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DETERMINATION OF RADIAL MOMENTS OF AN AEROSOL SIZE DISTRIBUTION FROM MEASUREMENTS OF LIGHT SCATTERING AND TRANSMISSION

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ABSTRACT

The lowest several radial moments of the aerosol size distribution contain important information about the distribution, including extensive properties such as the total concentrations of number, surface area, and volume, and they can be used to calculate important intensive properties such as the effective radius and effective variance. Moments can be propagated in aerosol models much more efficiently than bins or other methods of describing the aerosol size distribution, and many properties of interest can be parameterized in terms of moments. The ability to accurately determine such moments from measurements of light scattering and transmission would permit real-time determination of properties of the aerosol size distribution using relatively simple equipment.

Among easily measured optical properties of an aerosol are the aerosol optical thickness, which is the concentration of extinction cross section, and the concentration of the cross section for scattering at a given angle, both as a function of wavelength. Different sizes of particles, which contribute differently to the moments, also contribute different amounts to these quantities. Hence it may be possible to use measurements of these quantities to infer the lowest several moments of an aerosol size distribution.

A procedure is discussed that determines the lowest several radial moments of an aerosol size distribution from measurements of light scattering and transmission at several different wavelengths and angles, under the assumption that the aerosol consists of spherical particles with a known real index of refraction. The accuracy with which this determination can be made depends on the wavelengths, the angles, and of course the size distribution. Examples of the performance of this procedure are given, and various combinations of angles and wavelengths are investigated to obtain the maximum amount of useful information from the fewest and most robust measurements.

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