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Method of Thunderstorm Activity Monitoring Using Lightning Sensors and Electric Field Mills

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Method of simultaneous monitoring of the thunderstorm activity parameters and atmospheric electric field values is developed. The measurement technique and equipment with taking into consideration the possibility of their durable operation without maintenance to provide the sufficient number of measurements in short time were determined. The hardware-software complex was developed for the atmospheric electric field measurement under thunderstorm conditions. It included the atmospheric electric field mill EFM550 (Vaisala), the lightning sensor LS8000 (Vaisala), the software for measuring, transferring and visualization of the atmospheric electric field values and the lightning parameters.

The network of sensors is installed in the North Caucasus and is used to determine the lightning discharges disposition and parameters. The network consists of four lightning sensors LS8000 and the central station for data receiving and processing.

Approximately 3928 lightning discharges were totally registered during the experimental days (6th, 13th, 16th and 17th of May, 2013) over the sensor operation zone limited by the circle with 10 km radius at the EFM550 installation point. This set of data included 3610 of the cloud lightning events (“VHF”), 64 cloud-to-ground lightning events and flashes of the positive polarity (“LF+”) and 254 cloud-to-ground lightning events and flashes of the negative polarity (“LF–“).

The results represent a good correlation of the lightning parameters and atmospheric electric field data. It was found that the correlation is most notably occurred for cloud-to-ground lightning discharges. The part of the cloud discharges were not registered by the EFM550 mill. The cloud discharge is insignificant that too weak perturbation of the electric field is registered by the EFM550 mill, which is lower than threshold sensitivity of the sensor. Also the cloud discharge is directed horizontally. That is why the direction of the electric field vector before the discharge is horizontal, but the EFM550 measures the vertical component of the atmospheric electric field.

The electric field proceeds changing within a large diapason after the thunderstorm. This effect is explained by the precipitation in the vicinity of the atmospheric electric field point of installation. Since the precipitation particles can have different charges of opposite signs, it can affect the electric field mill readout. The second reason is that the electric field can be influenced by the thunderstorms occurring outside the 10 km territory of the experimental measurements.