



Lightning Activity of a Sprite Producing Storm over South East France

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On the night of 8 October 2009, a cold frontal wave passing over Western Europe caused the development of a thunderstorm over South East France which produced excessive rain, very high flash rate and eventually 77 transient luminous events (TLEs). The sprites were detected with camera from Sent Vicenç de Castellet, Spain, until the moment when the events became too far to be observed.

Six of the sprites were accompanied by a halo and in total 74 of the TLEs could be associated with a positive "parent" cloud-to-ground lightning (P+CG) flash. In the beginning of the sprite production period the events were mostly carrot shaped while at the dissipating stage of the storm sprites were predominantly column shaped. The average value of the P+CG peak current was 60 kA (with average values of 64 kA and 56 kA respectively for carrot and column sprites) and the maximum value was 183 kA. The average delay time of the sprites after the P+CG flashes was around 40 ms for the carrot shaped and around 30 ms for the column shaped sprites. The TLEs with high P+CG peak currents (above 100 kA) were characterized by short delay times (less than 20 ms) while those with low P+CG peak currents (less than 50 kA) had predominantly long delay times (above 40 ms). The P+CGs were located mostly in the stratiform region of the storm with reflectivity values around 45 dBZ and cloud top temperatures between -55°C and -60°C.

The analysis of the flash rate showed that there was almost no correlation between the frequency of negative and positive CG flashes. The +CG flash rate remained almost stable during the whole life of the storm with around 4 flashes per minute, while the -CGs had their maximum (60/min) with the maximum of the convective region of the storm and decreased gradually during the dissipation stage. The average -CG/+CG ratio for the whole lifetime of the storm was around 5. The average peak current values for -CGs and +CGs were respectively -22.5 kA and 24.6 kA, when excluding the lightning flashes with peak current values below -10 kA and 10 kA, assuming they were IC flashes. The maximum peak current value for negative and positive CG flashes was respectively -232 kA and 183 kA.

Most of the P+CG flashes were preceded by a short increase in the +CG activity around a minute before the sprite production and an overall tendency could be observed that the sprite production periods are co-appearing with the local maxima in the -CG rates.

The analysis revealed that the characteristics of the P+CG flashes in this study were according to the already established general picture of sprites and their parent lightning.