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Relation between charge amounts of lightning discharges derived from ELF waveform data and severe weather

SHIMIZU, Chiharu[1*] ; SATO, Mitsuteru[1] ; TAKAHASHI, Yukihiro[1] ; TSUCHIYA, Fuminori[2] ; HONMA, Noriyasu[3] ; HONGO, Yasuji[3] ; ABE, Shuji[4] ; YOSHIKAWA, Akimasa[4]

[1]Hokkaido University, [2]Tohoku University, [3]Tohoku Electric Power, [4]Kyushu University

Previous studies suggested that there are close relations between lightning activities and meteorological phenomena. But in these studies, only the occurrence frequencies of lightning discharges are considered. As lightning is a discharge phenomenon, it is more important to investigate the relation between electrical properties of lightning discharges such as polarities, peak currents, and charge amounts and the meteorological parameters of the severe weather. As the magnitude of the electrification in thunderclouds is considered to be proportional to the intensity of the vertical convection, charge amounts of lightning discharges can be a good proxy to represent the developing process of thunderclouds. In order to measure the lightning currents and to estimate charge amounts, induction magnetic coils named as Rogowski coils installed at tall towers are generally used. However, in this method, only the lightning discharges directly hitting the towers can be measured. Recently, it is shown that the shape of the lightning-generated induction magnetic field waveforms in the ELF frequency range is well comparable to that of the lightning current waveforms [*Sato et al*., 2013]. Therefore, the charge amounts of any lightning discharges occurring within the area where the induction magnetic fields are measured can be easily estimated from ELF waveforms by quantitatively evaluating the relation between ELF waveforms and the current waveforms. In this study, the lightning current waveforms measured by a Rogowski coil installed at Mt. Ogami and ELF waveforms measured at Onagawa observatory are analyzed. From these quantitative analyses, empirical equations that enable us to directly convert from the magnetic field intensities into the peak current intensities and charge amounts were obtained. Furthermore, using ELF waveform data obtained at Kuju station in Kyushu and lightning data of the Japan Lightning Detection Network (JLDN), peak current values and charge amounts for the lightning discharges occurring when severe down bursts were confirmed in the Kanto Plain are estimated by applying the empirical equations. Then, we newly found a clear feature showing that the time variation of charge amounts was drastically changed just before the downburst onset. At the presentation, we will show the results more in detail.