

Comparison of preliminary breakdown pulses of cloud-to-ground and intracloud lightning flashes

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Using Broadband Observation network for Lightning and Thunderstorm (BOLT) which locates radiation sources in 3D associated with lightning electromagnetic waves in a wide frequency range from 500Hz to 500kHz, we have observed and analyzed Preliminary breakdown (PB) which produces bipolar electric field change waveforms at the beginning of intracloud and cloud-to-ground lightning discharges. We classified PB pulses into +PB and -PB, depending on initial polarity of PB pulses in the physics sign convection and identified 334 +PB pulses and 400 -PB pulses. In this study, we set PB parameters (pulse width, pulse interval, pulse number, total pulse duration and PB initial height, propagation velocity) and analyzed differences between +PB which is at the beginning of intracloud discharges and -PB which is at the beginning of cloud-to-ground discharges. We found that some of +PB's parameters (pulse width, pulse interval, total pulse duration and height) were larger than -PB's parameters. On the other hand, pulse number, velocity were similar with each other. In addition, the results show that radiation sources of +PBs propagate upward while those of -PBs propagate downward or horizontally. In the case of downward propagating -PBs, the ending heights of the propagations are similar to the initial heights of horizontally propagating -PBs. We also use Phased Array Radar (PAR) to make a comparison of radar reflectivity factor and consider the association between thunderstorm's maturity degree and PB parameters.

Keywords: Preliminary breakdown, lightning discharges, EM source location