Characteristics of VLF/ELF sferics associated with winter lightning in Japan inducing sprites

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To investigate the characteristics of lightning discharges inducing sprites, we have carried out a campaign observation since the winters of 1998/1999. The observation system consists of an II-CCD camera and two sets of multi-anode array photometers (MAPs) and VLF receivers. In addition, we measured ELF sferics by a search coil sensor installed at Tohoku University Onagawa observatory. From the observation campaign of 2003/2004, long durational pulse trains (sferic cluster) are found to occur in the VLF data. An important finding is that transient ELF disturbances (ELF sferics) occur coincident with commencement of sferic clusters. Since VLF sferic clusters would be due to some kind of intra-cloud discharges, it is likely that intra-cloud discharge processes produce intense quasi-static electric field producing sprites in the mesosphere. In this presentation, we discuss the occurrence rate of sferic clusters and the temporal relationship between sprite luminosity enhancements and occurrence of sferic clusters using the VLF data obtained from whole winter sprite campaigns.