Directly observable optical properties of sprites in Central Europe

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Luminous optical emissions accompanying streamer-based natural electric breakdown processes initiating in the mesosphere are called sprites. 489 sprite events have been observed with a TV frame rate video system in Central Europe from Sopron (47.68N, 16.58E, 230 m MSL), Hungary between 2007 and 2009. On the basis of these observations, characteristic morphological properties of sprites, i.e. basic forms (e.g. column, carrot, angel, etc.) as well as common morphological features (e.g. tendrils, glows, puffs, beads, etc.), have been identified. Probable time sequences of streamer propagation directions were associated with each of the basic sprite forms. It is speculated that different sequences of streamer propagation directions can result in very similar final sprite shapes. The number and type variety of sprite elements appearing in an event as well as the total optical duration of an event was analyzed statistically. Jellyfish and dancing sprite events were considered as special subsets of sprite clusters. It was found that more than 90% of the recorded sprite elements appeared in clusters rather than alone and more than half of the clusters contained more than one basic sprite forms. The analysis showed that jellyfish sprites and clusters of column sprites featuring glows and tendrils do not tend to have optical lifetimes longer than 80 ms. Such very long optical lifetimes have not been observed in sprite clusters containing more than 25 elements of any type, either. In contrast to clusters containing sprite entities of only one form, sprite events showing more sprite forms seem to have extended optical durations more likely. The need for further investigation and for finding theoretical concepts to link these observations to electric conditions ambient for sprite formation is emphasized.