EGU21-1695
https://doi.org/10.5194/egusphere-egu21-1695
EGU General Assembly 2021

Dancing Sprites Above a Lightning Mapping Array - an analysis of the storm and flash/sprite developments

Maja Tomicic[1], Serge Soula[2], Thomas Farges[3], Serge Prieur[2], and Eric Defer[2]
[1]DTU Space, Technical University of Denmark, Lyngby, Denmark
[2]Laboratory of Aerology, University of Toulouse/CNRS, Toulouse, France
[3]CEA, DIM, DAF, Arpajon, France

This study is a multi-instrumental analysis of a ~20-hour duration northwestern Mediterranean storm on September 21, 2019 that produced 21 sprites recorded with a video camera, of which 19 (90 %) were dancing sprites. A dancing sprite is a phenomenon in which sequences of sprites appear in succession with time intervals of no more than a few hundred milliseconds. For the most part, the individual sprites are a consequence of discrete strokes from one extended lightning flash. In this case, we find that 87.5% of the sprite sequences were triggered by distinct positive cloud-to-ground (+CG) strokes. The time between successive sprite parent (SP)+CG strokes within the same dancing sprite was between 40 and 516 ms, and the distance ranged between 2 and 87 km. The storm size and vertical development were analyzed from the infrared radiometer onboard Meteosat Second Generation satellite and the lightning activity was documented with several lightning location systems (LLS): the French LF network (Météorage), the GLD360 network operated by Vaisala company, the VHF SAETTA Lightning Mapping Array (LMA) system located in Corsica. Additionally, the vertical electric field at the time of the dancing sprites was measured with a broadband ELF vertical dipole whip antenna ~700 km away from the storm. The SAETTA LMA allows to map the SP+CG flashes in their both full extent and temporal evolution, and to infer the charge structure of the parent storm. We show that the SP+CG flashes followed a common propagation: they originated from the convective and very electrically active regions of the storm, and then escaped and extended horizontally far (tens of km) into the stratiform cloud region. Most of the sprites were triggered by +CG strokes in the stratiform region often following flash development resembling cutoff of a long negative leader. Additionally, we present a detailed analysis of two dancing sprite events in which the SP+CGs triggered new bidirectional breakdown with fast moving leaders that extended into the stratiform cloud region and resulted in new SP+CG strokes. In both events, we find in both LLS and ELF vertical electric field records, that the last sprite sequence was triggered by three almost simultaneous +CG strokes.