Accuracy verification of lightning charge moment and lightning charge height remotely estimated by ELF observations using lightning current measurements at wind turbine

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In this paper, estimation accuracy of the lightning charge moment change (Qds) derived from the ELF magnetic field observation is reported. Horizontal magnetic waveforms in the ELF frequency rage (0.1 ~ 1 kHz) are continuously recorded in Moshiri, Hokkaido, and ELF electromagnetic radiations from powerful lightning discharges so-called ELF transients are observed. Qds of these lightning discharges are estimated remotely (till few hundred ~ 1000 km from the lightning source) by an integration of current moment I(t)ds in time also derived by ELF transients. In this paper eight lightning events were studied, and Qds of every lightning stroke was derived. Then estimated Qds from ELF measurement were compared with the lightning charge (Q) based on the electric current waveforms I(t) locally measured in wind turbine facilities by NEDO. As a result, extremely high cross-correlation coefficient was obtained between Qds (I(t)ds)from ELF and Q (I(t)) from wind turbine. We also calculated the height of charge lowered to the ground ds (dividing Qds (ELF) by Q (wind turbine)). Although ds has a considerable variation between lightning discharges, it was revealed that the charge height is located at around -10 ˚C to -20 ˚C in most events, which agree well with the charge structure of typical thunderstorm cells.

Keywords: ELF transients, charge moment, lightning charge, charge height, lightning current, wind turbine

