Optical and Electromagnetic Characteristics of Lightning and TLEs Derived from the JEM-GLIMS Nadir Observations

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During the three-year observation period started in November 2012, JEM-GLIMS successfully conducted the nadir observations of lightning and TLEs from the ISS and revealed the various optical and electromagnetic characteristics of these phenomena. A total of 8,357 lightning events including 699 TLEs were identified based on analyses of the JEM-GLIMS optical data and ground-based ELF observation data. Most of the events were detected over the continental regions, *i.e.*, central Africa, Southeast Asia, Melanesia, and North and South America. A total of 42 sprite events and 508 elves events in 699 TLEs are confirmed by the detailed analysis of two CMOS camera (LSI) data, spectrophotometer (PH) data, and ground-based ELF data. It is found that sprite emission was horizontally displaced from the parent lightning emission with an average distance of 9.7 km and that the average CMC value of the parent +CG discharges is +2567 C·km. The occurrence rate of sprites and elves is estimated to be ~0.7 and ~7.7 events/min, respectively, which is about two times higher than the results derived from the ISUAL measurements.

In order to clarify the relation between the temporal variations of the lightning optical emission measured by the nadir observations from space and the micro processes of lightning discharges, we compared the light curve data obtained by the broadband channel of the spectrophotometer (PH4) with the waveform data obtained by the ground-based LF sensor network (BOLT). In many events, light curve plots of PH4 show a gradual optical enhancement first, which has a time constant of 5-10 ms, and the following sharp optical enhancement and exponential decay, which have a time constant of a few ms. Based on the detailed comparison with the electric field waveforms data of BOLT, it is found that the gradual optical enhancement a the initial phase corresponds to in-cloud discharges, which may be associated with preliminary breakdown, while the following sharp optical enhancement and exponential decay correspond to a return stroke process. This is the first quantitative result showing the detailed relation between the temporal variations of the lightning optical emission measured from the spaceborne platform and the physical discharge processes of lightning.

At the presentation, the optical and electromagnetic characteristics of lightning and TLEs measured by JEM-GLIMS and ground-based networks will be presented more in detail, and the remarks for the future space missions will be made.