Latitudinal, Regional, and Seasonal Dependences of the IC to CG Ratio Derived from JEM-GLIMS and the Ground-based Lightning Network Data

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The occurrence ratio between intracloud (IC) discharges and cloud-to-ground (CG) discharges, which is denoted by *Z*, is an important parameter for the studies on the climatological and topographical differences of thunderstorm structures, the quantitative evaluation of lightning contributions to the global electric circuit (GEC), the intensity development of the severe weather predicted by lightning activities, and so on. However, the latitudinal, regional and seasonal variations of the Z-value are not fully clarified yet. The purposes of this study are (i) to develop a new method classifying a discharge type using satellite-based lightning observation data obtained by the Global Lightning and Sprite Measurements on Japanese Experiment Module (JEM-GLIMS) and ground-based lightning data obtained by JLDN, NLDN, WWLLN, and GEON, and (ii) to estimate the *Z*-value and its latitudinal, regional, and seasonal dependences. Firstly, we compared JEM-GLIMS lightning data to the ground-based lightning data in order to identify a discharge type. The intensity ratios between the blue and red spectrophotometer (PH) channels, *i.e.*, PH2(337 nm)/PH3(762 nm), PH5(316 nm)/PH3, PH6(392 nm)/PH3, PH2/PH4(599-900 nm), PH5/PH4, and PH6/PH4 were calculated for each lightning discharge. From these analyses, 582, 93, and 266 lightning events were classified into IC, +CG and -CG discharges, respectively. It is also found that the intensity ratios of +CG discharges calculated by the different PH channels and two CMOS cameras were the highest, followed by the ratios of IC and -CG discharges, respectively. In addition, the difference of the PH2/PH3, PH2/PH4, and PH6/PH4 ratios between IC, +CG and -CG discharges is relatively large, which suggests that these three ratios are the useful indicator to distinguish the discharge types for other 7414 lightning events detected by JEM-GLIMS. Using JEM-GLIMS data and ground-based lightning data and using above technique, we have estimated the *Z*-value and its latitudinal dependences. It is found that the *Z*-value ranges from 0.22 to 4.02 in the latitudinal range from the equator to +/-50°. The decreasing feature of the *Z*-value to increasing latitude is confirmed both in the northern and the southern hemispheres. We also found that the Z-value over Africa larger than that of South East Asia and America. Moreover, the result revealed that the *Z*-value in the summer season is higher than that in the winter season. The estimated latitudinal, regional and seasonal dependences of the *Z*-value will be used to quantify the lightning current in the GEC model, which we are now developing.

