Latitudinal and Regional dependences of IC/CG ratio derived from JEM-GLIMS lightning observations

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The ratio between intracloud discharge (IC) and cloud-to-ground discharge (CG), denoted by Z, is important parameter for the studies on the severe weather prediction, the production of NO_X by lightning discharges, and the quantitative contribution of lightning to the global circuit. However, the difficulties of Z-value estimation in previous studies are originated in (1) the ground-based lightning data obtained at limited and specific areas, (2) difficulties in detecting IC discharges, and (3) difficulties in distinguishing the discharge types (IC or CG) in the previous space observation data. So, the latitudinal and regional dependence of Z-value are not resolved yet. In order to solve these problems, the Global Lightning and Sprite Measurements on Japanese Experiment Module (JEM-GLIMS) mission was launched in 2012, and it conducted nadir observations of lightning discharges using both optical instruments (Lightning and Sprite Imager: LSI and six-channel spectrophotometers: PH) and electromagnetic wave receivers. Thus, the final goal of this study is to estimate Z-value and to clarify its latitudinal and regional dependences and to evaluate the contribution of lightning to the global circuit as a generator. For this purpose, we have developed new methods to distinguish IC and CG using JEM-GLIMS optical data and ground-based lightning data. As a first step, we selected 707 lightning events detected by LSI and PH on board JEM-GLIMS in the period from Nov. 2012 to Aug. 2015. These lightning events were detected over both land and oceanic regions. Then, we compared the JEM-GLIMS data to the ground-based lightning data obtained by the Japanese Lightning Detection Network (JLDN), the National Lightning Detection Network (NLDN), and the World Wide Lightning Location Network (WWLLN) and identified the type of the lightning discharge detected by JEM-GLIMS, As a next step, we have calculated intensity ratios between blue and red PH channels, such as 337nm/762nm, 316nm/762nm, 392nm/762nm, 337nm/(599-900nm), 316nm/(599-900nm), and 392nm/(599-900nm) for each lightning event. It is found that 400 of 707 lightning events (56.6%) were identified to be CG discharges while 307 of 707 (43.4%) were IC discharges. It is also found that the PH intensity ratio of IC discharges is clearly higher than that of CG discharges. In the case of IC discharge, the ratio of 337nm/762nm, 316nm/762nm, 392nm/762nm, 337nm/(599-900nm), 316nm/(599-900nm), and 392nm/(599-900nm) are estimated to be 1.06, 0.21, 1.04, 0.16, 0.04, and 0.17, respectively, while those of CG discharges are 0.46, 0.16, 0.74, 0.03, 0.03, and 0.13, respectively. As the difference of the 337nm/762nm and 337nm/(599-900nm) ratio in IC case and in CG case is relatively large, these two ratios are the useful proxy to classify the discharge types for other 7650 lightning events detected by JEM-GLIMS. At the presentation, we will also show detailed results derived from the analyses of LSI data and ground-based ELF observation data.

