A two-point direction finding method for impulsive electromagnetic signals produced by lightning

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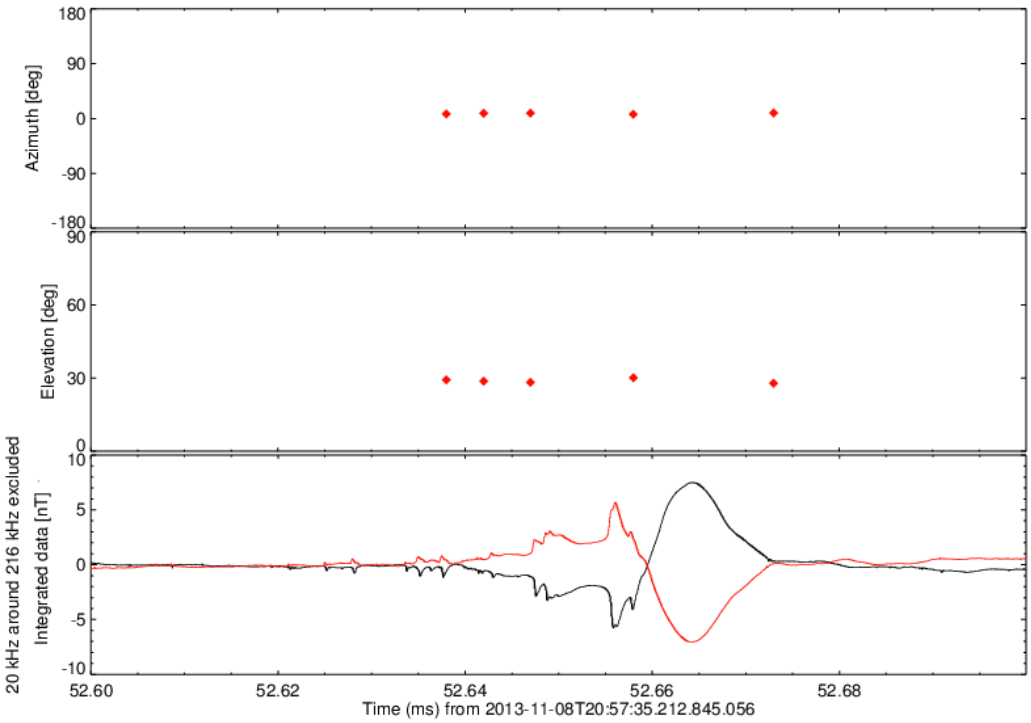
We describe a new experimental method for localization of impulsive electromagnetic signals produced by lightning return strokes, stepped leader processes, and preliminary breakdown pulses. We use a system of two perpendicular SLAVIA sensors (Shielded Loop Antenna with a Versatile Integrated Amplifier) to detect horizontal components of the magnetic field fluctuations in a frequency interval from 5 kHz to 90 MHz. The maximum sensitivity of the recording system is 6 nT/s/√Hz, corresponding to 1 fT/√Hz at 1 MHz. The direction to sources of broadband radiation is derived from a combination of the amplitude ratio and time delay of signals arriving at the two sensors placed at a distance of 89m.

We show examples of the first results obtained from this system installed on the summit of La Grande Montagne (1028 m, 43.9410N, 5.4836E), Plateau d'Albion. We compare our results with lightning localization data from the METEORAGE network. We successfully determine the direction to the source return strokes and our high-resolution broadband records show the corresponding trains of preliminary breakdown pulses and stepped leaders.



An example of localization of preliminary breakdown pulses. The pulses correspond to a +CG return stroke detected during a thunderstorm on 8 November 2013 and localized to the North of the receiving system. Integrated magnetic field waveforms from two SLAVIA sensors (black and red lines) are shown on the bottom.