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Lightning initiation seen by the magnetic loop antennas installed at LSBB

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Sequences of bipolar pulses, which are believed to identify the initiation of the majority of both cloud-to-ground (CG) and intracloud lightning flashes in electromagnetic recordings, have been regularly detected by magnetic loop antennas installed at the external site of LSBB at Vestale on the Plateau d'Albion. Since 2013, numerous studies on lightning initiation based on the LSBB data acquired by different antenna configurations have been already published. We present a few examples of our research on lightning initiation including the thundercloud charge structure derived from the electromagnetic recordings.

Energetic pre-stroke pulse sequences (called also preliminary breakdown (PB) pulses) were found in broadband electromagnetic recordings from a multi-cell summer thunderstorm. Combined analysis of electromagnetic and radar data placed the lightning initiation in small, short living cells outside or on edges of the main convective line. This observation can be explained by a presence of strong negative charge pockets and a strong lower positive charge region inside the thundercloud. In another study of PB processes, we found unexpectedly fast evolution of summer negative CG lightning strokes, which we could explain by the presence of a strong negative charge centre inside the thundercloud. By combining the magnetic field data with the electric field measurements located several hundred kilometres from LSBB, we found that PB pulses can be detected at distances up to 600 km from their source and that there was a significant sky wave energy from PB pulses in the signal beyond about 500 km. Recently we aimed at initial stage of energetic negative CG winter lightning flashes. We found specific patterns in the time evolution of PB pulse amplitudes and inter-pulse intervals and hypothesize that this pattern reflects a spatial arrangement of dense pockets of negative charge inside the thundercloud.

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