

Estimation of lightning magnitude using VLF sferics in Kanto region

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It is pointed out that the relationship between atmospheric parameters and occurrence frequency of lightning is closely correlated. By the current lightning detection systems operated in Japan, which measure higher frequency than VLF range, only the information of peak current of the stroke is estimated and information of its magnitude, such as charge moment change (CMC) cannot be derived. Since the most of the electromagnetic energy of lightning concentrates in the frequency range less than 10 kHz, in order to estimate CMC of lightning stroke, we need to observe the electromagnetic waves in lower frequency range than existing lightning networks which make use of order of several 10s of kHz to M Hz range. Carrying out the continuous observation of VLF sferic, we will investigate the quantitative relationship between atmospheric parameters and lightning activity including information of electrical magnitude for the first time.

We are constructing a VLF observation network with identical observation system, consisting of three observation sites in Kanto region, which enables us to geolocate lightning stroke by time of arrival (TOA) or direction finding methods with an error of 10 km. Each observation system is composed of two horizontal magnetic loop antennas and a vertical electric dipole antenna, receiver, PC and GPS clock. The higher cutoff and sampling frequency are 40 kHz and 80 kHz, respectively.

In order to estimate CMC, the temporal variation of source current with peak intensity is required. We estimated the peak current using a method proposed by Yanagi [2012]. The temporal variation of source current was estimated from the groundwave of electric field, using amplitude and zero-crossing time of the waveform.

In this presentation, we will report the situation of construction of this observation network and the estimation methodology of lightning peak current using sferic data. Also preliminary results based on the data obtained at Yamanashi station are introduced.

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Yanagi, Y., Development of VLF electromagnetic wave observation system and estimation method of lightning peak current, Master thesis, Hokkaido University, 2012.

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