X-ray micro-CT imagery of deposited snow in optical modeling of atmospheric ice particles

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Cryogenic X-ray computed microtomography (micro-CT) is a powerful tool that can be used to analyze the detailed three-dimensional structure of deposited snow. To investigate the optical properties of real snow particles, we developed a technique to extract individual shapes of snow particles from X-ray micro-CT data, and we calculated their single-scattering properties using the conventional Geometrical Optics Method (CGOM) [1]. If we assume that the original shapes of falling ice particles remain in a structure of new deposited snow, realistic models of some large ice particles in the atmosphere, such as snowflakes and graupels, are obtained from the micro-CT data. Moreover, the extracted shape data can be used for the modeling of inhomogeneous particles of an ice/water mixture by adopting numerical simulations of ice melting.

Microwave scattering properties for the modeled particles are calculated by applying the DDA or the FDTD method. On the other hand, the CGOM and the improved geometrical optics method (GOM2/GOIE) are basically applicable to the particles of large size parameters at visible and infrared wavelengths, though some improvements for the numerical codes are necessary because of the two components for the particle material and of the complex shapes defined by a large number of facets. The approach of our particle modeling by using micro-CT data for the calculations of light scattering properties is discussed.

Reference

[1] Ishimoto H., S. Adachi, S. Yamaguchi, T. Tanikawa, T. Aoki, and K. Masuda, 2018: Snow particles extracted from x-ray computed microtomography imagery and their single-scattering properties. *J. Quant. Spectrosc. Radiat. Transfer* **209**, 113–128.

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