

Seasonal variations of global lightning and TLE occurrence distributions derived from ELF measurements

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In order to study the global occurrence rates and distributions of intense lightning discharges and sprites and their seasonal variations, we have analyzed the 1-100 Hz ELF magnetic field waveform data obtained at Syowa station in Antarctica (69.0°S , 39.5°E), Onagawa in Japan (38.4°N , 141.5°E), and Kiruna in Sweden (67.8°N , 21.1°E) for one-year period from September 2003 to August 2004. We have selected totally 1.7×10^5 events of transient Schumann resonance events from the ELF magnetic field waveform data whose amplitude exceeds 40 pT at all stations. We have developed a data processing algorithm to estimate lightning locations automatically using both direction finding method (DF) and a wave arrival time difference method (TOA). An incircle center of a triangle determined by the three DF great circles and three TOA great circles was defined as the lightning occurrence location. Using the lightning data obtained by the FORMOSAT-2 satellite, the average value of the triangulation error was estimated to be 0.5 Mm. The longitudinal distribution of global lightning occurrences shows clear peaks at 0° - 50°E , 60° - 130°E , and 50° - 110°W , which are related to the lightning activity in Africa, Asia and America, respectively. The latitudinal distribution in the summer and fall seasons shows clear peak at 10°N , while that in the winter and spring seasons at 10°S . These facts are consistent with the characteristics derived from the previous satellite observations. We have also calculated charge moment values of lightning discharges and estimated the distribution functions. Then, we have estimated global sprite occurrence rates and distributions, and their seasonal variations using a sprite occurrence probability derived from ELF and ISUAL measurements. We will present the results of the ELF data analysis first, then we will discuss similarities and differences between the global sprite occurrence distributions derived from ELF data and ISUAL data in detail.