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Optimizing the Ice Crystal Scattering Database for GCOM-C/SGLI Satellite Mission

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Cirrus Clouds (CC) regularly cover about 30-40% of the global, have been identified as one of the major unsolved components in weather and climate research. CC has a significant impact on the radiation budget in the earth–atmosphere system, and climate change. Because of high located in earth atmosphere, their detailed microphysical compositions and radiative properties have been studied through the aircraft equipped. Several projects like the First International Satellite Cloud Climatology Project (ISCCP) Regional Experiment (FIRE) and the International Cirrus Experiment (ICE), were implemented for understanding the microphysical compositions and radiative properties of cirrus clouds in weather and climate research. Therefore, the single-scattering property of the ice crystal is important for retrieval of CC optical and microphysical properties. It is fundamental to an understanding of the radiation budget of the earth atmospheric system.
To retrieve the optical and microphysical properties of cirrus clouds from satellite remote sensing data, it is required to develop the scattering and absorption property database for non-spherical ice crystal using above light scattering solvers. In the scattering and absorption property of the PingYang's Database, ice particles has been developed at 56 wavelengths between 0.2 and 5μm, and 49 wavelengths between 3 and 100μm. The wavelength almost covers the whole visible to infrared channels in satellite sensor. However performance of scattering and absorption property database of the non-spherical particles for satellite sensor, determined by the particle shape, size parameter, and the wavelength. Manny satellite sensors have different channels and bandwidth. So, when we develop the ice particles scattering database for a particular satellite sensor, it is necessary to optimize the database based on the channels and bandwidth of the satellite sensor.
In this paper, parameterization of the single-scattering properties of individual ice crystal of cirrus clouds were investigated using Geometrical-Optics Approximation (GOA), Improved Geometrical-Optics method (IGOM) and Surface Integral Equations Method of Müller-type (SIEM/M) methods for developing ice crystal scattering database of Global Change Observation Mission (GCOM-C)/Second generation Global Imager (SGLI) satellite data. Hexagonal plates were assumed to be the effective shape of the cirrus clouds ice crystal. Wavelength origin design was used in the light scattering database for optimizing the SGLI channels. The light scattering database was developed for 110 refractive index, 3 aspect ratio and 250 size parameters. 19 channel of the SGLI sensor were computed to 110 calculating wavelengths by 3 steps size in 1.5 times bandwidth. Additionally, phase functions of GOA and SIEMM used in this study were compared to conventional methods of IGOM and Finite Different Time - Domain (FDTD) technique and it is confirmed that phase functions of both data are similar in general. Finally, error analysis of the new database and conventional database were compared and evaluated.