

Artificially triggering lightning and its application in China

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Artificial lightning triggered technique with rocket-wire is very useful for study of lightning physical processes and its protection. The classical and altitude techniques for triggering lightning have been developed and experiments have been conducted in different areas of China since 1989. The experiments and characteristics of triggered lightning are briefly reviewed and most of results of these experiments are outlined.

(1) Characterization of lightning current and the close lightning electric and magnetic field changes

The serious lightning-induced damages are usually caused by the close lightning discharges. Artificially triggered lightning provide unique opportunity for measuring the discharge current and close electromagnetic fields. About 30 current waveforms of return stroke and the correlated close electromagnetic field were analyzed. The relationship between current and electromagnetic field are discussed.

(2) Differences of triggered lightning characteristics between the northern and southern China
The characteristics of triggered lightning appear to be significant different in the north and south of China. Triggered lightning discharges in the southeast of China were often associated with negative charge overhead, while those in the northern China always with lower positive charge overhead. Triggered lightning in the northern China appeared to be weak discharge contained only upward leader and following continuous current. Those in the south of China showed more energetic with the peak current in the range of a kA to tens of kA and usually contained return strokes, more like the natural lightning.

(3) Optical characteristics of lightning channel and new insights into the mechanism of the upward positive leader

The observations of high-speed cameras revealed the bidirectional leader processes during the initial processes of altitude triggered negative lightning flashes. The propagation speed of the upward positive leader before the initiation of the downward negative leader was at the order of 10^4 to 10^5 m/s; In classical triggered negative lightning flashes, the propagation speed of the upward positive leaders ranges from 0.35×10^5 to 7.71×10^5 m/s, and the variations of its luminance and velocity were quite complex during the development process.

(4) Application of artificially triggering lightning technique

A non-conventional lightning rod (Semiconductor Lightning Eliminator) was tested experimentally by using the triggered lightning experiment. The results show that the non-conventional lightning rod was neither superior to a traditional lightning rod in terms of prevision of lightning attachment points and paths for the lightning current to flow into ground, nor capable to eliminate any possibility of lightning.

The testing experiments of lightning protection system for a 4-element Automate Weather Station (AWS) have been conducted since 2007 in Guangdong by using the triggered lightning technique. The induced effects caused by the lightning and the key lightning protection problems were studied for the AWSs near the lightning channel. The induced overvoltage and SPD residue voltage characteristics caused by triggered lightning with multiple return strokes on the transmission line of the AWS were measured.

The triggered lightning technique was also used to test the detection efficiency and precision of lightning location system. The triggered lightning flashes and the records of lightning location system (LLS) in Guangdong were analyzed. The results show that the detection efficiency of flash and stroke were 93% (13/14) and 42% (26/62) for rocket-triggered lightning, respectively. There were 24 LLS records achieved by more than 3 detection stations, 21 of which were ground-triggered strokes and the mean space location error was 760 meters (sample size:21). The relative deviation of lightning current amplitude are 14% (9).

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