Analysis of a Single-Stroke, Negative CG Flash with 700 Millisecond Continuing Current, At Least 14 M Components and Comparison with Nearby Contemporaneous CG and IC Flashes

Intended for the Lightning Occurrence Relative to Meteorology Session Topic

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We present analysis of a cloud-to-ground (CG) lightning flash recorded by high-speed video at 10,000 frames per second and also mapped by the Oklahoma Lightning Mapping Array (OKLMA). This CG flash lowered negative charge to ground, had a continuing current that lasted for more than 700 ms, and had at least 14 M-components visually identified during the first 300 ms of the continuing current. Although there were approximatly 3000 VHF source locations in the cloud associated with the flash, very few of them were co-located with the stepped leader, the return stroke, the continuing current, and the M components. There were, however, groups of VHF sources located in the cloud that appeared to be temporally associated with M components. The flash is unique in that it was a single-stroke, negative flash with continuing current. Most negative CG flashes with continuing current have multiple strokes, and the stroke with following continuing current is usually one of the subsequent strokes rather than the first stroke. We examine the visible characteristics of the M components in comparison with VHF source locations during the period. The OKLMA VHF source location data for the flash appear to be unique when compared with data from other nearby CG and IC flashes observed in the same storm before and after the flash. We subjected the data to statistical tests that confirm that the flash propagated through a larger horizontal region of negative charge than the other flashes in the data set and that the longer the time between two successive flashes, the more likely it was that the second flash would come to ground. On the basis of these results, we discuss possible scenarios by which the configuration and generation of charge could be a factor in determining whether or not a flash will come to ground and whether or not a ground flash will have continuing current. It is not clear whether or not the increased area of propagation is related to the fact that this flash has long continuing current and many M components. We suggest the hyppothesis that flashes with continuing current either propagate over a larger horizontal area, accessing more charge than normal CG flashes or involve breakdown processes that may be physically different than other flashes, causing them to radiate more effectively at VHF than normal CG flashes. More CG flashes need to be examined in the future to see whether or not those with continuing current truly have VHF characteristics that differ from those that do not have continuing current. This could be relevant to fire weather prediction.