Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

AAS22-06 Room:511 Time:April 30 17:30-17:45

Development of an angle-resolved polar nephelometer and its application to non-spherical particles

NAKAGAWA, Maho[1*] ; SASAGO, Hiroshi[1] ; NAKAYAMA, Tomoki[1] ; MATSUMI, Yutaka[1] ; UEDA, Sayako[1]

[1]Solar-Terrestrial Environment Laboratory, Nagoya University

Angular distribution of scattering is one of the important optical properties contributing to the radiation balance in the Earth's atmosphere. Therefore,accurate description of the single-scattering properties of aerosol particles is required. In addition, the angular distribution of scattering of individual aerosol particle provides useful information to determine its size, shape, and refractive index of particles.

We are developing a new polar nephelometer, which can measure angular distribution of the optical light scattered by an individual particle. Laser light at 532 nm from a 300 mW YAG laser was used as light source. The laser beam intersects with a stream of aerosol particles introduced with a sheath flow using a double pipe. There are 21 photodiode detectors arrayed in each plane, totaling 42.Detector apertures were placed to limit sensing angles and minimize background light scattered from walls.

In this system, angular distributions of scattering for an incident light polarized parallel and perpendicular to the scattering plane were measured simultaneously. In the experiments, particles were atomized using a nebulizer and dried using a diffusion dryer. Then, size of particle was selected using a Differential Mobility Analyzer (DMA) and Aerosol Particle Mass Analyzer (APM) and introduced into the polar nephelometer.

The performance of the system was tested by measuring angular distributions of scattering by gaseous molecules (HFC-134 and CO2) and spherical particles. Polystyrene latex sphere is non-light absorpbing spherical particle, while nigrosine are light-absorbing spherical particle. The measured scattering angular distribution was compared with the simulation result calculated from the Mie scattering theory considering detection efficiency and of scattering angle range of each detector.

As a result, the scattering angular distributions could be reproduced by the simulation results for PSL particles with diameters between 150 and 900 nm. The scattering angular distributions for nigrosine particles, were in good agreement with the theoretical curve calculated using a literature refractive index value, $n = 1.63 + 0.24\, i$. This result suggests that light absorbing particles is distinguishable by the scattering angle distribution measurement.

In order to examine the influence of the difference of the shape, we also performed measurements of the scattering angle distributions of non-spherical particles such as sodium chloride and soot particles. In the presentation, capabilities of the system to determine the shape and refractive index of particle will also be discussed.