ES/EM computer simulation of the mesospheric optical emissions for Japanese summer and winter lightning

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There have been carried out a lot of works on the observations in different places in the world and the generation mechanisms of transient luminous emissions in the mesosphere and lower ionosphere. But the generation mechanisms are still poorly understood. Especially, the sprites in the Hokuriku area of Japan(Japan sea side)are recently detected, but we have to answer why such a small cloud of winter lightning in the Hokuriku area can trigger a sprite. The characteristics of Japanese winter sprites are found to be very different form those of the summer continental ones due to MCSs.

In this paper we use the ES/EM code of computer simulation developed by Cho and Rycroft(1997). The final goal is to answer the question why the continental lightning triggers a carrot-type sprite, while Japanese winter sprites are of simple structure(column). This paper intends to answer the whole aspects of the sprite generation in Japan in summer and in winter. By changing the charge altitude, charge transfer (charge moment change), current waveform etc. of the lightning, we will show what is the main factor in distinguishing the complicated (carrot) shape and a simple structure (column). As the conclusion of the present computer simulation studies, we have found the following things. The most important factors leading to the morphological difference of the summer-time and winter-time sprites in Japan, are the lightning height (ds) and current waveform.