

## Winter sprite and parent thunderstorm

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VHF lightning events, thunderstorms, and 2-D surface electric field relating to sprites were observed simultaneously during 2004/2005 winters in the Hokuriku area of Japan. These integrated data analysis enables us to study the relationship between thunderstorm structure and charge distribution just before the sprite genesis. Typical winter sprite parent thunderstorms had a large stratiform cloud embedding in small convective radar echo cells ranging from several to at most several tens of kilometers. Winter sprite causative positive charge reservoirs would tend to reside in the upper part of the parent thunderstorm. We found three possible locations of positive charge reservoirs in the thunderstorms: (1) anvil-like stratiform region, (2) convective region, and (3) stratiform precipitation region. A total amount of positive charges removed from the thunderstorms was estimated larger than 100 C when the sprites were generated except for one event. Our results suggest that vertical locations of sprite causative positive charges removed from winter thunderstorms may be different from summer ones. The difference for the positive charge locations may come from the difference of thunderstorm structure in winter and in summer (e.g. very low cloud top and base for a winter thunderstorm depending on the meteorological condition). This difference for thunderstorm structure may affect the characteristics of lightning discharge and also have an indirect effect on the sprite feature (e.g. complexity of the morphology of sprites and sprite relative location from the causative discharge)

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