

Application of sensitive magnetic sensor in the measurement of rocket-triggered lightning

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During the Shandong Artificially Triggered Lightning Experiment (SHATLE) and Guangdong Comprehensive Observation Experiment on Lightning Discharge (GCOELD), we applied a broadband (~6 kHz to 300 kHz) magnetic sensor with high sensitivity to detect the current pulses of rocket-triggered lightning at two different distances (about 80 m and 1 km, respectively) from the channel base. According to the analyses of comprehensive measurement data acquired for tens of successful triggered lightning cases, several achievements have been made in these measurements: (1) our magnetic remote sensing method is capable of retrieving the weak current pulses during the initial stage of upward lightning leader, and at 78 m distance, this method can detect the initial current pulses as low as 200 mA (in general, the sensitivity of our method is higher than the traditional method by a factor of ~50); (2) our measurement observes for the first time the burst of magnetic pulses radiated by the successive stepping progression of upward positive leader during the initial continuous current (ICC), and the individual magnetic pulse is attributed to the meter-scale discharging process at the tip of advancing leader; (3) by integrating the magnetic signals, we can also effectively eliminate the impact of random noise and derive the time-resolved current of initial continuous current with significantly reduced noise, which makes it possible to resolve the weak current fluctuations superimposed on the initial continuous current as driven by the stepping of upward positive leader.

Keywords: Lightning discharge, Magnetic field sensor, Rocket-triggered lightning, Upward lightning leader

