Lightning and sprite dynamics

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We continue to analyze new aspects of high speed images of sprites (up to 10,000 frames per second) and simultaneous ground-based electric and magnetic field measurements (from below 1 Hz to roughly 25 kHz) recorded during a 2005 field campaign near Fort Collins, Colorado. These data sets are combined in an effort to probe the details of the connection between the low altitude lightning processes and high altitude transient luminous events (TLEs). The low frequency sensitivity of the magnetic field sensors enabled measurement of the continuing lightning current that is involved in many complex sprites but that can be difficult to detect by other means, while the high speed video gave precise timing of TLE onset and features relative to the driving lightning processes below. We report results from an ongoing detailed and quantitative analysis of this combined data set. The background electric field in which sprites initiate is estimated from remote measurements of the driving lightning current and detailed modeling of the high altitude electromagnetic fields, enabling a comparison with theoretical predictions of the field required to initiate a sprite. High speed imaging observations show that most downward propagating sprite streamers exhibit nearly constant deceleration below about 60 km altitude The connection between strong electric currents in the sprite itself and time-resolved optical sprite processes will be reviewed and updated. Lastly, further bounds on charges and currents associated with sprite development will be estimated from both time-resolved streamer tip dynamics and from the presence or lack of discernable electromagnetic signatures associated with different sprite processes.