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09:30-09:45

Numerical simulation of polar mesospheric cloud emissions observed by Himawari-8

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Recently, we reported that polar mesospheric cloud (PMC) emissions can be observed by Himawari-8, the Japanese geostationary earth orbit (GEO) meteorological satellite. The full disk images of Himawari-8 provide PMC emissions in the Earth's limb region, which allows us to perform continuous PMC monitoring from a fixed point, the GEO orbit, more routinely. It is noted that the intensity of the measured PMC emissions does not indicate directly the number density of PMC particles because the emission intensity captured by the sensor is the sum of PMC emissions along the satellite line of sight and the scattering cross section of PMC particles depends on the size and the scattering angle due to configuration of the sun, the earth, and the satellite. Therefore, a numerical simulation is necessary to identify PMC parameters such as number density, radius distribution, and their spatial distribution, from Himawari-8 observation data.
In this study, we develop a numerical simulation method to reproduce the emission intensity observed by the Himawari-8 with a given PMC distribution. In the proposed method, the PMC particles are assumed to be lossy dielectric spheres because the size of PMC particles is considerably smaller than the observation wavelengths, which are three visible bands: blue (0.47 um), green (0.51 um), and red (0.64um). For this case, the exact solution of scattering cross section is given by Mie theory. We use the common assumption regarding particle size distribution, which is given as a log-normal form. The light traveling in the atmosphere is attenuated due to scattering by air molecules and PMCs, which is also considered in the proposed method. The attenuation due to the air molecules (described by Rayleigh scattering) is calculated from number density and temperature of the air molecules, which are given by the NRLMSISE-00 atmospheric model.
The developed simulation method shows a good agreement with observed data. It is demonstrated that number density and particle size distribution can be uniquely identified by using data observed with multiple wavelengths. The developed method enables us to retrieve spatial distribution and particle size distribution of PMCs from Himawari-8 data.