Fine and coarse mode aerosol parameters retrieved from SGP MFRSR network data

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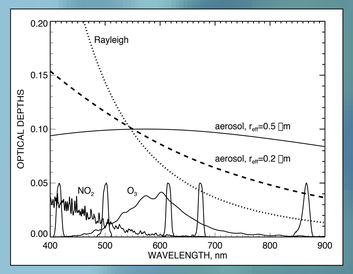
Multi-Filter Rotating Shadow-band Radiometer (MFRSR)



The MFRSR makes simultaneous measurements of the direct solar beam and horizontal diffuse flux at six wavelengths (nominally 415, 500, 615, 670, 870, and 940 nm) at 20 sec intervals throughout the day.

The gaseous absorbers in MFRSR channels: NO_2 (415, 500, 615 nm), O_3 (500, 615, 670 nm), water vapor (940 nm). Aerosols and Rayleigh scattering contribute in all channels.

Summary

We retrieve fine and coarse mode aerosol optical depth (AOD) and fine mode effective radius from MFRSR measurements.

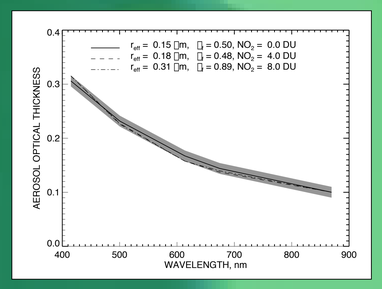
Sensitivity study demonstrated that for 0.01 accuracy in AOD the trade-offs between the aerosol extinction and NO_2 absorption prevent a conclusive estimate of NO_2 column and may bias aerosol size retrievals.

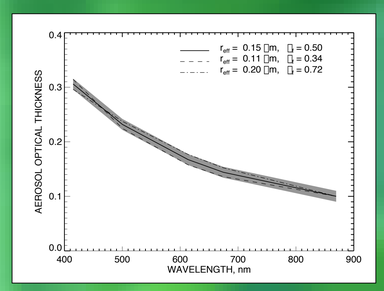
The retrieval algorithm uses climatological amounts of NO_2, compiled from SCIAMACHY data, and takes ozone from TOMS.

Our retrievals of total, fine, and coarse AOD, and fine mode effective radius agree well with the correlative AERONET almucantar scan analysis (Version 2) for a CIMEL sunphotometer co-located with the two MFRSRs (C1, E13) at the SGP's Central Facility.

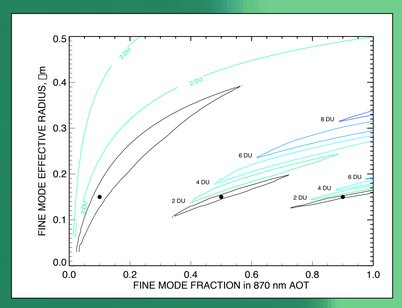
Can we retrieve NO_2 from MFRSR data?

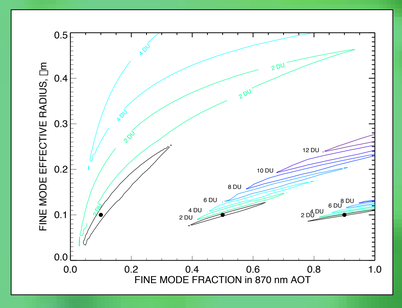
NO, because of trade-offs between spectral absorption of NO_2 in visible range and extinction of small aerosol particles.





Left: The model spectral AOD curves derived using Mie theory for bimodal gamma aerosol size distribution with fine mode reff = 0.15 mm, coarse mode reff = 1.5 mm, and fine mode fraction in 870 nm AOD of 0.5. The two competitive aerosol models fitting within 0.01 error margin (grey area) are shown by dashed and dash-dotted lines. Right: Same as left but with adding some pre-assumed spectral NO2 absorption (3 - 8 DU) to the fit AOD curves.

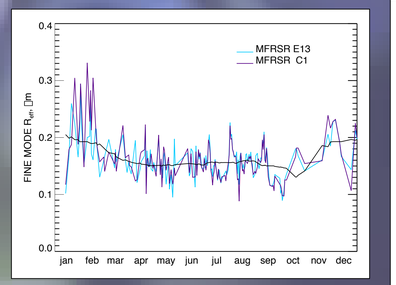




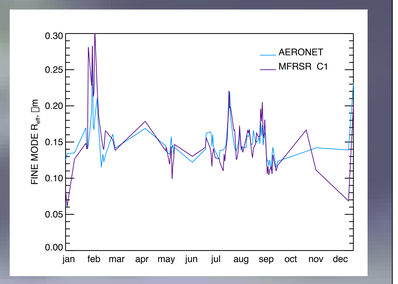
Sensitivity of retrievals of fine mode reff and fine mode fraction in 870 nm AOD and NO2 column amount to an error of 0.01 in measured optical thickness. AOD at 870 nm is assumed to be known precisely and equal to 0.1. The plots correspond to fine mode reff = 0.1 and 0.15 mm. Each plot shows data from three test aerosol models with fine mode fraction at 870 nm of 0.05, 0.5, and 0.95, depicted by bullets.

Retrievals from SGP's CF, comparison with AERONET

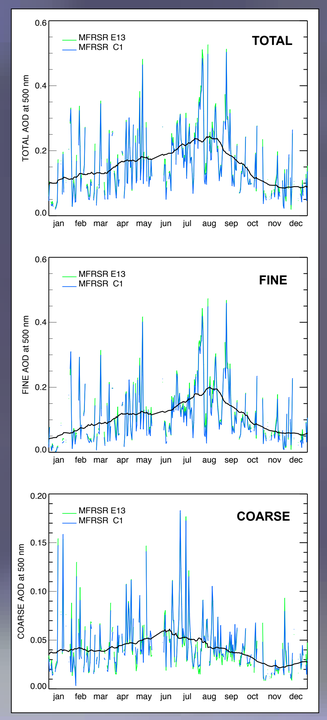
AERONET's CIMEL sun-photometer is co-located with C1 and E13 MFRSRs at SGP's Central Facility.



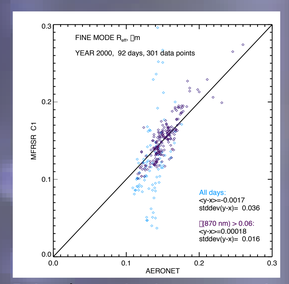
Time series of daily mean fine mode r_{eff} from C1 and E13 MFRSRs for the days in 2000 with τ(870 nm) > 0.006.

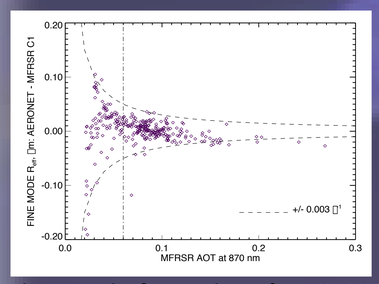


Comparison between time series of daily mean fine mode r_{eff} from C1 MFRSR and AERONET almucantar retrievals for 2000.

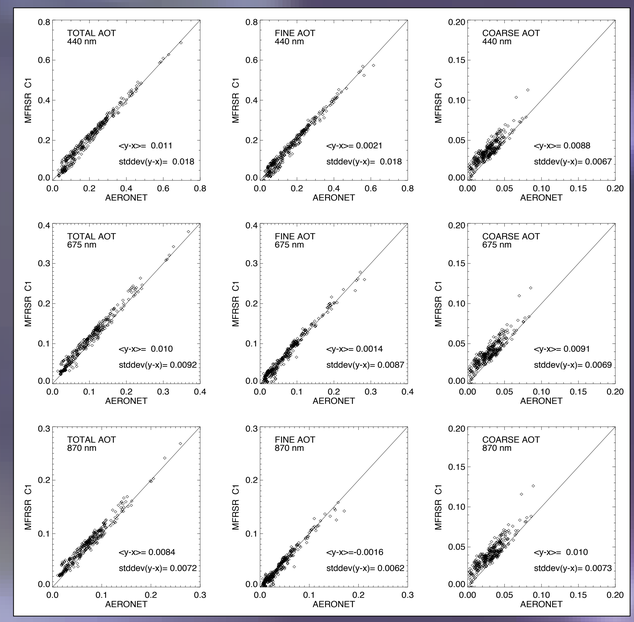


Daily mean total, fine, and coarse AOD in 500 nm channel from C1 and E13 MFRSRs data for 2000.





Point-by-point intercomparison between the fine mode r_{eff} from C1 MFRSR and AERONET almucantar retrievals for 2000. Right: difference between C1 and AERONET r_{eff} v.s. 870 nm AOD. Vertical line: threshold AOD (0.006).



Point-by-point intercomparison between total, fine, and coarse AODs from C1 MFRSR and AERONET almucantar retrievals for the year 2000.