

Horizontal Distributions of Sprites Measured by Lightning and Sprite Imager Onboard JEM-GLIMS

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Sprite is a transient discharge phenomenon occurring in the mesosphere and lower thermosphere and is mainly excited by positive cloud-to-ground (CG) discharge. Various studies of the sprite occurrences have been performed by numerical simulations and optical observations from ground and airplanes. However, the physical mechanism determining the horizontal distribution of sprite is not clear so far. Recent studies suggested that an activity of the in-cloud discharges preceding a return stroke of a CG discharge would have a severe impact on the determination of the horizontal distribution of sprites. In order to clarify this, it is essential to carry out nadir observations of lightning discharges and sprites from the space.

JEM-GLIMS is a space mission to carry out nadir observation of lightning discharges and sprites from International Space Station (ISS) and started continuous observations from November 20, 2012. In this mission, lightning and sprite emissions can be measured by Lightning and Sprite Imager (LSI), which consists of two CMOS cameras and captures images at a difference wavelength. A wide-band camera named LSI-1 is equipped with an optical filter whose pass-band ranges from 740-830 nm and observes mainly lightning emission, while a narrow-band camera named LSI-2 is equipped with an optical filter whose central wavelength of 762 nm with 10 nm FWHM and observes mainly sprite emission since the lightning emission at 762 nm would be severely absorbed by oxygen molecules in the atmosphere. A spatial resolution of LSI is about 300 m/pix at the 70 km altitude. Then, it is possible to detect the emissions of a columniform sprite whose horizontal scale is a few km typically. In JEM-GLIMS mission, there are also six-channel spectral photometers (PH). One of these PH channels measures UV emission at 150-280 nm, which becomes a good proxy of the sprite occurrence since the UV emission of lightning discharges would be severely absorbed. We have chosen 76 events of transient optical emission captured by LSI and PH. For the purpose to distinguish weak sprite emission from strong lightning emission, we have developed an image subtraction method using LSI-1 and LSI-2 image data. Using this method, we have analyzed 76 events and succeed in detecting sprite emission and clarifying the horizontal distribution of sprites. At the presentation, we will show the characteristics of the horizontal distribution of sprites and their parent lightning discharges more in detail.

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