



Analysis of lightning associated with a sprite displaced from its parent positive cloud to ground lightning flash

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During the Eurosprite observation campaigns associated with the CAL (Coupling of Atmospheric Layers) project, a large number of sprites were observed during the summers of 2003, 2005, and 2006 over France and Spain. For some cases of thunderstorms producing them, the lightning activity could be analyzed from several detection systems, in VLF, LF, and VHF ranges. On 16th of August 2005, a sprite was detected over Catalonia (northeastern Spain) from the camera operated at Pic du Midi (France). This sprite occurred above a mesoscale convective system (MCS) with a stratiform area of several tens of km, according to the C-band radars operating in the study region and providing volumetric reflectivity. It was associated with a positive cloud-to-ground lightning flash (+CG) detected by the Spanish Lightning Detection Network (SLDN) about 50 ms before with a peak current of 24.5 kA. The observation of the sprite with only one camera allows determining its direction crossing the stratiform area of the convective system at a distance of 50-60 km away from the +CG stroke. It can be therefore named a displaced sprite. The total lightning activity in the region of the convective system was available thanks to a Safir system, the Catalan Lightning Location Network (XDDE) operated by the Catalan Meteorological Service. This system detects and locates by interferometry VHF sources produced by the leader phases of any lightning flash. Several sequences of VHF sources were detected a few tens of milliseconds before the +CG flash. Their location and their time occurrence clearly

indicates the characteristics of the propagation of a negative leader towards the stratiform area with an inferred connection to the +CG flash stroke, evacuating positive charge from this stratiform area. The sprite direction crossed the end of the path defined by the VHF sources, which can let suppose it corresponds to the location of the positive charges neutralized by the +CG flash in the cloud system. Data from a VLF-broadband antenna showed a spheric cluster starting at the time of the +CG stroke until the occurrence of the sprite, indicating the presence of K-streamers depositing charge onto the pre-existing channels (at ground potential since the return stroke) from neighbouring charged areas. The observations explain the displacement of the sprite in comparison of the +CG stroke and the role of the intracloud activity in the sprite production.