Optical properties of oriented ice crystals and applications in lidar remote sensing and optical phenomenon simulations

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Ice clouds are ubiquitous over the globe, and these clouds consist of various nonspherical ice crystals. Among these ice crystals, horizontally oriented hexagonal plates (HOPs) and columns (HOCs) have unique single-scattering properties such as extremely strong backscattering and angular scattering anisotropy about the scattering azimuth angle. These scattering properties sometimes cause specific optical phenomena in the sky. However, these horizontally oriented ice crystals have significant impacts on lidar measurements [1] and even non-negligible impacts on passive-satellite measurements under particular sun–view geometries [2]. Therefore, better quantitative understanding of the single-scattering properties of horizontally oriented ice crystals is essential to take account of oriented ice crystals in the remote sensing of ice clouds. A recently developed physical-geometric optics method (PGOM) efficiently computes the single-scattering properties of ice crystals [3], which is fairly consistent with the counterparts computed with a rigorous computational technique, the invariant-imbedding T-matrix method (II-TM) [4].

This study develops a single-scattering property database of HOPs and HOCs in various sizes and incident angles at three wavelengths: 355, 532, and 1064 nm using PGOM. In the talk, we will demonstrate the single-scattering properties of a HOP and HOC, and their applications to the simulations of lidar signals and optical phenomena.

References

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