Space-based Observations of Thunderstorms and TLEs during the MEIDEX-sprite campaign

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Abstract. We present the results of space-based observations of Transient Luminous Events (TLEs) obtained during the MEIDEX sprite campaign conducted on-board the space-shuttle Columbia during its STS-107 mission in January 2003. A total of ~6.5 hours of non-overlapping data were saved from 21 different orbits. We imaged sprites from various geographical locations, mainly over central Africa, northern Australia and South-America, and also over the Pacific and Indian oceans. Sprites were observed from ranges 1600-2000 km from the shuttle, at altitudes of 40-90 km. Their brightness was in the range of 0.3-1.7 MR in the 665nm filter, and 1.7-1.44 MR in the 860nm filter. We observed a unique sequence of events relating columniform sprites and meteors, which supports existing theories of sprite structure. Based on the frequency of observed events and the number of global thunderstorms we estimate the sprite rate in the tropics to be of the order of tens per minute.

We report an observation of an unusual transient luminous event that was detected in the Near-IR, south of Madagascar above the Indian Ocean. This event was delayed 0.23 seconds from a preceding visual lightning flash which was horizontally displaced ocer 1000 km from the event. The calculated brightness in the 860 (+/-50) nm filter was ~310+/-30kR, and the morphology of the emitting volume did not resemble any known class of TLE (i.e. sprites, ELVES or halos). This TIGER event (Transient Ionospheric Glow Emission in Red) may constitute a new class of TLE, not necessarily induced by a near-by thunderstorm. We discuss possible generation mechanisms, including the conjugate sprite hypothesis caused by lightning at the magnetic mirror point, lightning-induced electron precipitation and an extraterrestrial source, meteoric or comet-related.

We also report the observation of what appears to be a semi-cyclic pattern where distant thunderstorm cells "ignite" lightning flashes in each other in a sequence. Lightning occurring in one cell are followed by lightning in other cells, separated by tens or hundreds of kilometers. The time delay of the onset of a visible flash in one thunderstorm from that of the following flash in a distant cell varies from several milliseconds to seconds. Several mechanisms for the possible tele-influence of the lightning-emitted electromagnetic radiation on the breakdown process within a distant thundercloud, leading to a new flash, will be discussed.