

First simultaneous observations of optical lightning and terrestrial gamma flash from space

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Abstract

In this paper we present the very first simultaneous detection of a terrestrial gamma-ray flash (TGF) and the optical signal from lightning. By fortuitous coincidence two independent satellites passed less than 300 km from the thunderstorm system that produced a TGF that lasted 70 μ s. Together with two independent measurements of radio emissions we have an unprecedented coverage of the event. We find that the TGF was produced inside the thundercloud at the initial stage of an intracloud (IC) lightning just before the leader reached the cloud top and extended horizontally. A strong radio pulse was produced by the TGF itself. This is the first time the sequence of radio pulses, TGF and optical emissions has been identified. **Figure 1** shows the three data sets and illustrates our interpretation of this unique event.

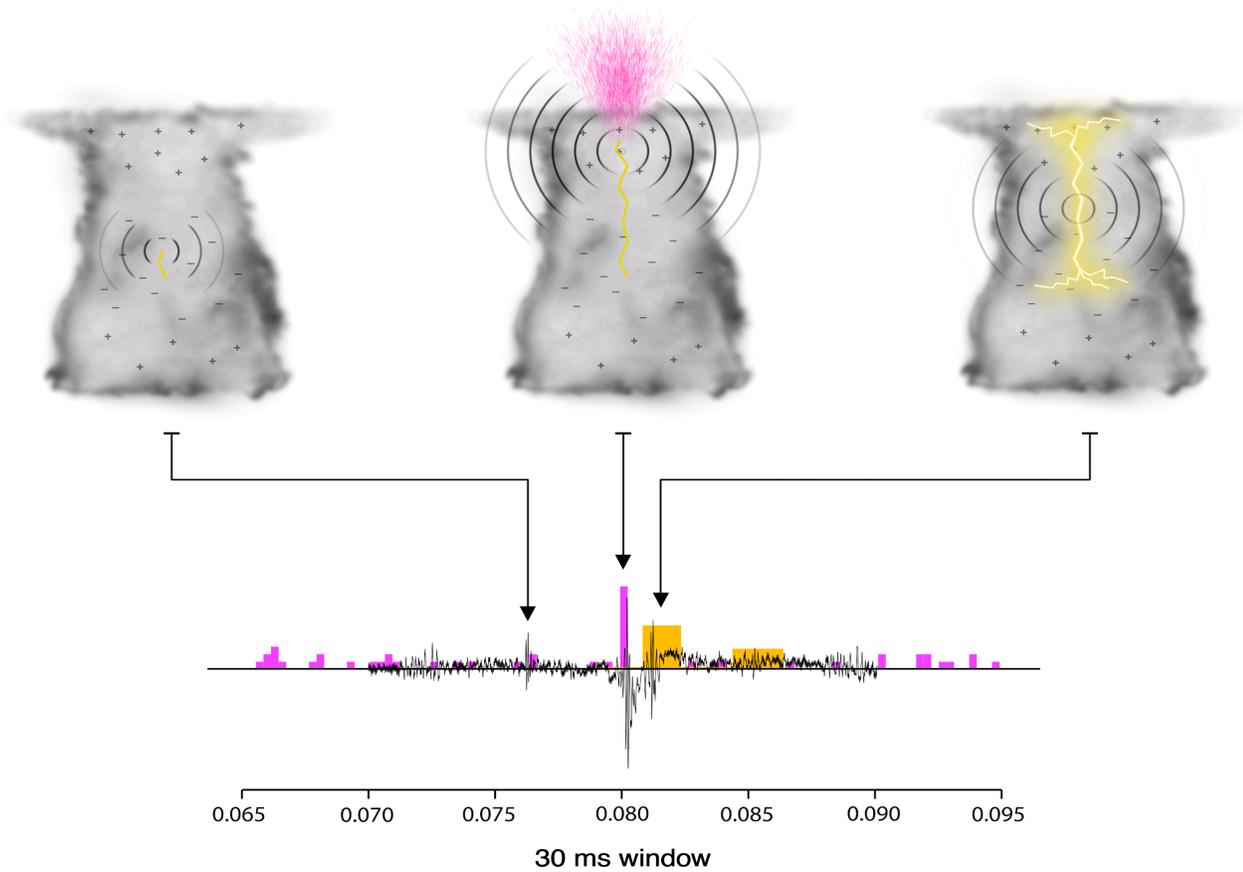


Figure 1: Bottom: The radio data from Duke University (black), TGF measured by RHESSI (purple) and optical lightning by TRMM LIS (yellow). All data are transformed to the time at the source location determined by LIS. Top: As the arrows indicate, the first radio pulse is interpreted as a signature of a leader forming from the negative charge layer. The terrestrial gamma-ray flash coincides with a strong radio pulse 0.5 ms just before optical lightning is seen by TRMM LIS. A the third radio pulse is simultaneous with the optical signal.