Searching for the VHF signature of the tip of an intra-cloud positive leader

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We have used the LOw-Frequency ARray (LOFAR) to search for the growing tip of an intra-cloud (IC) positive leader. LOFAR is an extended astronomical radio telescope consisting of many (thousands antennas arranged in stations operating at very-high frequencies (VHF). For these lightning observations we have used about 170 dual polarized antennas in the Netherlands with baselines up to 100 km.

Even with our most sensitive beamforming method, where we coherently add the signals of all 170 antenna pairs, we were not able to detect any emission from the tip of an IC positive leader. Instead, we put constraints on the emissivity of VHF radiation from the tip at 1 aJ/MHz at 60 MHz, well below the intensity of the galactic background.

We conclude that these IC positive leaders propagate in a continuous process which is in sharp contrast to what is seen to the step-wise propagation seen in some cloud-to-ground positive leaders and for negative leaders.