Geophysical Research Abstracts
Vol. 14, EGU2012-13413-1, 2012
EGU General Assembly 2012

Development of sprite streamers and preceding halos and elves

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The relationship between diffuse glows such as elves and sprite halos and subsequent discrete structure of sprite streamers is considered to have a key to solve the generation mechanism of streamers. However, it's not easy to image at high frame rate both the diffuse and discrete structures simultaneously, since it requires high sensitivity, high spatial resolution and high signal-to-noise ratio. To capture the real spatial structure of TLEs without influence of atmospheric absorption, aircraft would be one of the best solutions. The aircraft can approach thunderstorm up to a few hundred km or less to image TLEs with high spatial resolution and can carry heavy high-speed cameras with huge size data memories. In the period of June 27 - July 10, 2011, a combined aircraft and ground-based campaign, in support of NHK Cosmic Shore project, was carried with two jet airplanes under collaboration between NHK, Japan Broadcasting Corporation, and universities. On 8 nights out of 16 standing-by, the jets took off from the airport near Denver, Colorado, and an airborne high speed camera captured over 40 TLE events at a frame rate of 8300 /sec. Here we introduce the latest analysis of a very complicated time development of sprite streamers and its relationship to the structures of preceding halos and elves, which are always showing some inhomogeneity, suggesting a mechanism to cause the large variation of sprite features.