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Experiment on physical modeling of ash clouds with simultaneous recording of the atmospheric electric potential gradient

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In order to study the processes of formation of bulk charges in the eruptive cloud on the Ebeko volcano in the period from 07/29/2020 to 08/05/2020, observations of the atmospheric electric potential gradient (PG) in the near zone from the crater of the volcano were carried out. As a result of the observations, 24 responses of the PG associated with the propagation of an eruptive cloud were recorded. Three types of characteristic responses were identified: I) bay-shaped, negative polarity, 17 events were registered or 71%; II) a bay–shaped, negative polarity and in the minimum region there is a positive pulse-type disturbance exceeding the background value of PG - 5 events (21%); III) a bipolar response, the shape of which indicates the passage of a horizontal dipole – 2 events or 8%. Based on the analysis of the data obtained, the question was raised about the possibility of forming a positive volumetric charge in the lower region of the eruptive cloud during its lateral demolition, as a result of two main factors: the first is the induced positive charge on the surface of the volcano slope from the main charge of the eruptive cloud, the second is the occurrence of turbulent movement of ash particles at the boundary with the surface of the volcano slope, which occurs in its lower region when it propagates at a speed of more than 8-10 m/s. To confirm this pattern, an experiment was conducted on the physical modeling of an ash cloud and its propagation conditions with simultaneous registration of PG. Laboratory studies of the ashes for granulometric composition, chemical analysis and natural radioactivity were previously carried out. An experimental stand has been developed. Charging the ash cloud to the intensity values at which discharges are possible [1; 2] was not required, which greatly simplified the design of the stand. The release of ash from the chamber occurs due to the supply of compressed air from the compressor to the funnel. The ash under the influence of air pressure from the chamber rushes into the narrow neck of the upper funnel. This design significantly increases the triboelectric effect of ash charging. The atmospheric electric field sensor (type EF-4 [3]) was installed at distances of 0.5 m from the ash chamber, 1 m, and 5 m.

As a result of the experiments, a set of data was recorded and three types of responses corresponding to field observations were identified. Modeling the conditions of the ash cloud propagation during the experiment allowed us to show that when the lower region of the cloud interacts with the earth's surface, this region is recharged and a positive volumetric charge is formed. The work was supported by the RNF grant 22-17-00125.

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