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Multi-angle Polarized Remote Sensing of Non-Spherical Aerosol Particles

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Aerosol particles in the atmosphere are known to play an important role in the climate system by altering the earth's energy budget through the scattering and absorption of radiation. Aerosol has been known to be a source of significant uncertainties in studies of earth's climate, which is explained by difficulties in monitoring spatially- and temporally-variable aerosol properties. The only way to obtain the aerosol particles properties on a global scale is by means of satellite remote sensing. Several approaches to the satellite remote sensing of aerosol particles optical and microphysical properties using measurements of solar reflectance have been developed. Despite this multitude of approaches, the AOD retrieval from satellite data is still not satisfactory. The accuracy of remote sensing aerosol characterization is limited by the difficulty to model the optical properties of non-spherical aerosol particles.

Earlier on, and in some applications even today, aerosol particles have been assumed to be isotropic, homogeneous, and spherical. With these assumptions one can apply the Mie theory and compute the exact single-scattering properties of aerosol particles. There is sufficient experimental evidence that the non-spherical of aerosol particles can cause scattering properties significantly different from those predicted by the Mie theory. Many research efforts have focused on the improving the accuracy of aerosol retrievals in the presence of non-spherical particles. However, dealing with non-sphericity is not a completely resolved issue.

In this paper, the microphysical and optical properties of non-spherical aerosol particles are studied, and the vector radiative transfer model coupling the BRDF model and BPDF model of surface reflectance was used study the TOA reflectance and polarized reflectance of non-spherical aerosol. The sensitivity of reflectance and polarized reflectance to non-spherical aerosol particles microphysical optical parameters are evaluated. Based on the studies of the sensitivity, the basic theory of using the remote sensing data of multi-angular polarized to retrieve the shapes of non-spherical aerosol particles is proposed. The conceptual aerosol retrieval was applied using the multi-angle polarized remote sensing data.