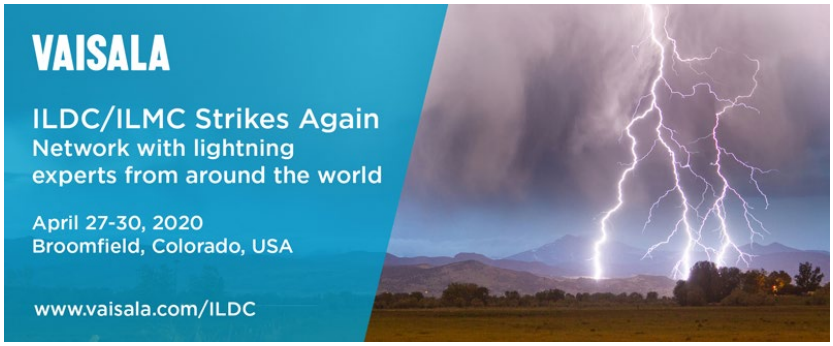

Observing ground TGFs with the Telescope Array Surface Detector in correlation with IBPs.

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Abstract

this work presents the first observation of ground based gamma-ray bursts initiated in the Earth’s atmosphere in coincidence with the Initial Breakdown Pulses (IBPs) of a cloud-to-ground flashes. The results provide key information on the origin of Terrestrial Gamma-ray Flashes (TGFs). The TGFs in this work were observed by the Telescope Array surface detector (TASD), Lightning Mapping Array (LMA) detector, in addition to a VHF interferometer (INTF) and a fast electric field change antenna (FA). The INTF and the FA were installed a few kilometers east of the TASD detector in July 2018.

The TASD was designed to detect particle showers generated by the interaction of ultra-high energy cosmic rays in the Earth's atmosphere. It is a 700 square kilometer array of plastic scintillator detectors located in the western desert of Utah 1400 m above see level. The TASD size and elevation makes it the world leading detector in ground based TGF detection with over 25 TGFs observed in the last ten years.

In the ILDC/ILMC of 2018 we have presented the detection by TASD, Lightning Mapping Array (LMA) and slow antenna (SA) of energetic showers with footprints on the ground of order 10 square kilometers, originating in the first one to two milliseconds of downward lightning leaders. Scintillator waveform and simulation studies confirmed that these showers must consist primarily of gamma radiation, thus the observations were identified as low-fluence TGFs near their initiation threshold.

Here, with the addition of the INTF and FA, we report new observations of several events in which fast initial breakdown pulses produced the leader-stage gamma showers. These events further connect the phenomenon to the satellite observations, providing knowledge into the fundamental question of how are the TGFs initiated.

Topic Areas

Lightning Physics, Characteristics and Measurements

Submission Format

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