

Special negative lightning strokes in winter with extremely short preceding discharges

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The return stroke (RS) is the most well-studied process in lightning. The first RS in a negative cloud-to-ground (-CG) flash is usually preceded by the preliminary breakdown (also called initial breakdown) and the stepped leader, and the typical time difference between the start of a -CG flash and the first RS is from several to a few tens of ms. In winter, however, thunderclouds are much shallower and the time difference can be much shorter. -CG flashes with the time difference between the first RS and the start of the flash shorter than 1 ms have been reported. In this study, we will analyze negative strokes in winter with the duration of preceding discharges shorter than 1 ms based on the observation of FALMA (Fast Antenna Lightning Mapping Array). Particularly, we will focus on strokes with the duration of preceding discharges shorter than 200 μ s, and we will demonstrate that these strokes are systematically different from those with longer durations of preceding discharges. These special strokes with extremely short preceding discharges frequently occur at high mountain areas. It is estimated that their channel lengths are only hundreds of meters, an order of magnitude shorter than those of normal negative RSs.

Keywords: Return stroke, Winter lightning, Negative cloud-to-ground lightning