

Statistical Features of Winter Lightning Activity in Tohoku District

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Coastal area of Sea of Japan is one of the well-known hotspots of winter lightning activity. Since winter lightning contains more electrically intensive discharges than summer lightning (Hojo et al., 1989), winter lightning often causes serious damage on electrical equipments in the coastal area (Transmission lines, wind turbines etc.). Previous research also indicates that thunder-day frequency in winter season in Japan has been increasing during the past several decades (e.g. Fujibe et al., 2005).

Numerous studies have been conducted concerning both the electrical and meteorological aspects of winter lightning activity in Japan (e.g. Michimoto, 1993 and Kitagawa and Michimoto, 1994). However, previous studies typically focused on the Hokuriku district of the mid-winter season. On the other hand, there have been few studies that examine statistical features of winter lightning activity in Tohoku district, mostly due to lack of available lightning observational data in this area.

This study investigates seasonal and inter-annual variability of lightning frequency in Tohoku district and the northern part of Hokuriku district based on the observational dataset obtained by Lightning Location System (LLS). The LLS has been operated by Tohoku Electrical Power Co. from 1994 to 2011, measuring real-time lightning location, polarity and peak current within Tohoku, Kanto and Hokuriku districts. The estimated lightning location accuracy and detection efficiency are approximately 2km and 63% respectively during the winter season (Honma et al., 1998 and Honma et al., 2010).

Based on the analysis of lightning location data, the maximum lightning frequency (maximum number of detected lightning discharges within a ten-day period) was found to appear typically from early October to late November in many parts of the study area. The seasonal variation of lightning frequency map shows that lightning hotspot appears around the northern part of Tohoku district during the late autumn season (October - November) and moves southward during the winter season (December - March). In addition, many of the lightning discharges during the late autumn season occur over the ocean area, as opposed to the lightning discharges during the winter season which are concentrated within the coastal area of Sea of Japan. Inter-annual variability of lightning frequency in the study area was also investigated. The results indicate that lightning frequencies in the late autumn season were remarkably high during the EL-Nino years (1997, 2002 and 2006), except for 2009.

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