

Characteristics of thunderstorm structure and lightning activity causing negative and positive sprites

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Abstract: This paper reports observation of two negative sprites and three positive sprites over a mesoscale convective system in a 15 min window. The negative sprites occurred during strong convection, indicated by the increase of the area of the thundercloud with radar echo top of 8-11, 9-11 and 6-12 km. The strong convection and large wind shear in thunderstorm middle and upper region provide favorable conditions to produce the parent cloud-to-ground (CG) lightning discharges of negative sprites. The parent CGs for the two negative sprites are likely to be hybrid intracloud-negative cloud-to-ground lightning (IC-NCG). The peak current of the parent CG of one of the negative sprites is -106.6 kA, agreeing with the values reported previously; the parent flash of the other negative sprite may be a negative CG with two return strokes with peak currents of -39.7 kA and -40.9 kA, suggesting that negative sprites can also be produced by -CGs with moderate peak currents. Finally, the two negative sprites were separated by 2.66 min in time but have similar spatial features, indicating that the effects of sprites on the mesosphere may last on the order of minutes.

Keywords: negative sprite; positive sprite; radar; lightning; magnetic field.