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Characterization of fine and coarse modes of atmospheric aerosols using ground-based sun-photometry

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Ground-based sun-photometry provides an important source of information for characterization of atmospheric aerosols, as well as a validation tool for global satellite aerosol retrievals. We present recent results of our analysis of Multi-Filter Rotating Shadowband Radiometer (MFRSR) data. The MFRSR makes precise simultaneous measurements of the direct solar beam and horizontal diffuse flux, at six wavelengths (nominally 415, 500, 615, 670, 870, and 940 nm) at short (20-60 sec) intervals throughout the day. Our MFRSR data analysis algorithm allows us to partition the spectral aerosol optical thickness (AOT) into fine and coarse modes and to retrieve the fine mode effective radius. We also developed retrieval techniques for spectral aerosol single scattering albedo (SSA) and precipitable water vapor content. Our recent sensitivity study demonstrated that for a typical accuracy 0.01 of AOT measurements the trade-offs between the spectral aerosol extinction in visible range and NO_2 absorption effectively prevent conclusive estimation of NO_2 column from MFRSR data, and may bias aerosol size distribution retrievals. This prompted us to adopt a constrained retrieval method which relies on climatological amounts of NO_2 and uses ozone columns from TOMS satellite measurements. To examine geographical and seasonal variability of aerosol properties the described algorithm was applied to a multi-year dataset from the local MFRSR network at the Southern Great Plains (SGP) site operated by the U.S. Department of Energy Atmospheric Radiation Measurement (ARM) Program. The network consists of 21 instruments located at SGP's Extended Facilities and covers the area of approximately 3 by 4 degrees in northern Oklahoma and southern Kansas. Our retrievals of aerosol parameters are in agreement with the correlative AERONET's almucantar scan analysis results derived from a CIMEL sunphotometer co-located with the MFRSR at the SGP's Central Facility.