Sprite streamer luminosity response to multi-stroke lightning dynamics

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Streamers observed in the middle atmosphere located above positive cloud to ground lightning strikes are referred to as sprites. Sprite streamers initiate between 70 and 80 km and are observed to propagate first downward and then sometimes upward, at speeds up to one-third the speed of light. We report on observations of sprite streamer luminosity as a function of time using high speed cameras mounted on a Gulf Stream V research aircraft. The sprite streamers were observed above a lightning mapping array (LMA) deployed near Concordia Kansas. Data from the LMA show the extent and altitude of the charge region which was tapped to produce the field change triggering the sprites. Remote magnetic field measurements are used to determine the polarity and charge moment change of the causative lightning. Observations on 2 August 2013 show multiple positive cloud to ground (CG) flashes in the trailing stratiform region of a storm. The active, convective region to the south was producing primarily negative CG flashes. The flash at 07:48:04 UT started near the convective region, then propagated 40 km to the NW, then another 60 km to the NE, before the first positive CG stroke at 07:48:04.731401209, followed by another positive CG stroke at about the same location at 07:48:04.786102453, and a third CG stroke at 07:48:04.815211564 about 20 km south of the first two. The first two CG strokes were separated by only 150 m. The first CG stroke caused sprite streamers recorded at 10,000 frames per second by high speed cameras on the plane. The sprite streamers are seen to die out, and then brighten during the subsequent second and third CG strokes. Other sprite streamer events were recorded by remote ground based cameras during this storm, and are used to triangulate the streamer location with respect to the CG lightning as observed by the LMA.