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Split Condition of Sprite Streamer Tips Derived From High-Speed Camera Observations

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In order to clarify the split condition of sprite streamer tips, the detailed spatial and temporal development of sprite streamers are the key physical properties. According to the pervious ground-based observations using high-speed cameras, it was found that streamer tips usually appear at around ~80 km at the initial stage of the sprite development and propagate downward with an accelerated and expanded motions. After they reach ~70 km altitude, they tend to start splitting. However, detailed splitting mechanism of streamer tips is not fully understand yet since it is difficult to capture the detailed development and fine structures of the splitting streamer tips. In order to specify the detailed spatiotemporal evolution of sprite streamers and to identify the physical parameters determining the splitting condition of streamer tips, we have analyzed image data obtained by high-speed cameras onboard two jet aircrafts.

In the period from June 27 to July 10, 2011, we have succeeded in capturing 12 sprite events over the Great Plains in summer US, where the multiple splits of streamer tips are clearly measured by high-speed cameras with a sampling rate of 8300 fps. It was found that streamer tips initiated from approximately 75 km altitude propagate downward with an exponential increase of the brightness before they start splitting first. We estimated brightness changes of streamer tips at each frame of image data recorded by the high-speed cameras, and we also estimated the ratio of the streamer tip brightness just after the tip splits to that just before the tip reaches next split. It is found that the ratio of the brightness at the streamer tip initiation to the brightness just before the first split becomes greater than 1.0. However, it is found that the ratio of the brightness of 1st (2nd) split to 2nd (3rd) split becomes about 1.0. At the presentation, we will show more detailed results.