PMC detection method applying to Himawari-8 data

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Polar mesospheric clouds (PMCs) or noctilucent clouds (NLCs) consist of water-ice particles, which can be produced in summer at the mesopause region, mainly at high latitudes. Since the first report on PMCs in 1885, various methods have been used to perform PMC observations. Optical observations by ground-based cameras, imagers, or lidars are often limited by weather conditions because a clear sky is required for such observations. Hence, satellite observations from space are valuable for more continuous observations, which enable significant systematic data coverage. Such systematic data coverage would be of benefit, for example, for monitoring long-term PMC activity, which may be related to global changes, because water-ice particle production can be enhanced by CO_2 cooling and H_2O increase, which may be induced by increases in the greenhouse gases such as CO_2 and CH_4. Many PMC observations have been done by low- Earth-orbit (LEO) satellites. By contrast, there are only few reports of PMC observations by Geostationary Earth Orbit (GEO) satellites.

Recently, we made an initial report on PMC observations using limb-data by Japanese GEO meteorological satellite Himawari-8 [Tsuda et al., 2018]. In this presentation, we will show our PMC detection method for application to the Himawari-8 data. Before the PMC detection, we have calculated positions of tangential points in the limb of Himawari-8 full-disk image. Then, based on the position data, we have made spatial averaged emission intensity data in the Himawari-8 band-1 (~470 nm) at each bin with 1º latitude and 1-km altitude, and thus we have obtained height profiles at each latitude. Our PMC detection method is applied to these height profiles in the averaged emission intensity data. The detection method consists of mainly three steps. First, we have set a threshold based on dark level which is determined from emission intensity data above 90 km, where there is basically no emission, and extract PMCs with strong emission intensity compared with the threshold. To extract PMCs with weaker emission intensity, removal of emissions from Rayleigh scattering is needed. So, as the second step, we have reproduced emission profiles only due to Rayleigh scattering using polynomial approximation, and then we have removed the reproduced Rayleigh scattering-induced emission intensities. Finally, by setting a smaller threshold compared with that in the first step, we have extracted weaker PMCs. This method can be applied long-term data from Himawari-8. We are planning to create a new PMC data set for investigation in, for example, long-term PMC variations in the future.

References

Tsuda, T. T., Y. Hozumi, K. Kawaura, K. Hosokawa, H. Suzuki, and T. Nakamura, Initial report on polar mesospheric cloud observations by Himawari–8, Atmos. Meas. Tech., 11, 6163-6168, 2018.