

# **RETRIEVAL OF AEROSOL PROPERTIES FROM SAGE III MEASUREMENTS**

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## How to Retrieve Aerosol Properties from SAGE III Measurements?

Paper	Method	Feature
• Wang et al. (Applied Optics, 35, 433, 1996)	• Nonlinear least-square algorithm • Optimal Estimation Theory • Randomized Minimization Search Technique	• Retrieval of 3 aerosol size distributions studied • All aerosol extinctions were used for retrieval
• Anderson et al. (Journal of Geophysical Research, 105, 2013, 2000)	• Constrained Linear Inversion • Randomized Minimization Search Technique	• Retrieval of 10 aerosol size distributions studied • Properties retrieved indirectly • 6 to 8 aerosol extinctions were used for retrieval
• Yue (Journal of Geophysical Research, 105, 14719, 2000)	• Linear Minimizing Error Method	• Retrieval of 1400 size distri- butions & properties studied • Properties retrieved directly • 4 aerosol extinctions used • Linear expressions derived • Retrieval error as a function of size distribution studied

## Method to Retrieve Aerosol Property

- Assume aerosol size distributions are either unimodal or bimodal in the form:

$$\frac{dN(r)}{dr} = \sum_{i=1}^2 \frac{N_i}{\sqrt{2\pi r \ln \sigma_i}} \exp\left[-\frac{\ln^2(r/r_{gi})}{2\ln^2 \sigma_i}\right], \quad (1)$$

where  $N_i$ ,  $r_{gi}$ , and  $\sigma_i$  are the number concentration, mode radius, and width of the  $i$ th mode with  $i = 1, 2$ .

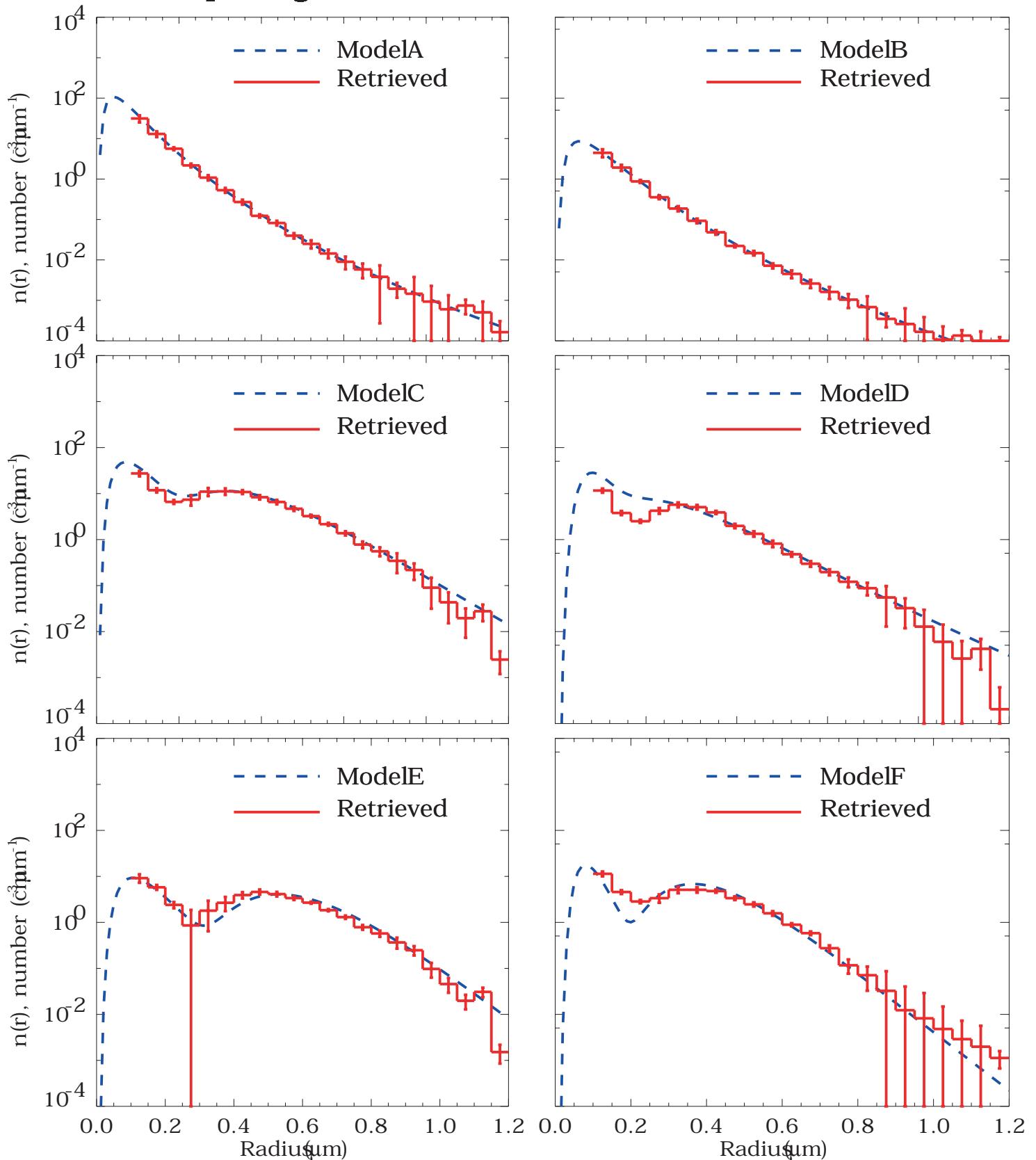
- Assume certain ranges of values for  $r_{gi}$ ,  $\sigma_i$ , and  $N_2/N_1$ .
- Use random number generators to produce a set of testing size distributions. The corresponding extinctions  $E_i$  at all nine SAGE III aerosol wavelengths and property  $P$  are calculated.
- Assume  $P$  can be estimated by the linear expression:

$$P = \sum_{i=1}^p C_i E_{qi}, \quad (2)$$

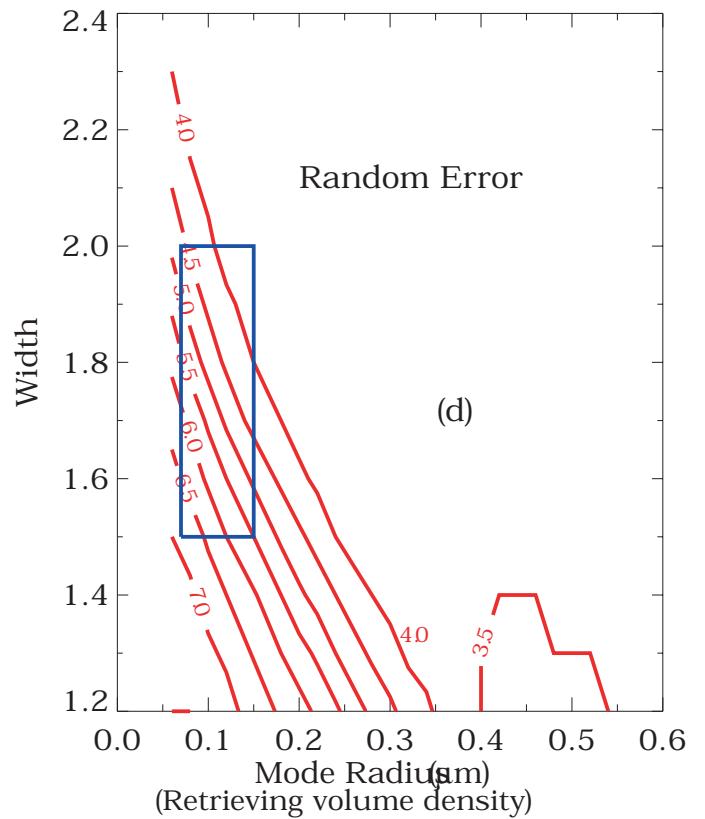
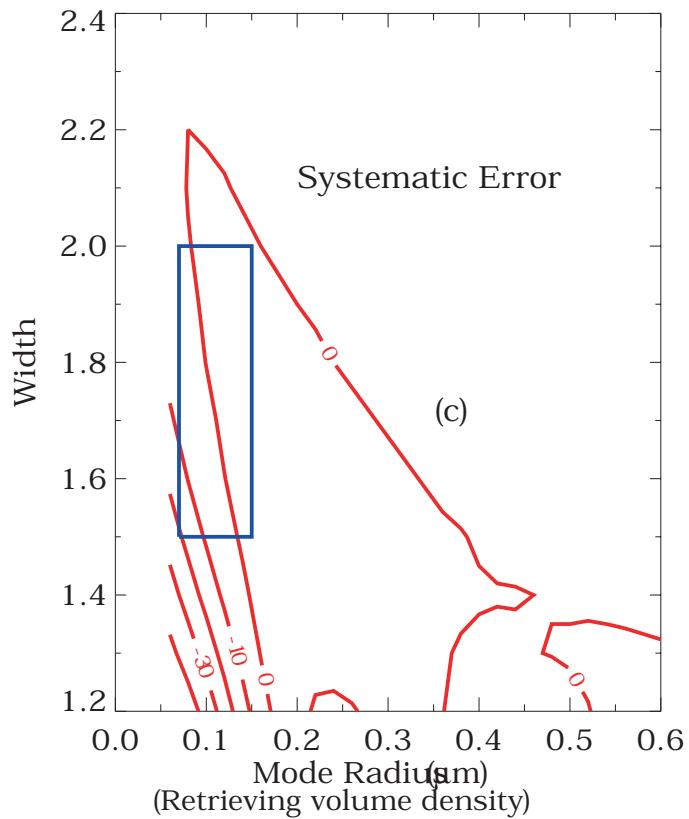
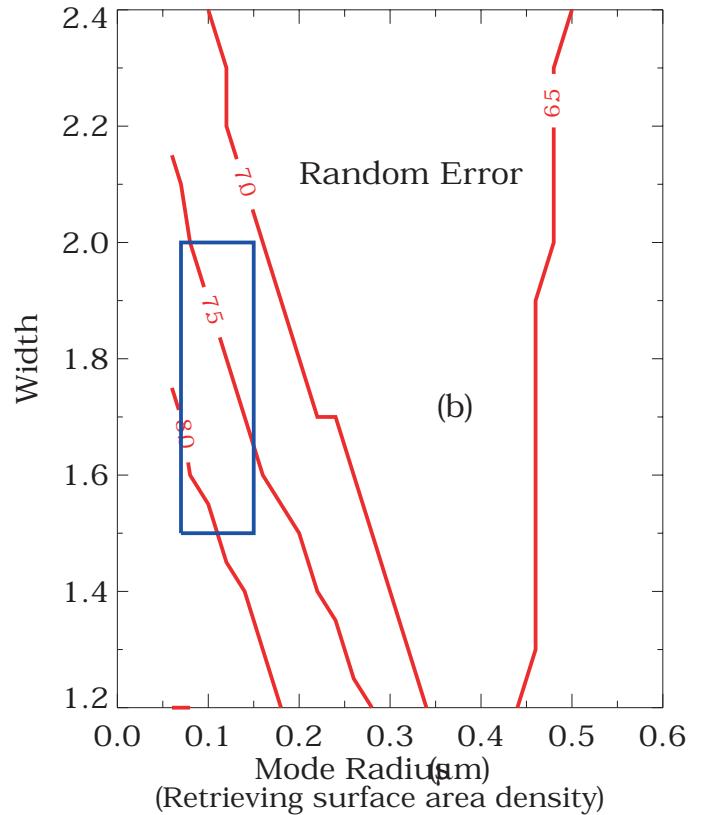
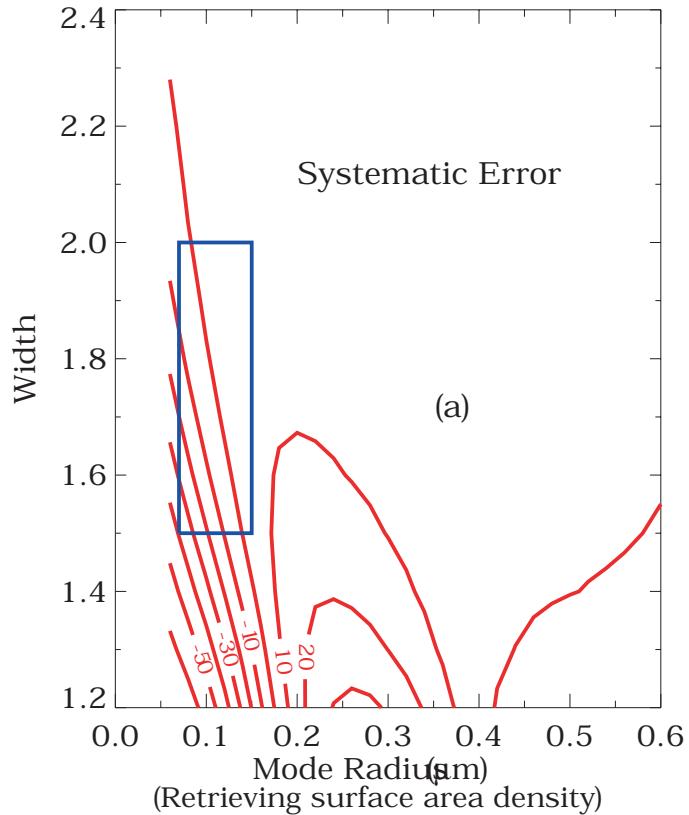
where  $p$  is the number of aerosol extinctions used for retrieval and  $C_i$  is the coefficient to be determined.

- $p$  testing size distributions are chosen randomly and a possible set

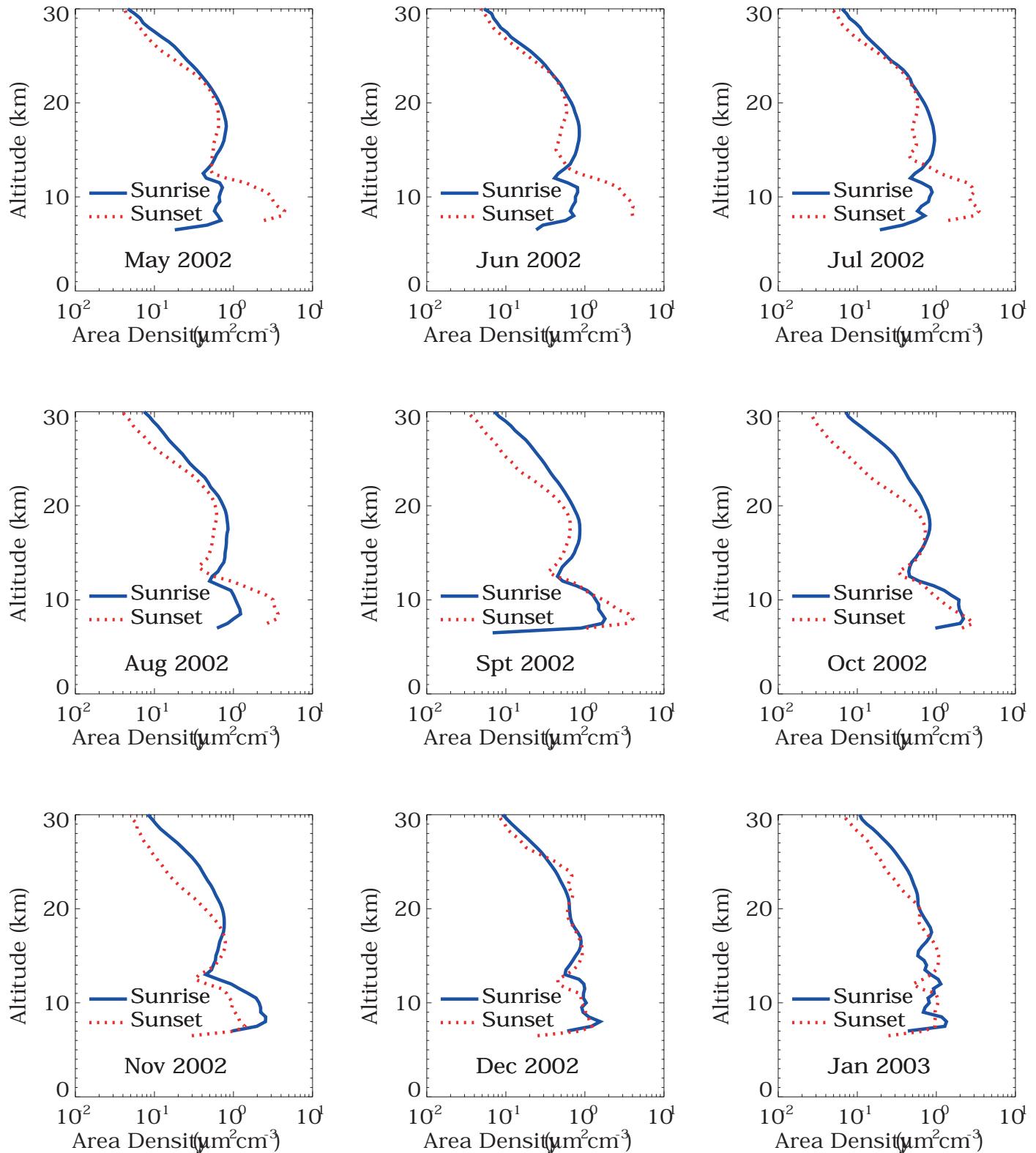
## Comparing Model and Retrieved Size Distributions



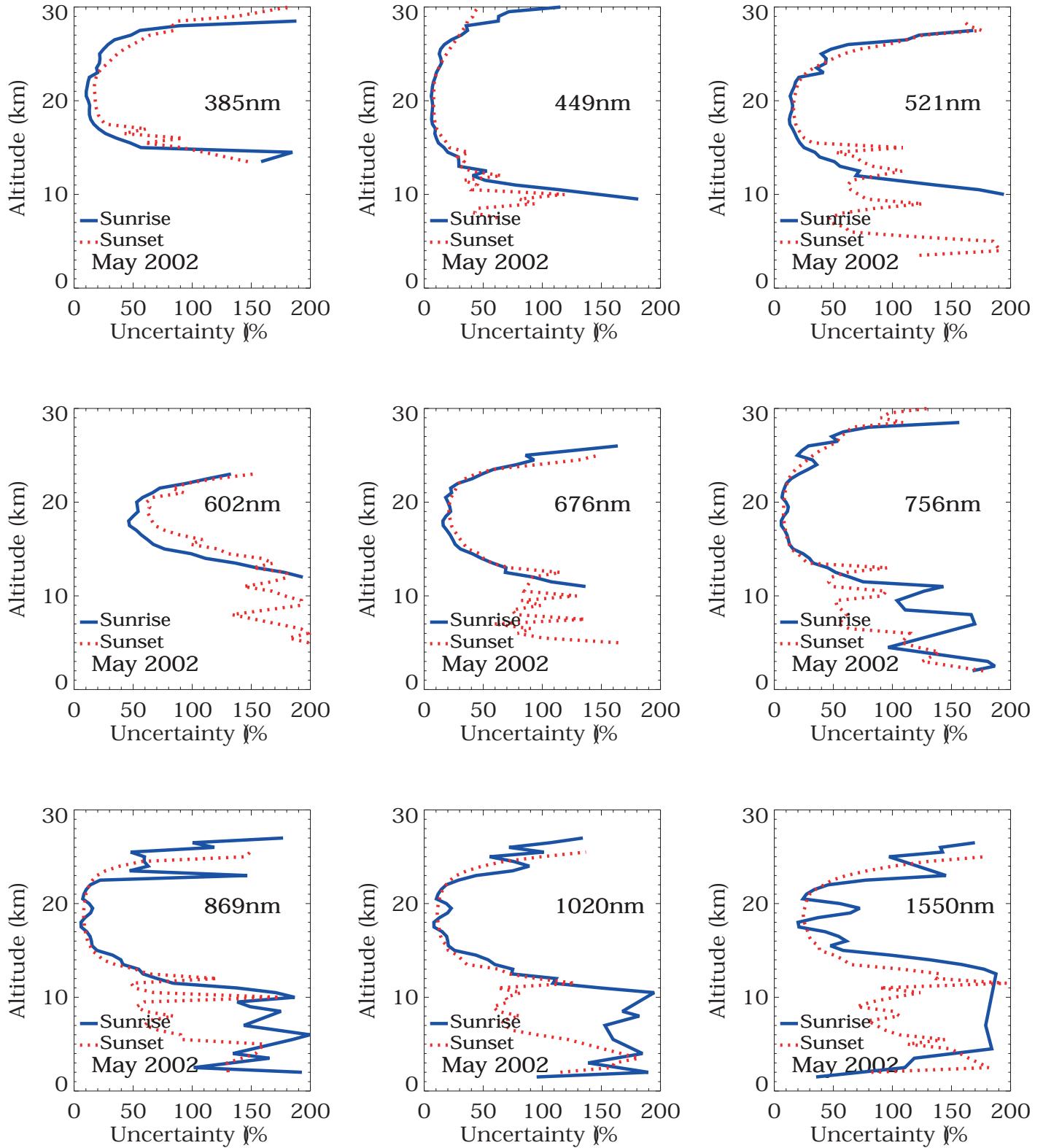
# Errors for Retrieving Surface Area and Volume Density



## SAGE III Monthly Mean Aerosol Surface Area Density



# SAGE III Monthly Mean Aerosol Extinction Uncertainty



# **Title: Development of Retrieval Techniques to Generate and Validate SAGE III Products**

## **Research Plan (First Year)**

- Study the influence of extinction measurement uncertainty on the retrieval of aerosol property
- Develop technique to retrieve aerosol mean and effective radius from SAGE III measurements
- Study the temporal and spatial variations of aerosol surface area and volume density retrieved from SAGE III
- Study the temporal and spatial variations of aerosol mean and effective radius retrieved from SAGE III
- Comparing SAGE III and HALOE aerosol measurements by converting the extinctions at visible and near IR to extinctions at IR and vice versa