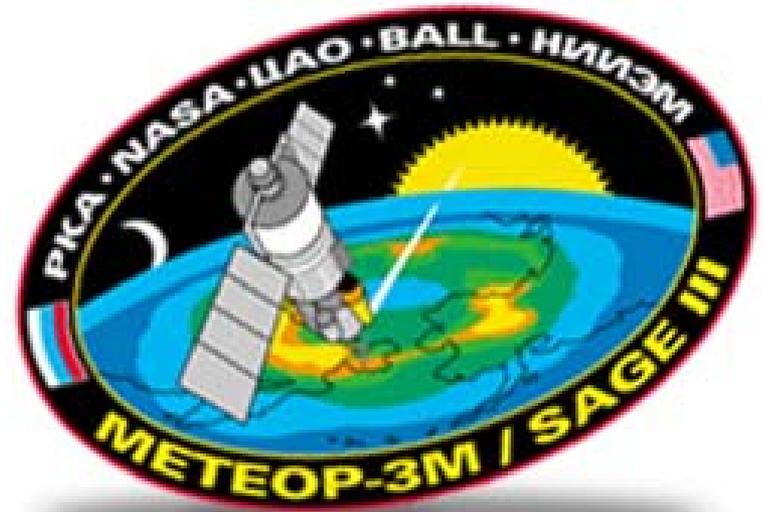


SAGE III Aerosol Studies: Size Distribution Retrievals and Validation

Mark Hervig

GATS Inc.



Planned Investigations

SAGE III Validation Studies:

Addressing stratospheric aerosols and cirrus

Comparisons with:

HALOE, balloon-borne OPCs, and SAGE II

Stratospheric Aerosol Size Distribution Retrievals

SAGE III Aerosol Validation

Comparisons with HALOE

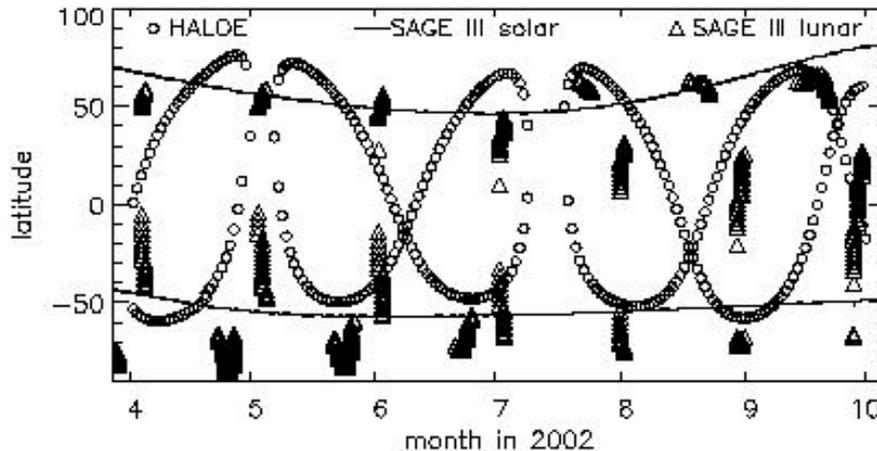
HALOE measures aerosol extinction profiles at 4 IR wavelengths

2.45, 3.40, 3.46, and 5.26 μm

size distributions are retrieved from stratospheric measurements

compare size distribution, surface area, etc...

calculate extinction at SAGE wavelengths using the HALOE size distributions



224 coincidences during
6 months in 2002

(176 solar, 48 lunar)

Comparisons with balloon-borne optical particle counters (OPCs)

OPCs measure size distribution profiles

compare size distribution, surface area, etc...

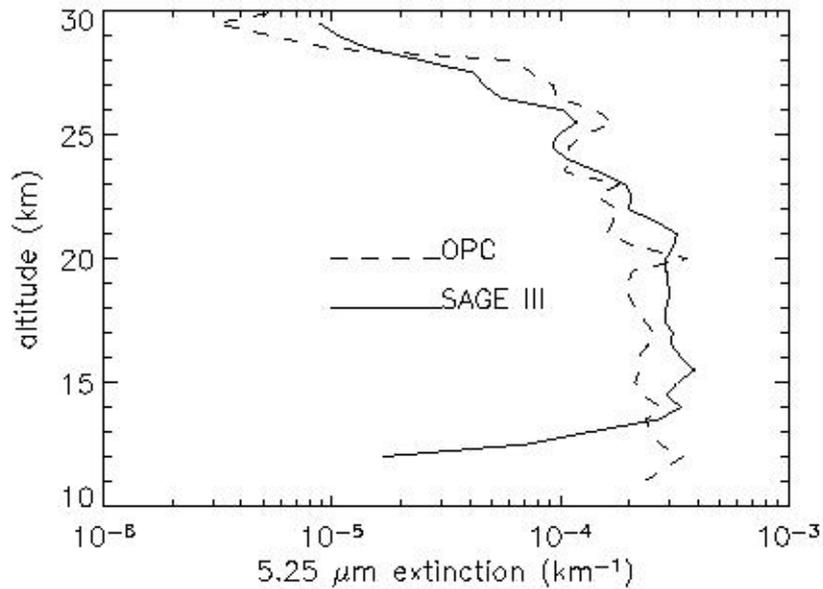
compute extinction at SAGE wavelengths using the OPC size distributions

Terry Deshler collaborating (University of Wyoming)



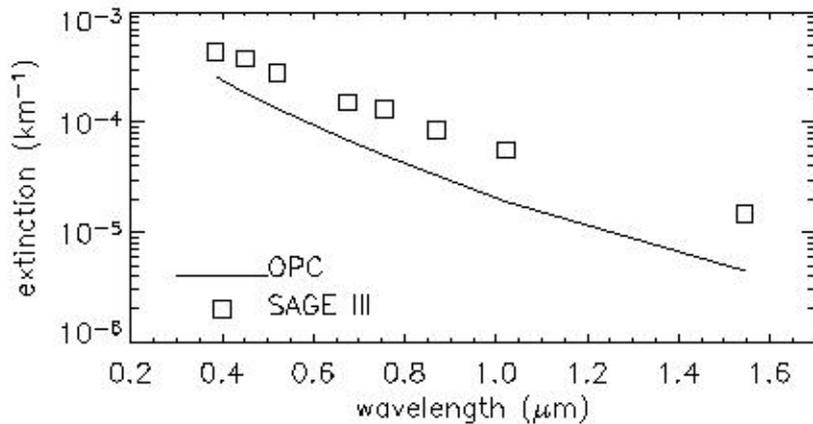
Example comparison between SAGE III and OPC over Laramie

40°N, summer 2002

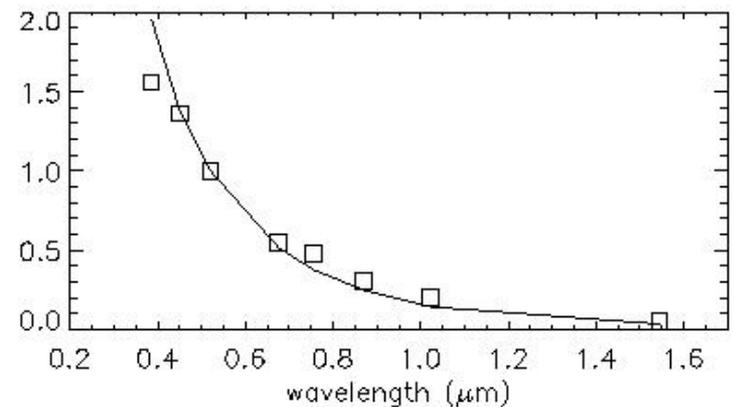


← Profiles over Laramie

Extinction spectra at
21 km altitude



Normalized spectra, 21 km



Extinction profile comparisons

SAGE II and HALOE

281 coincident measurements

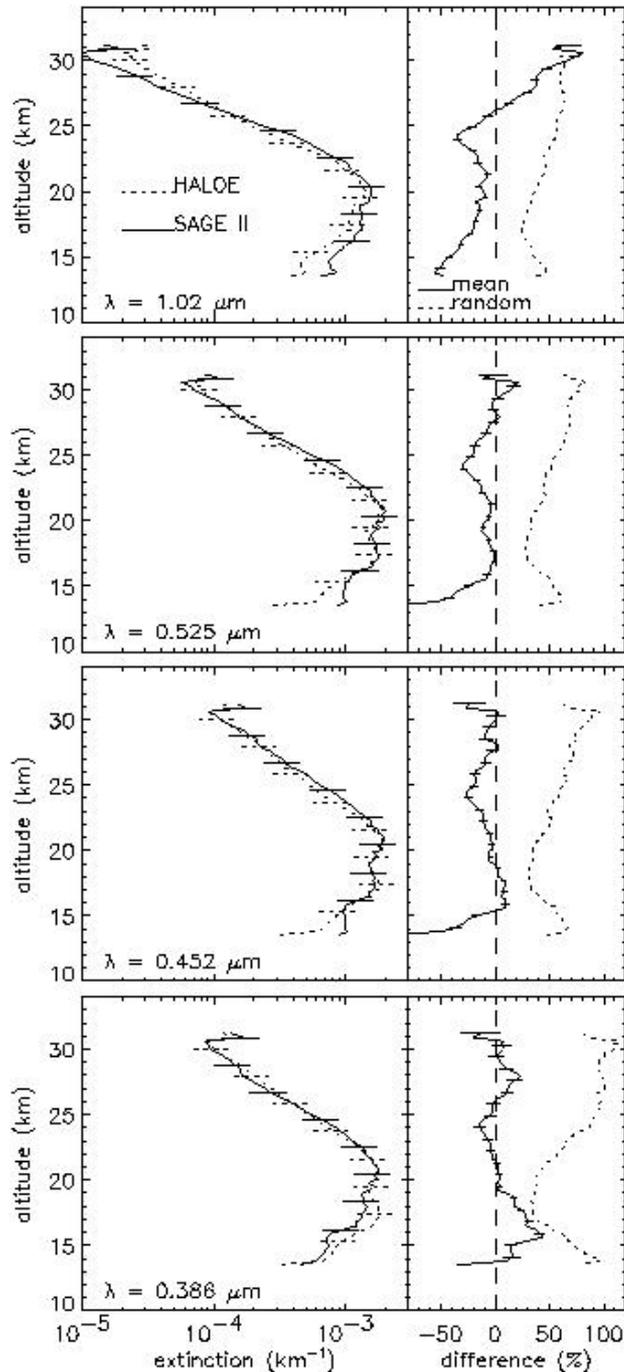
near 41°N, 1991-1998

Average separations:

12.1 hours

0.8° latitude

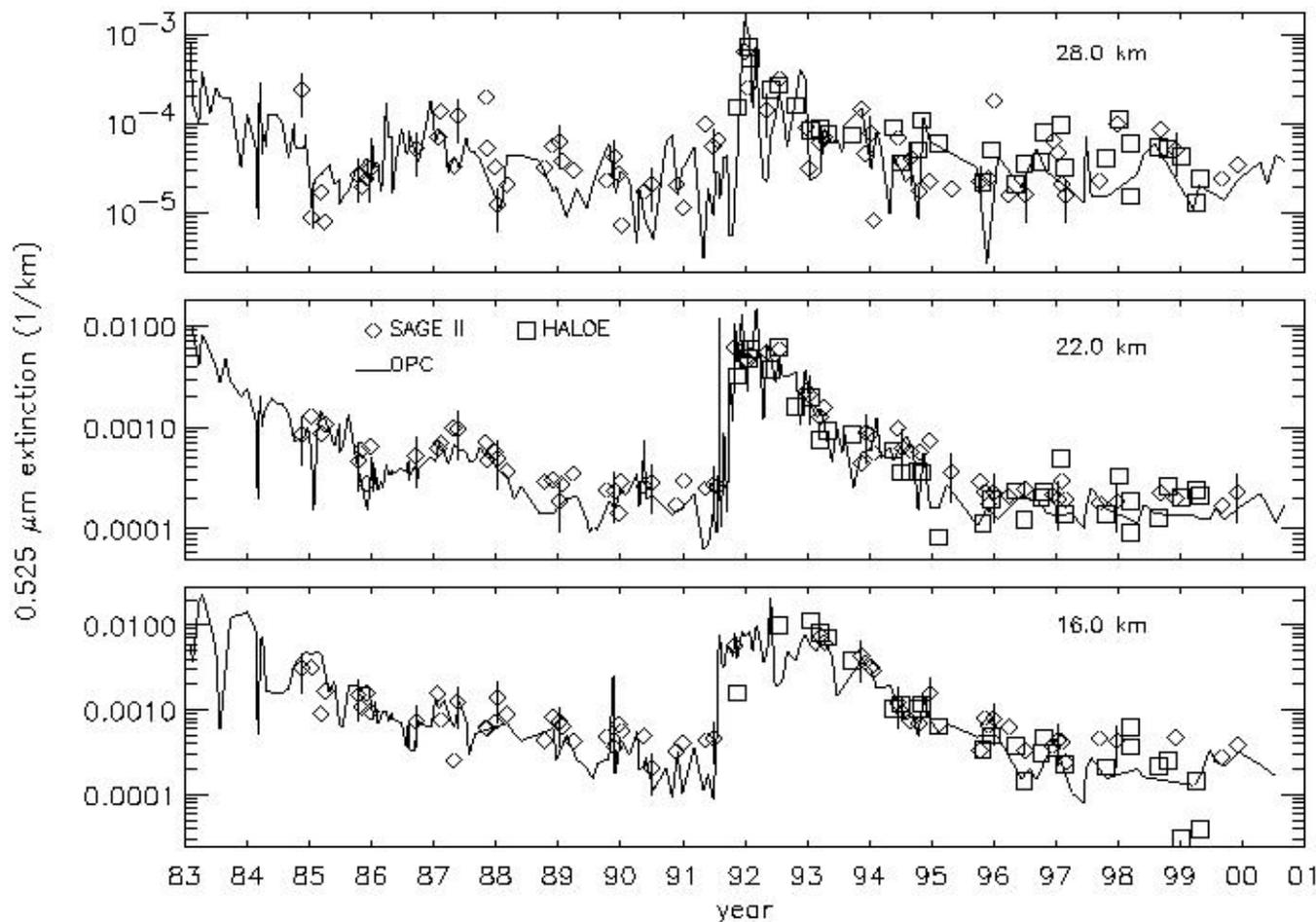
8.0° longitude



Extinction time series comparisons

SAGE II, HALOE, and OPCs

Measurements over Laramie

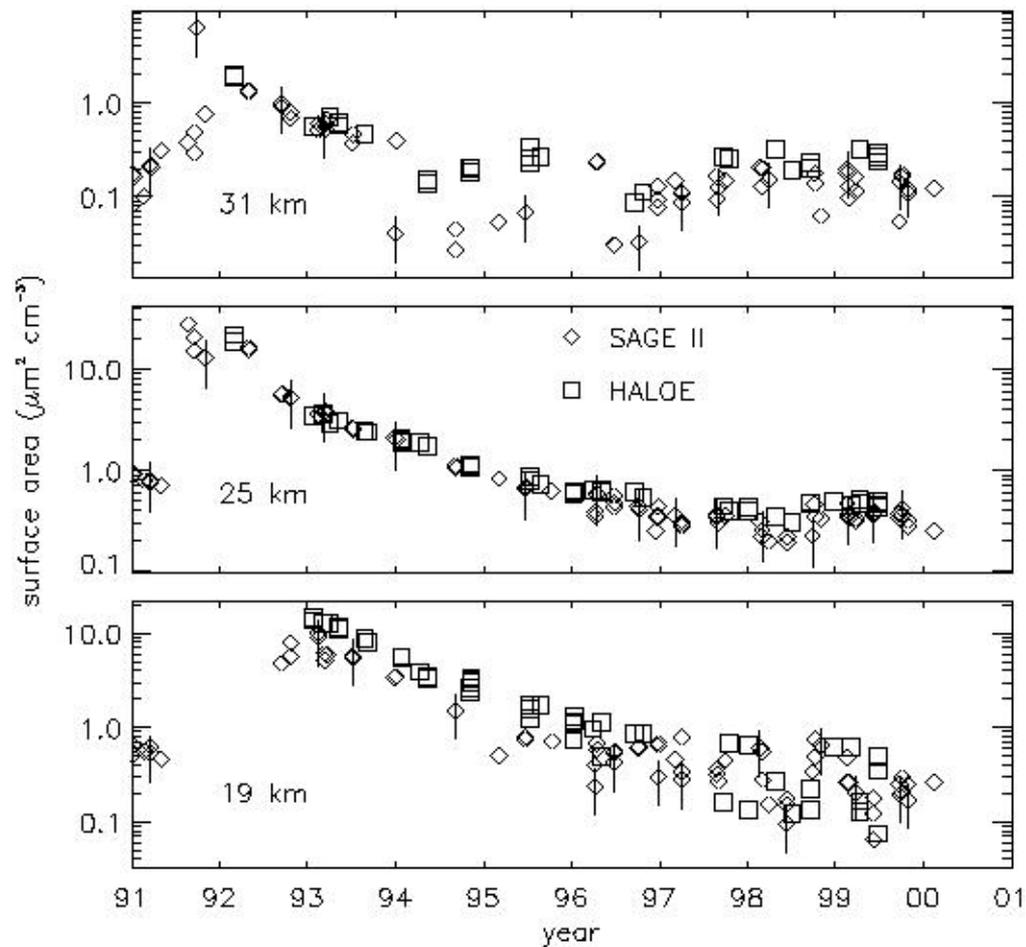


Non-coincident
measurements within
the same location

Surface area time series comparisons

SAGE II and HALOE

Over the equator



Non-coincident
measurements within
the same location

SAGE III Cirrus Validation

Compare SAGE III and HALOE cirrus measurements

Using very close coincidences:

Cloud presence (yes/no)

Cloud altitude

others? optical depth, effective radius, volume

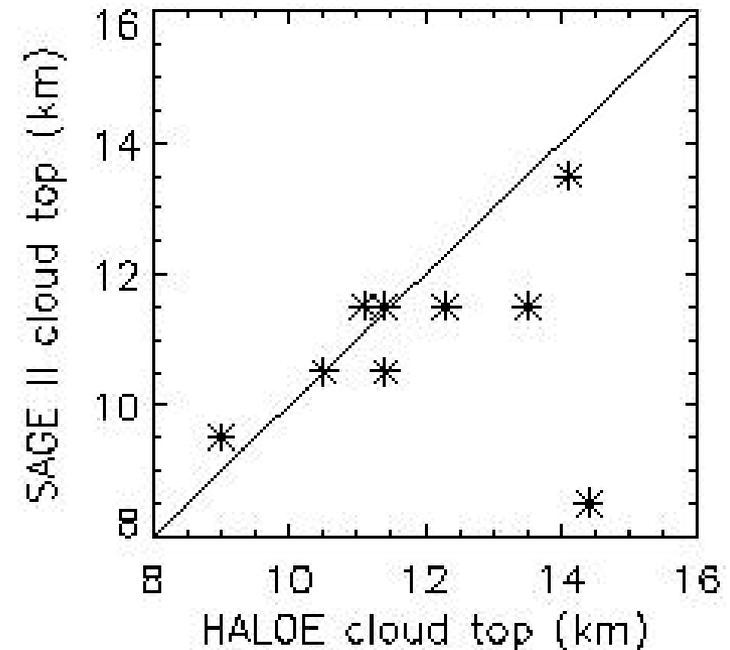
Statistical comparisons:

occurrence frequency vs. space, time

Example comparison of SAGE II and HALOE cloud top heights

9 coincidences, average separation:

3 minutes time and 61 km distance



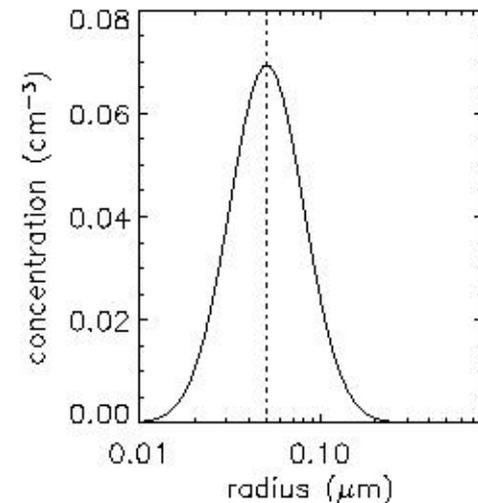
SAGE III Aerosol Size Distribution Retrievals

Retrieve aerosol size distributions from extinction at 8 (9) wavelengths

Assume lognormal distributions, 3 parameters:

total concentration, median radius, and distribution width

Begin with single mode, possible bimode (6 parameters)



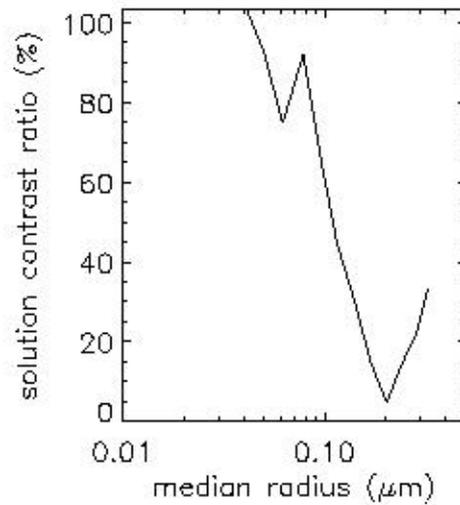
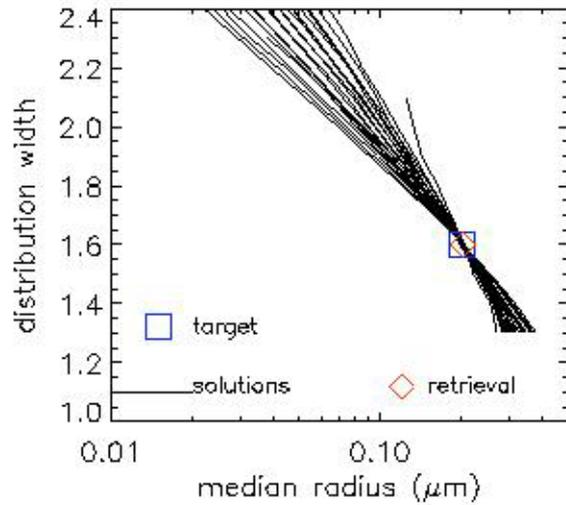
Step 1:

Find distribution shape (median radius and width) using extinction ratios

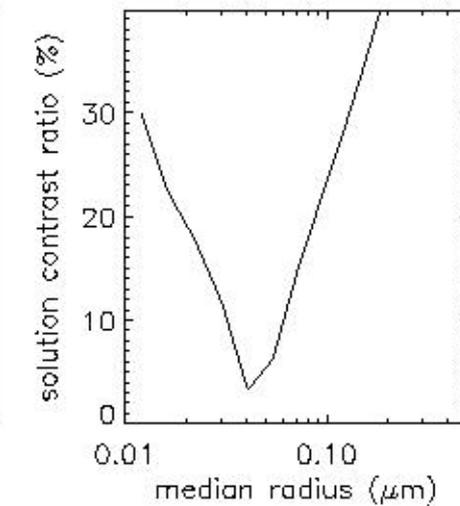
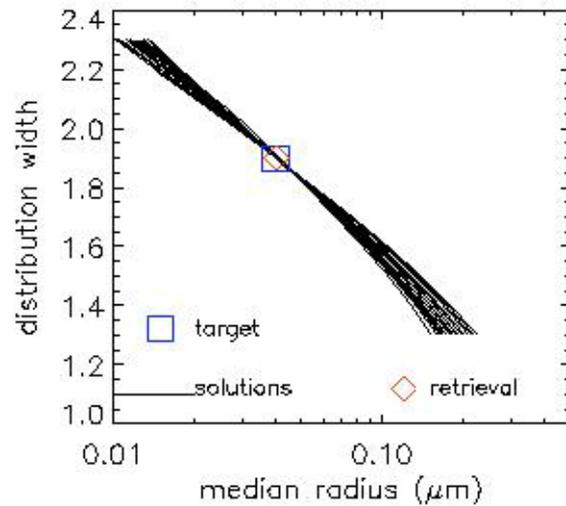
Step 2:

Find concentration by adjusting simulated extinction to measurement at one wavelength

Simulated SAGE III Size Distribution Retrievals



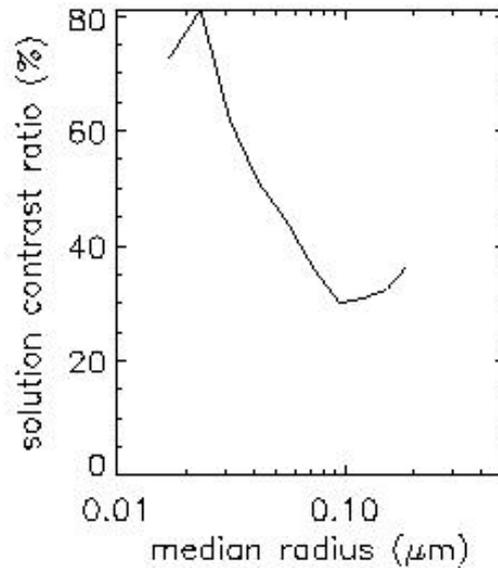
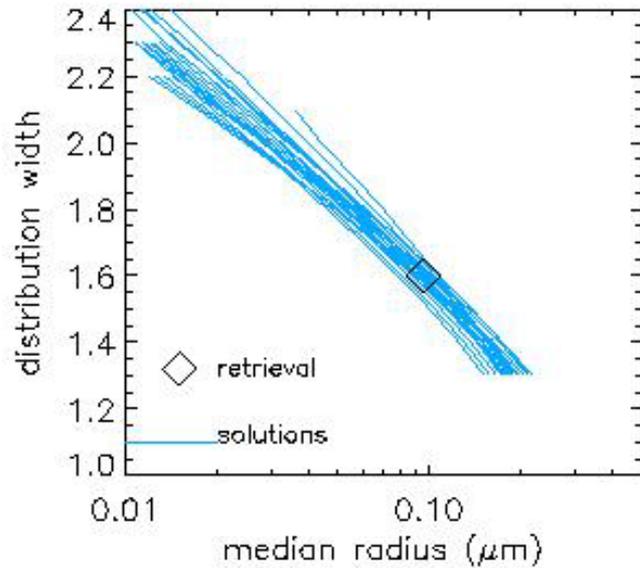
← volcanic aerosols



← background aerosols

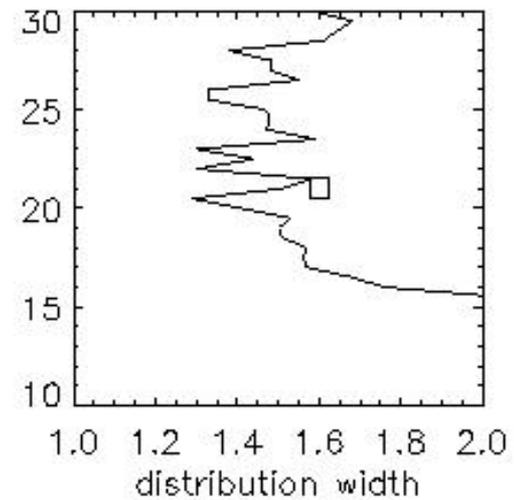
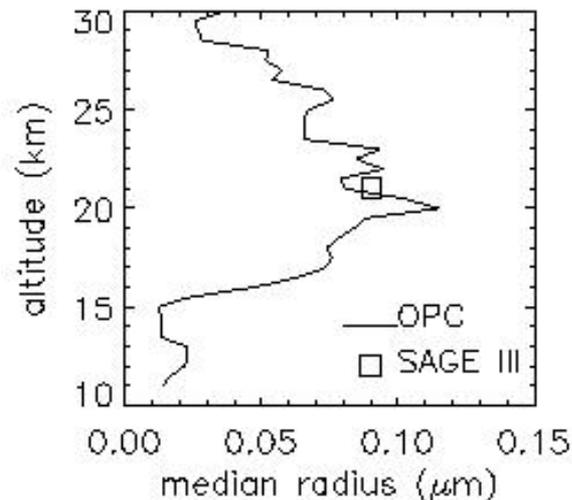
Example retrieval using SAGE III measurements

21 km altitude, 40°N, summer 2002



SAGE III size distribution retrieval

Comparison with OPC measurements



Summary

SAGE III Validation:

Stratospheric aerosol extinction, surface area, size distribution

Cirrus altitude, occurrence frequency...

Comparisons with HALOE, OPCs, SAGE II

SAGE III Aerosol Size Distribution Retrievals:

Infer lognormal size distributions for stratospheric aerosols

Make results and software available on the web