

# Analysis of Bimodal Aerosol Size Distributions at SGP Using RSS 105 and AERONET CIMEL Data

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# Need for Improved Aerosol Size Distribution Monitoring

- *Liu et al., 2006*: Aerosol size distribution climatology in GISS GCM does not agree with observations.
- *Dusek et al., 2006*: Variations in CCN concentration depend on variations in aerosol size distribution far more than chemistry.

# The Data

- Two devices
  - RSS 105 and CIMEL
  - at C1 of SGP
  - 2003 to 2005
- Two retrieval algorithms
  - *Gianelli et al., 2005*
  - *Dubovik and King, 2000*

# Information Limits (*Box et al., 1996*)

- At most, three items of independent aerosol information obtainable from optical thickness data in wavelength range of RSS and CIMEL, assuming 10% relative error.
- Information is added/subtracted by broadening/narrowing the wavelength range.

# Size distribution retrieved from dependence of AOT on wavelength

- Mie scattering: assumes spherical particles
- For a smaller particle:
  - Greater extinction at short wavelengths
  - Less extinction at long wavelengths

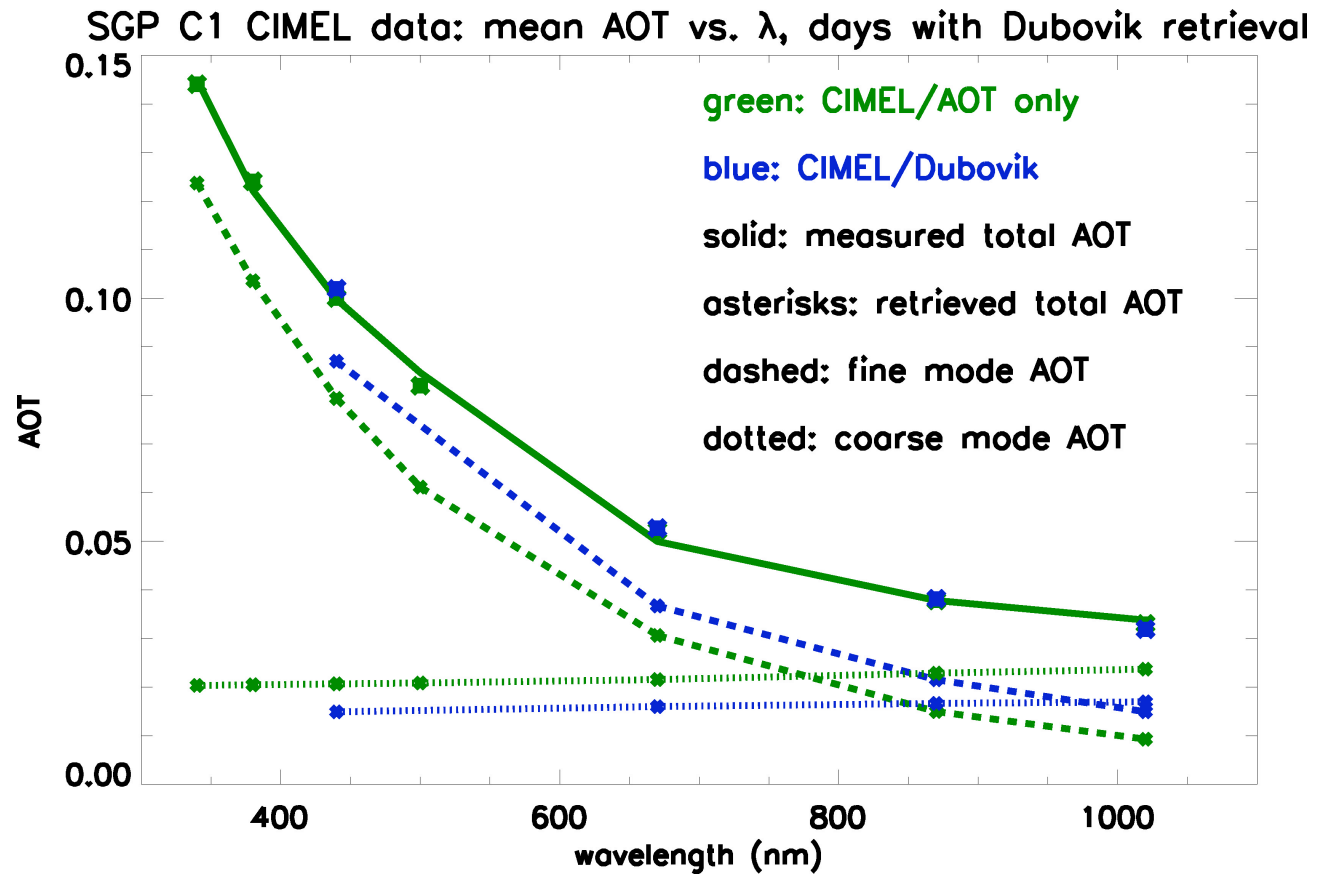
## *Gianelli et al., 2005*

- Retrievals using RSS 102 optical thickness data
- Fine and coarse mode AOT values are separable
- Fine mode  $R_{\text{EFF}}$  is retrievable, but with uncertainties --  $\text{NO}_2$ , fine mode  $V_{\text{EFF}}$
- Algorithm applicable to other devices

## *Dubovik and King, 2000*

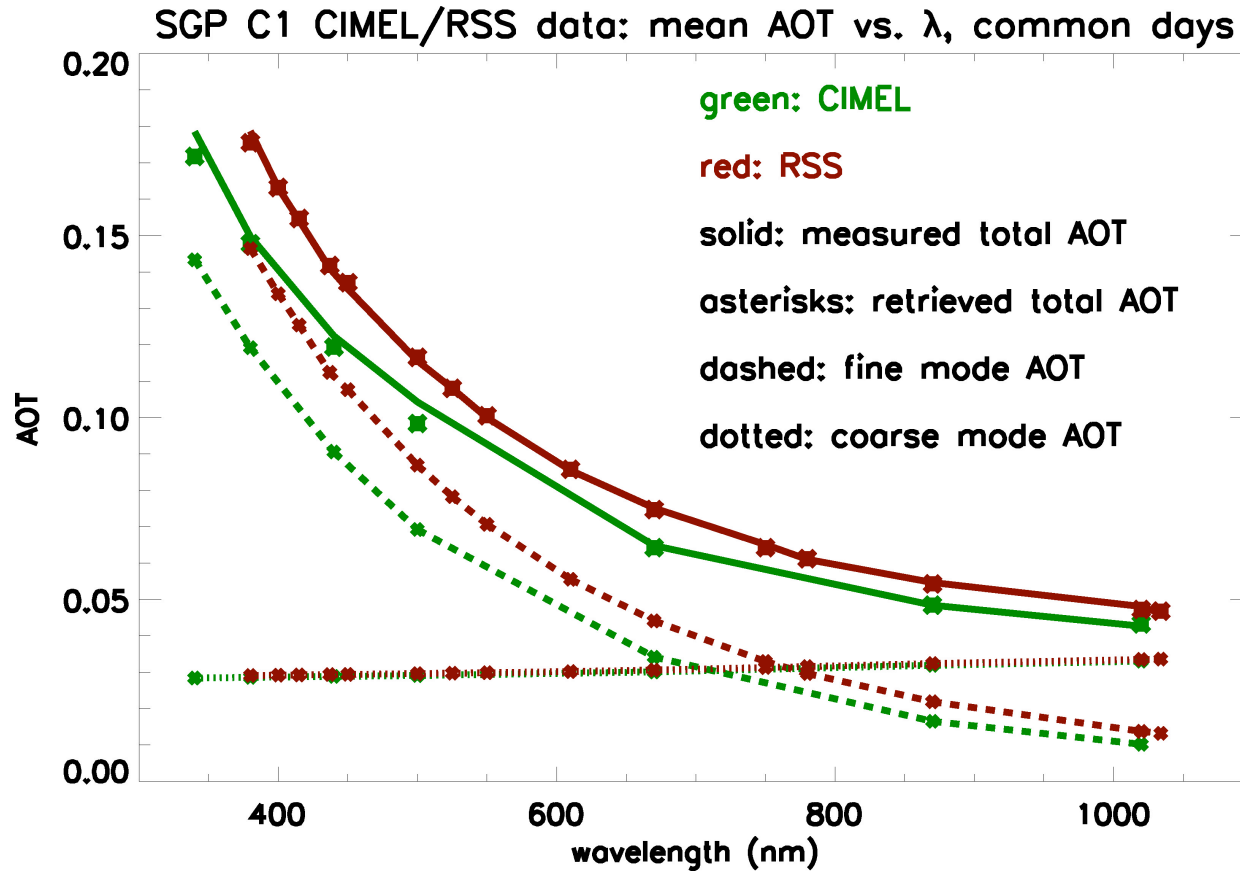
- Uses sun and sky radiance measurements from AERONET data
- Only four channels -- 440, 670, 870, and 1020 nm
- Retrieves full size distribution, plus real and complex index of refraction
- $R_{\text{EFF}}$  and  $V_{\text{EFF}}$  for both modes can be calculated from size distribution

# Different retrievals, same data

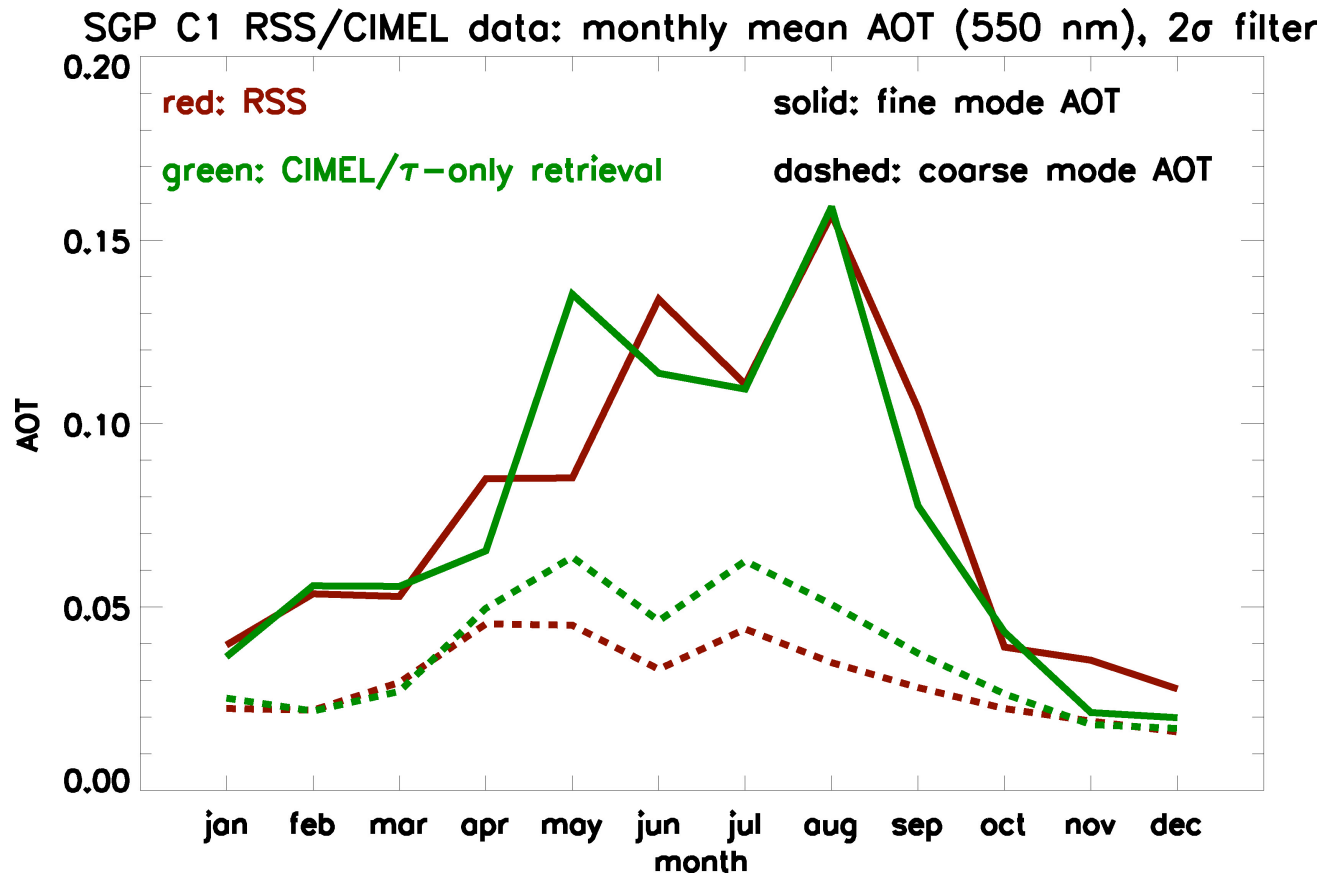




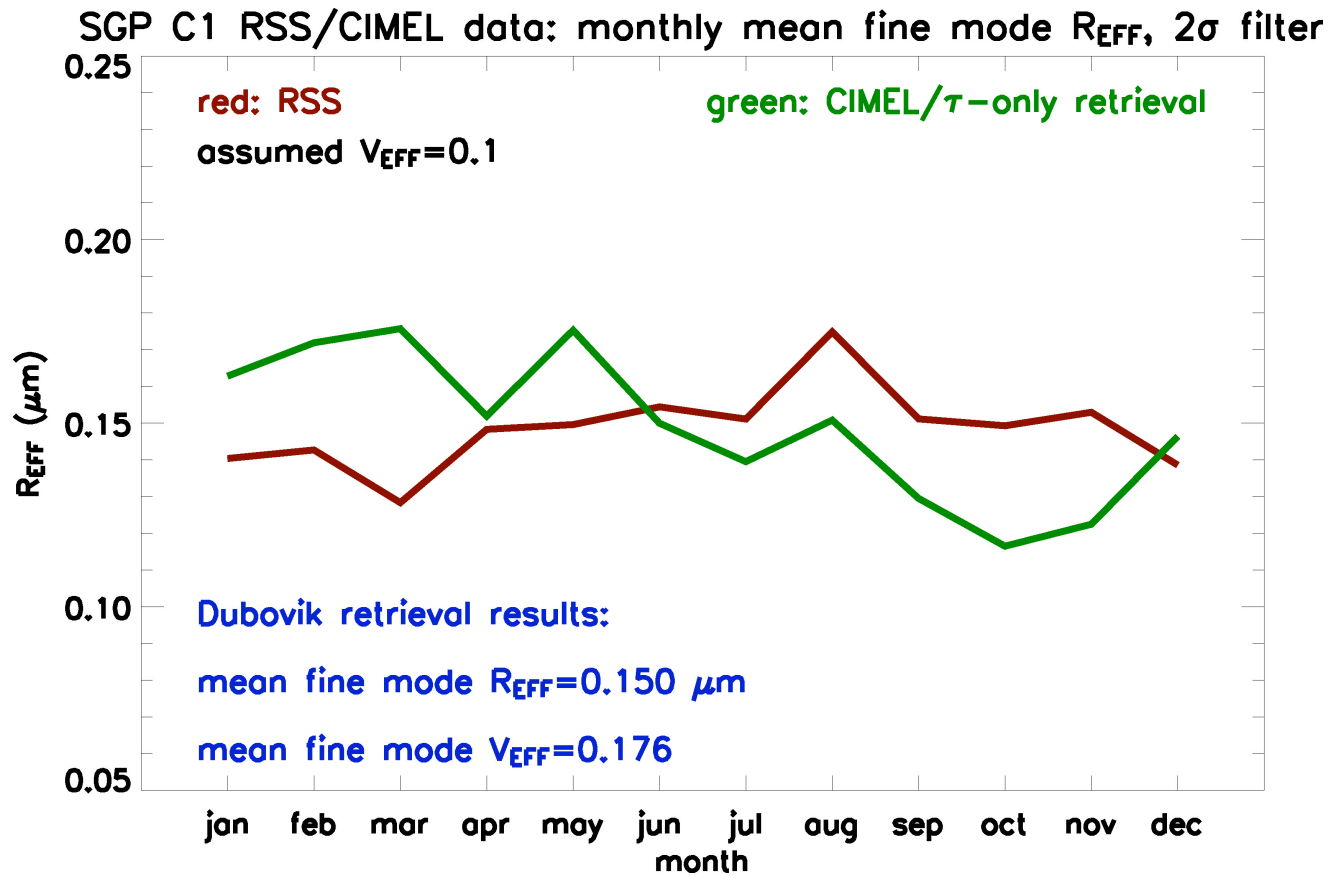
# Optical thickness-only retrievals for the RSS 105 and CIMEL



# Climatologies: AOT



# Climatologies: Fine mode $R_{EFF}$



# Conclusions

- For the CIMEL: Can the wavelength range of the sky radiance measurements be extended?
- Time to add an IR channel?
- Incorporate diffuse radiation into RSS retrievals, to assess  $\omega_0$  in addition to size distribution.

# Conclusions

- Why do the climatologies of the coarse and fine aerosol modes differ?
- Does the fine mode effective radius have an annual cycle or not?