MEASURED SCATTERING MATRIX ELEMENTS FOR SPHERICAL AND NON-SPHERICAL AEROSOLS

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ABSTRACT

This paper reports experimental results on all non-zero elements in the scattering matrix from the following two types of laboratory generated clouds:

(a) Spherical water droplets

(b) Non-spherical NaCl particles

The main purpose has been to carefully document the departures from Mie theory in the case of non-spherical particles of various sizes.

The measuring instrument is a new polarization-modulated, polar nephelometer, which measures as a function of scattering angle, any of the sixteen elements of the general Mueller matrix describing scattering from small particle systems. Incident light was either He-Ne or He-Cd laser light. To produce the well defined clouds of the scattering system, an ultrasonic nebulizer was used. The output of the nebulizer was used directly for the water droplets, while NaCl-water solutions of varying strengths were nebulized and passed through drying stages to produce the non-spherical NaCl particles.

Scattering matrix elements were calculated using Mie theory for optical constants of H_2O and of NaCl with varied particle sizes and size distributions. The ability to fit the scattering theory precisely to experiment in the case of the water droplets illustrates

the potential of this type of measurement for determining cloud droplet size. In the case of the non-spherical particles, scattering matrix elements matched rather well with Mie calculations for clouds of particles of radius less than about .5 micron. In the larger sizes, however, there was little correspondence between theory and experiment.