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ESTIMATING AEROSOL OPTICAL DEPTH USING GROUND BASED NEPHELOMETER MEASUREMENTS AT THE SOUTHERN GREAT PLAINS (SGP) ATMOSPHERIC RADIATION MEASUREMENT (ARM) SITE

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It has been estimated that the scattering of shortwave radiation by anthropogenic aerosols during clear sky conditions creates a global radiative perturbation of comparable magnitude but opposite sign to the forcing by anthropogenic greenhouse gases. This 'direct' radiative aerosol forcing effect depends primarily on the aerosol optical depth (AOD), which is the integral of the aerosol extinction coefficient, bext, with height. The aerosol extinction coefficient is the sum of the aerosol scattering, bsp, and absorption, bap, coefficients. We present a comparison of AOD estimates made by sun photometer and nephelometer measurements on April 10, 1996 at the SGP ARM Site. Direct solar irradiance was measured with a Cimel sun photometer at 6 wavelengths from 339 nm to 1021 nm. These data are used to estimate AOD's by Langley analyses for clear sky conditions. The aerosol scattering coefficient, bsp, was measured at wavelengths of 450 nm, 550 nm, and 700 nm with a TSI Integrating Nephelometer. In addition the aerosol absorption coefficient, bap, was measured at 550 nm. The AOD estimates are compared from 18:00 to 21:00 UMT on April 10, a period of time that was characterized by generally clear sky conditions and very stable values of bsp and bap. Radiosonde temperature profiles indicated a well mixed layer in the lower 1200 m of the troposphere. During this time period the Angstrom exponent (slope of bsp or AOD vs. wavelength curve on a log scale) based on nephelometer measurements is 2.2 (for bsp values at 450 nm and 700 nm) compared to a value of 1.2 from the sun photometer measurements (for AOD's at 437 nm and 669 nm). This discrepancy may be largely due to differences in the RH between the nephelometer (20%) and the atmosphere (35%-60%), which can lead to significant differences in the aerosol particle diameters due to hygroscopic growth. The aerosol optical depth estimates from sun photometer and nephelometer measurements are within 40%. The reason for this discrepancy will be discussed, as well as the uncertainties in the factors that are used to estimate aerosol optical depth from nephelometer measurements.

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