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Irregularly shaped ice aggregates on the optical modeling of convective ice clouds

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For the application to satellites and ground-based cloud remote sensing, a shape model for ice particles that originated from the convective clouds is proposed and a database of its light scattering properties is developed. According to the results of microphysical observations, ice particles in the convective clouds tend to have a highly irregular structure due to the aggregation process, while some regular shapes of crystals, such as hexagonal plates/columns and bullet rosettes, are dominant for stratiform ice clouds. Another habit of crystal model, that has a nature of high irregularity and complexity in the shape, will be useful to retrieve particles' effective radius and ice water content (IWC) from remote sensing data. On the calculations of light scattering properties for cloud ice particles in visible to near-infrared wavelength, ray tracing approaches (GOM and IGOM) are important as well as rigorous numerical method (e.g. FDTD or DDA). Since the detailed information of the target surface is necessary for geometrical optics calculations, a simple method to define the surface of irregular shaped particles including roughness is required. In this work, a cell-type aggregate structure which appears in spatial Poisson-Voronoi tessellations is used as a model of rough surfaces. Furthermore, fractal-like overall shapes of particles with their sizes larger than 200 micron are applied, taking into account the reported mass- and area-dimensional relationships. Numerical calculations of light scattering properties for the modeled particles are conducted by using FDTD method, IGOM and GOM, according to their size parameters. Results of randomly oriented scattering properties show some typical features of the complex and irregular shaped particles, such as weak halo and flat side-to-backscattering angle dependence in phase functions, and small values of the maximum linear polarizations.