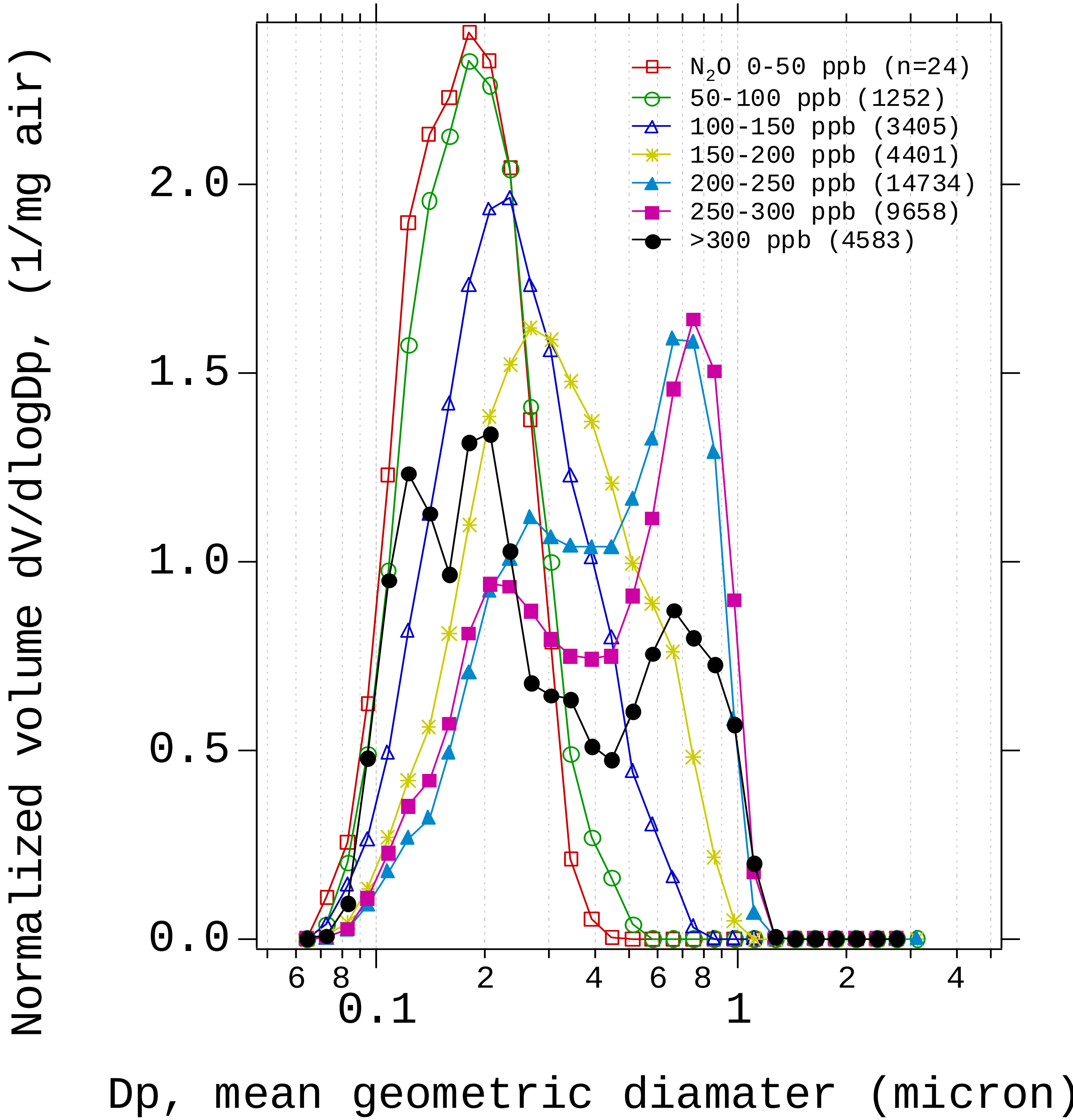
Particle number size distribution in the tropical troposphere (theta < 360 K). Concentrations ranged to 34,765 /cc with a mean of 2847 /cc. Two different types of size distributions dominated. The nucleation mode dominated the number distribution.



Sulfate mass mixing ratio in different latitudes as a function of N_2O mixing ratio.



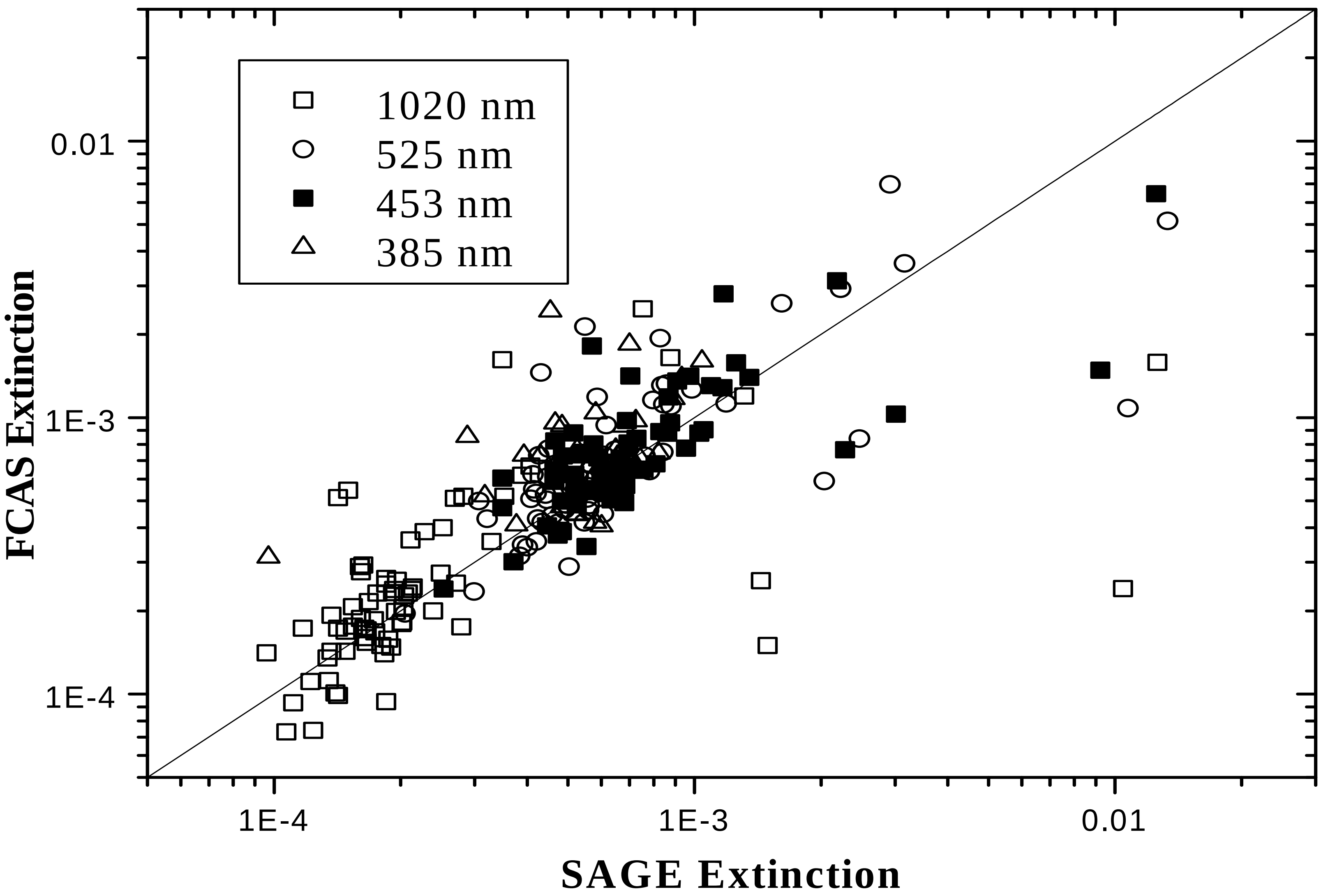
Normalized particle volume concentrations as a function of N_2O mixing ratio. This shows clearly a particle sedimentation process during the particle aging.

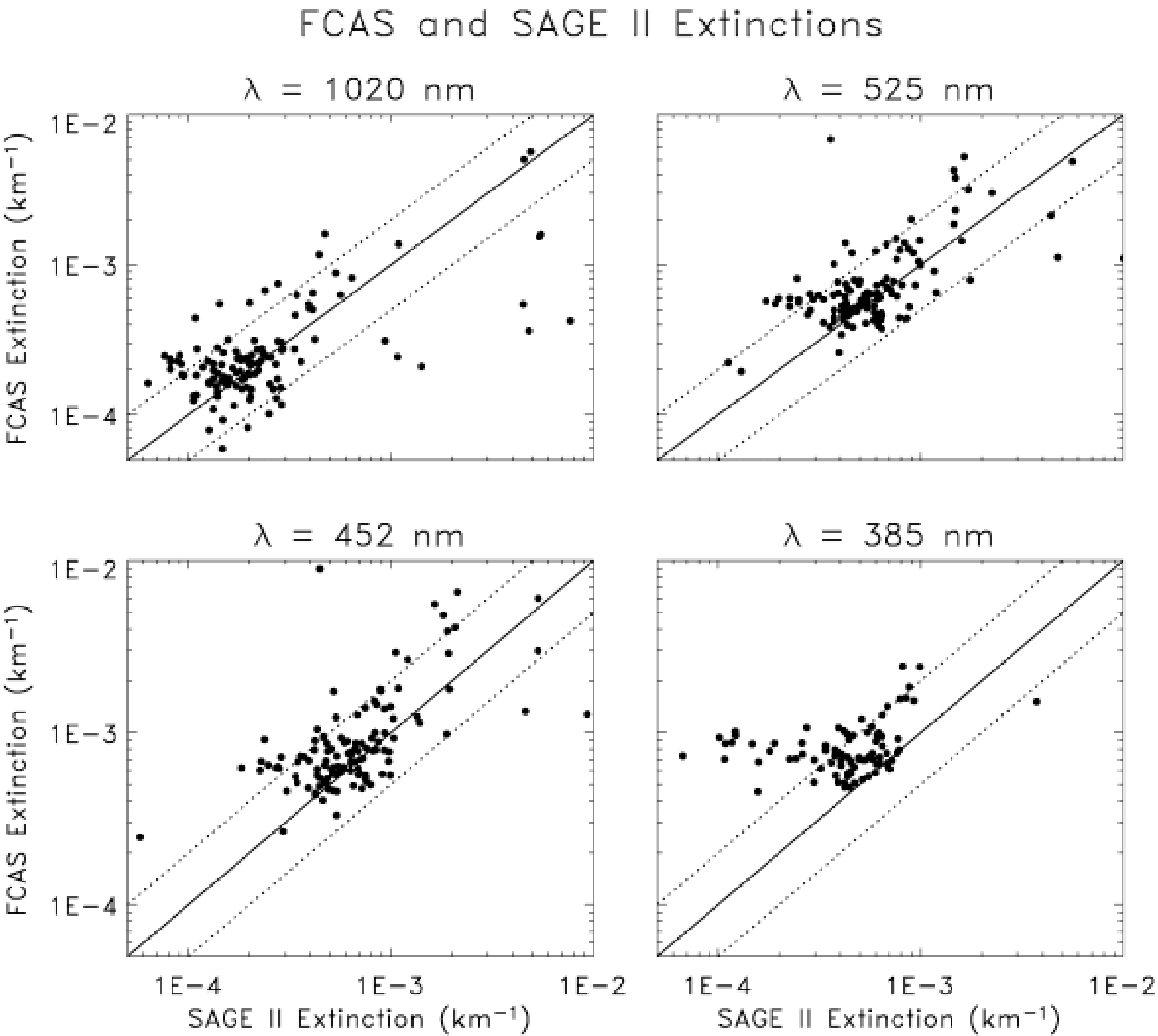


Comparisons of FCAS In Situ Measurements with SAGE II

- High latitude measurements (POLARIS)
- SAGE II, version 6.1surface product
- Matched on Latitude, Longitude and Time
- Optically active aerosol measured with the FCAS. When the instrument response to 400 calibration aerosols was processed using the Twomey method, the median discrepancy between the DMA size and that indicated by the FCAS II was 2.6%. The concentration indicated by the FCAS II in the lab calibrations is checked using a condensation nucleus counter. These concentrations have an uncertainty of about 15%.

FCAS Extinction VS OLD SAGE II

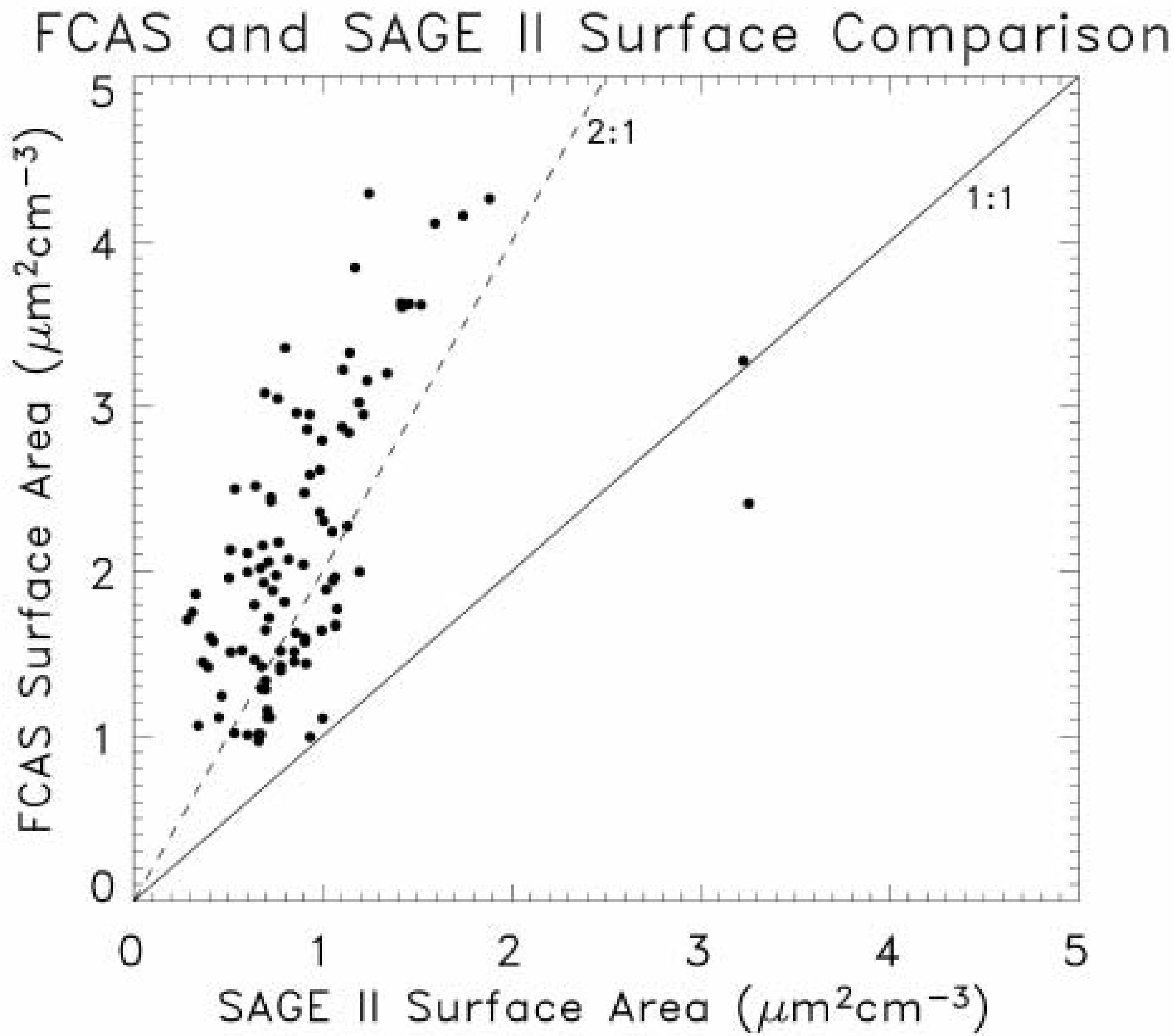




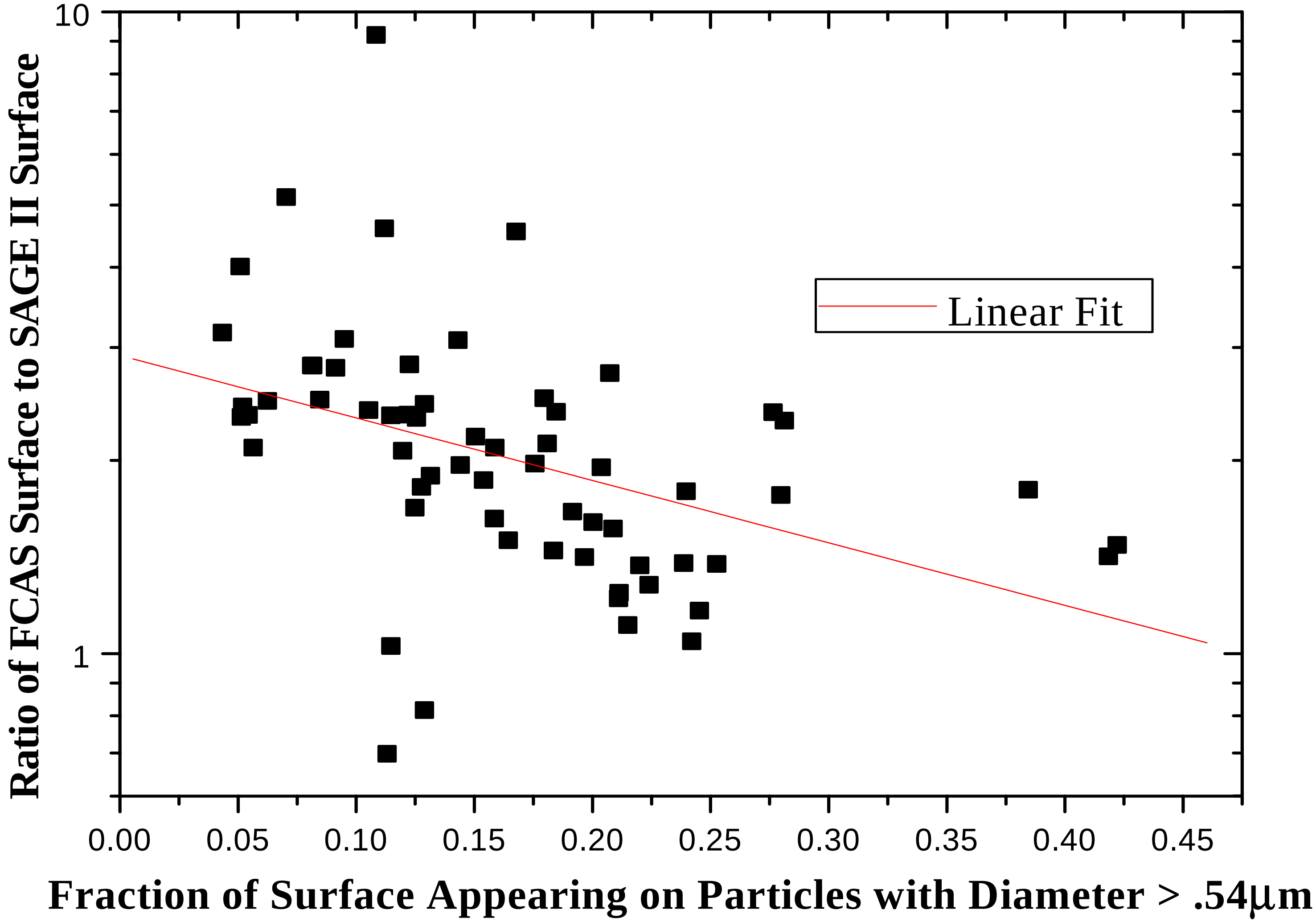
SAGE II
V. 6.10

~100 pts

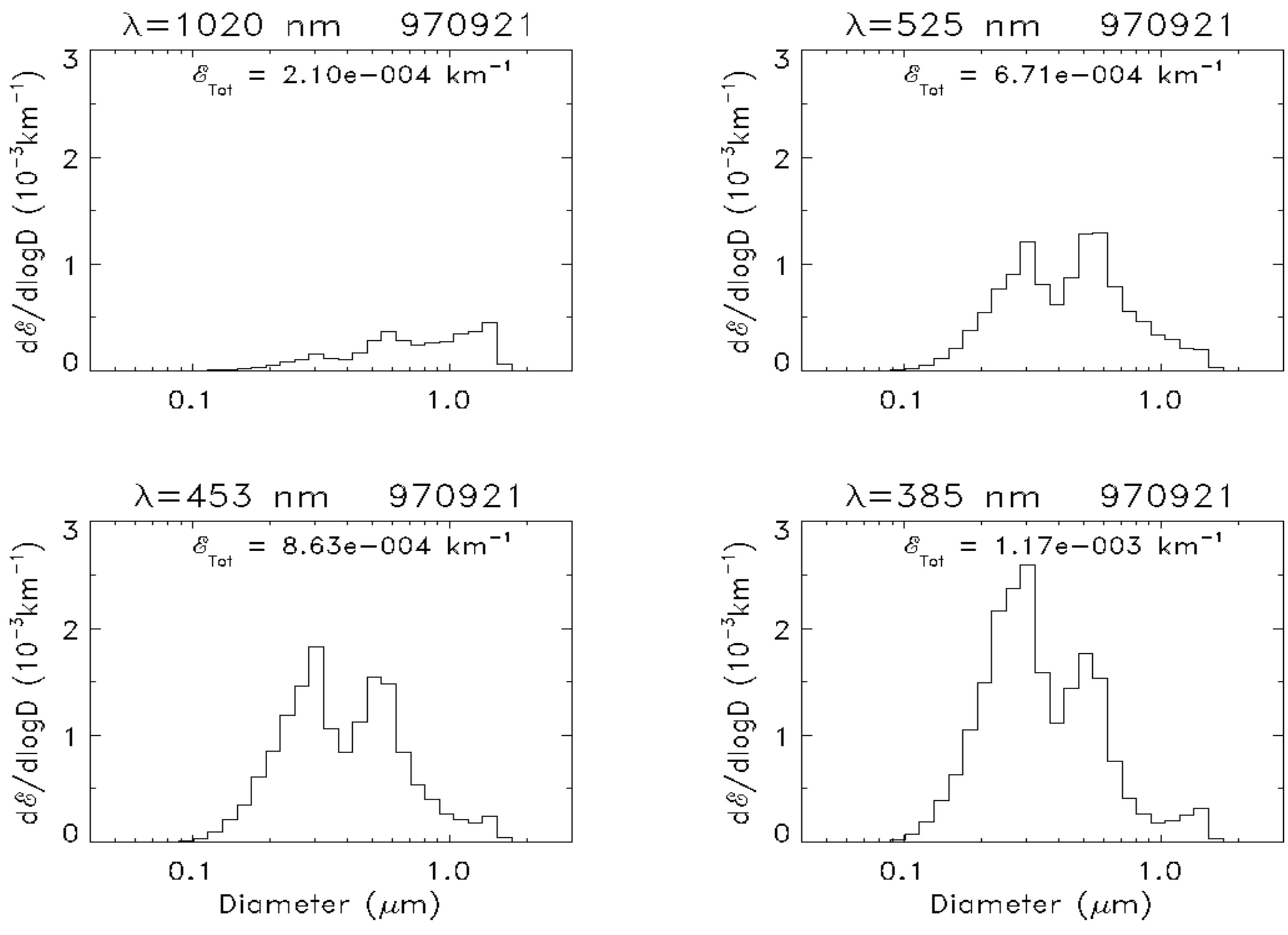
Version 6.1 Aerosol Surface Comparison



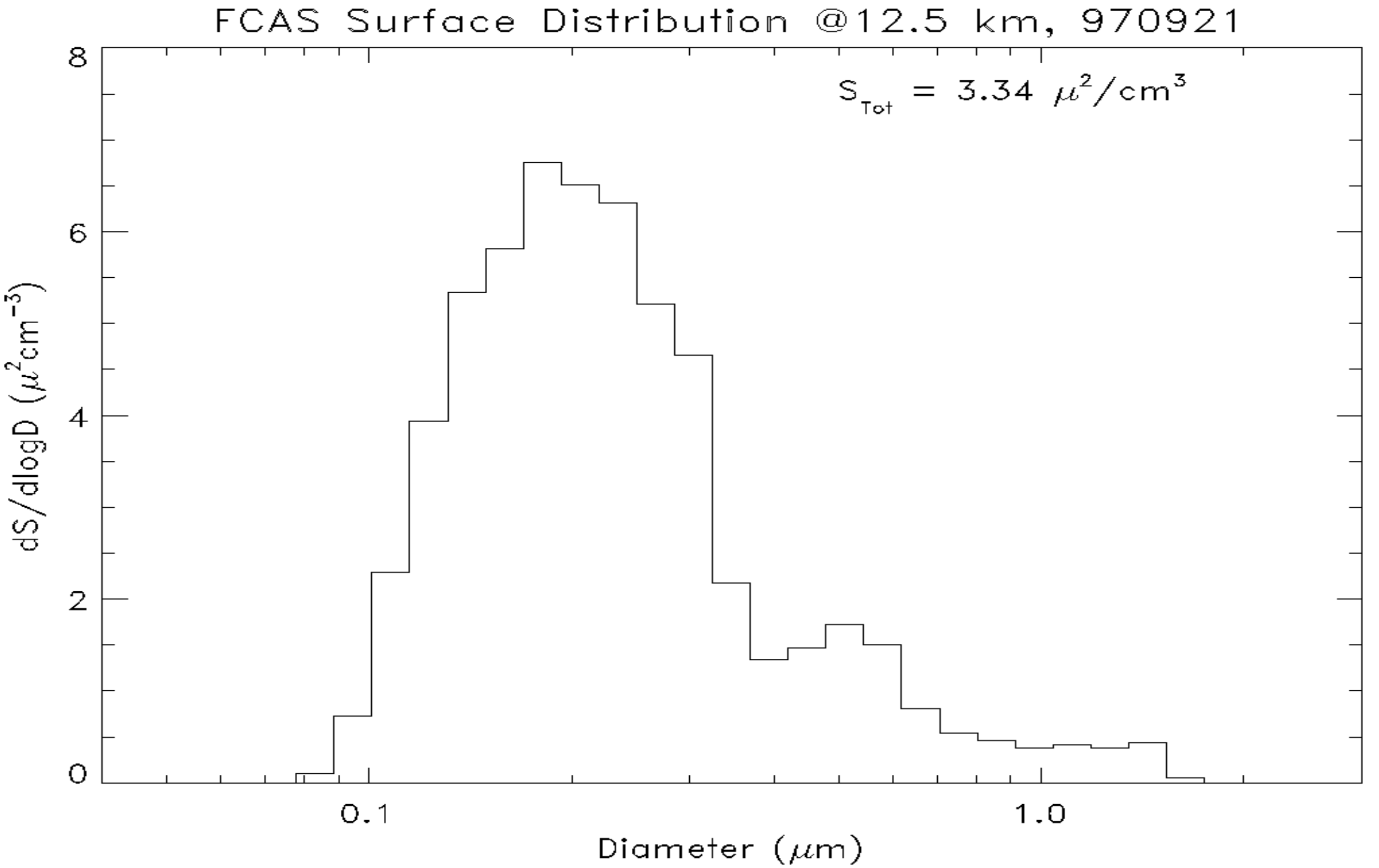
Dependence on Size (Old Data)



Differential Extinction: 12.5 Km



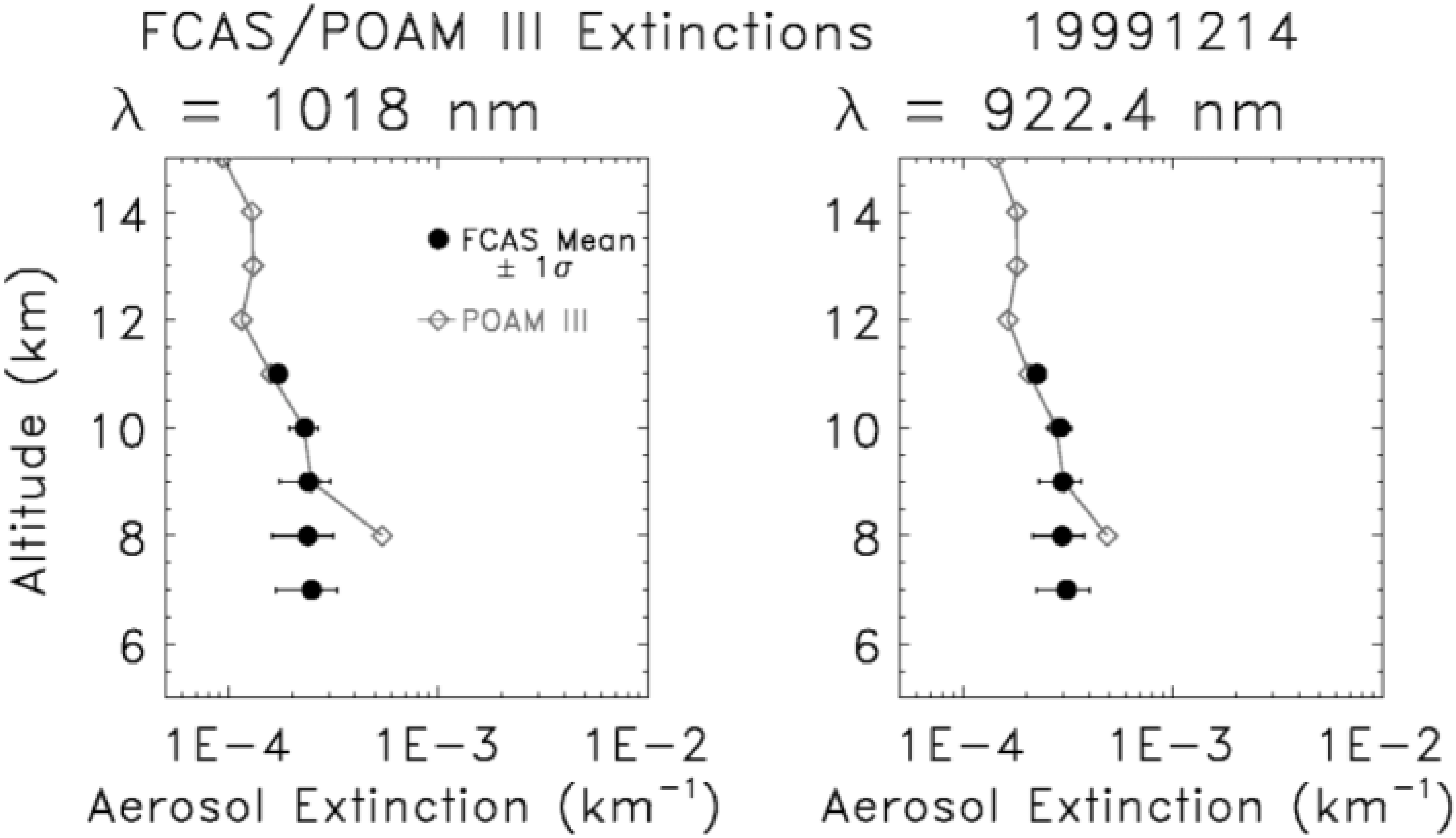
Surface Distribution



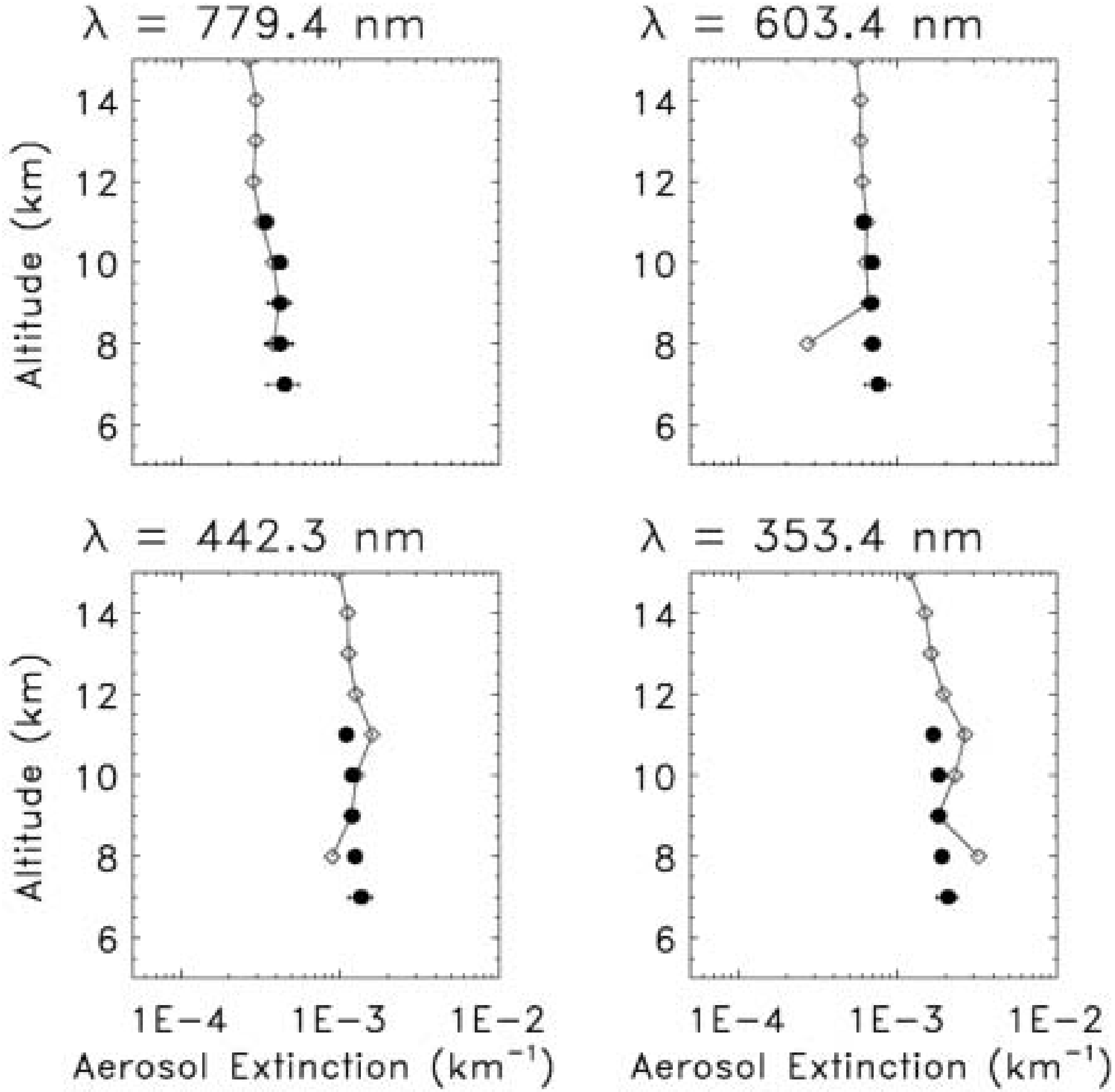
Suggestions

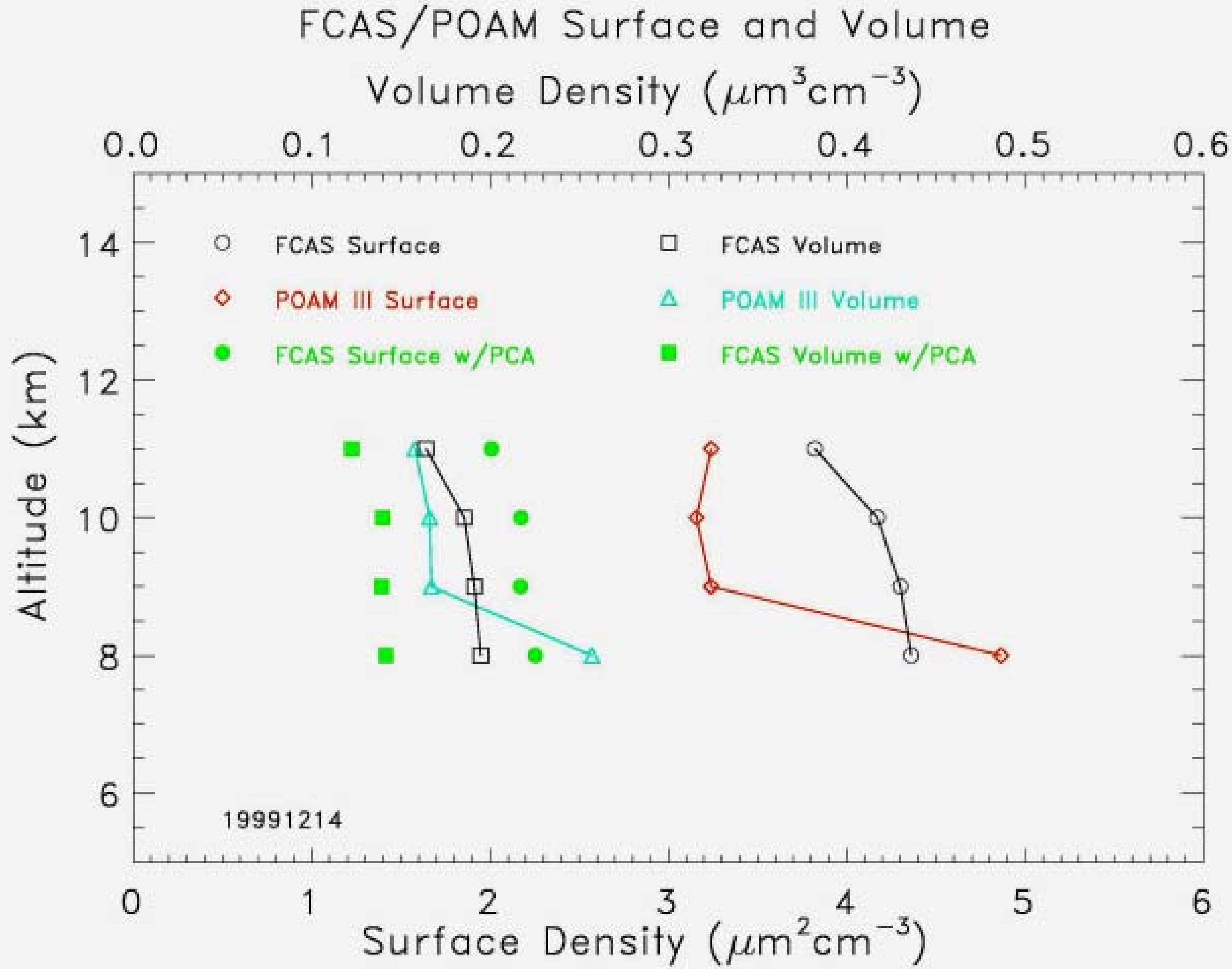
- Our comparisons are preliminary. For example, we have not evaluated motion of SAGE measurements.
- It is possible that 6.1 has not improved short (385 nm) wavelength aerosol extinctions
- Would like to get good information on surface to 0.1 micron.
- There may be useful information about aerosol surface down to 0.1 microns in the shorter wavelengths (385 nm)
- If these wavelengths are accurately measured and correctly used, one might get most of the surface
- Number distributions extend to 4 nm

POAM III Comparisons



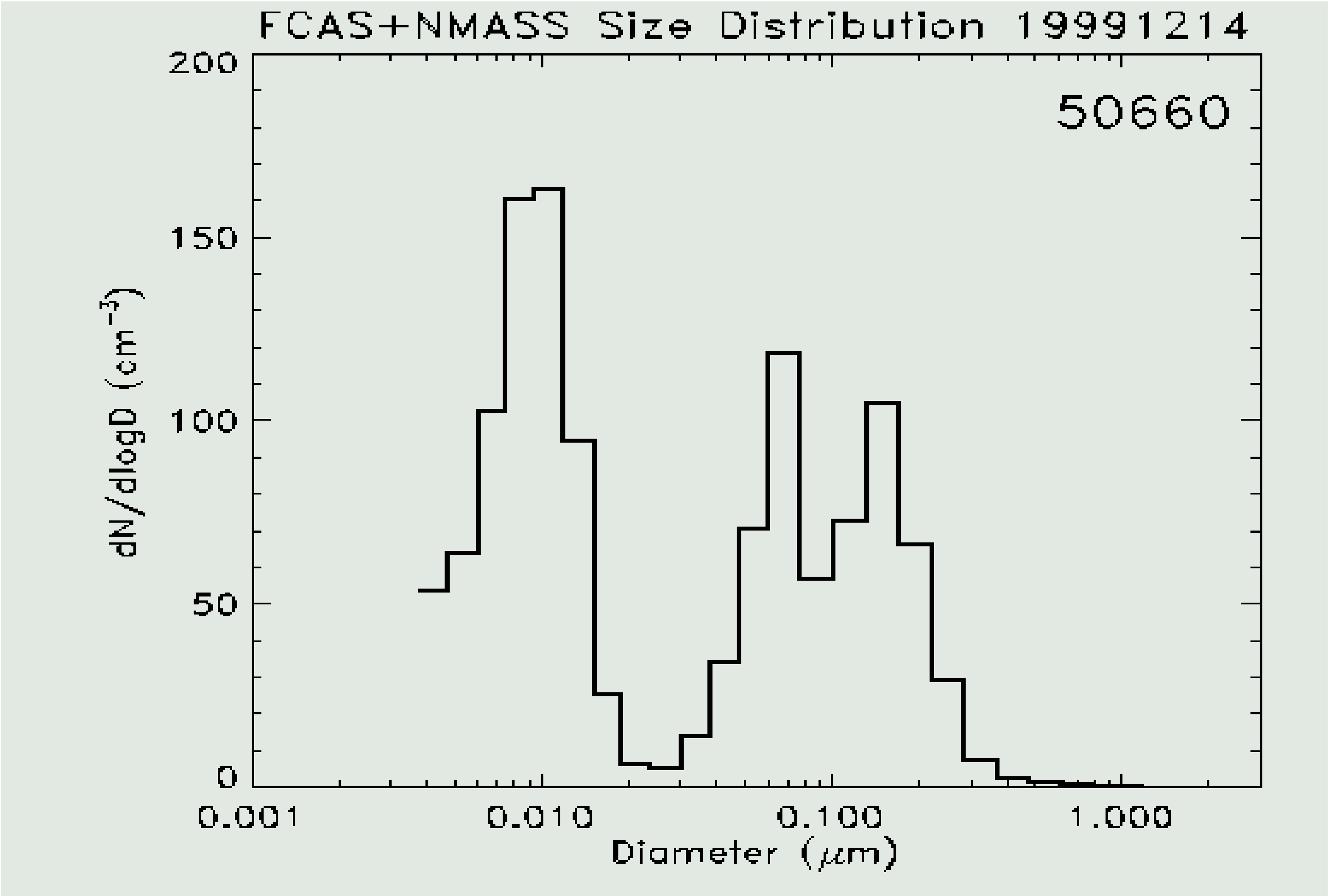
POAM III Comparisons





FCAS/POAM Surface and Volume
Volume Density ($\mu m^3 cm^{-3}$)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Altitude (km)
14
12
10
8
6
FCAS Surface
POAM III Surface
FCAS Surface w/PCA
FCAS Volume
POAM III Volume
FCAS Volume w/PCA
19991214
0
1
2
3
4
5
6
Surface Density ($\mu m^2 cm^{-3}$)

Size Distribution for POAM Comparison: 10 km



Suggestions

- Accurate extinctions at the short wavelengths would be very useful
- Algorithms which make use of accurate short wavelength data may well reveal useful information about aerosol surface.