Global geomagnetic perturbations caused by the eruption of the Tonga volcano in 2022

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The study focuses on the analysis of geomagnetic field disturbances and the Schumann resonance (SR) response caused by the Tonga volcanic eruption of January 15, 2022. Global geomagnetic disturbances can be associated with the generation of atmospheric-ionospheric waves at the time of the eruption, which lead to changes in ionospheric conductivity, ionospheric currents and geomagnetic field values. Ten INTERMAGNET stations located at distances of hundreds to tens of thousands of km from the volcano were selected for detailed analysis. Characteristic features of the temporal form of geomagnetic field variations were identified, which made it possible to carry out their comparative analysis, independent of the influence of local ionospheric inhomogeneities on the acoustic-gravity wave (AGW) propagation path and differences in the signals at different azimuths with respect to the source. Analysis of these data allowed us to determine the velocity of geomagnetic disturbances, which was 270 m/s, which corresponds to the AGV velocity. The eruption was also accompanied by unprecedented thunderstorm activity, which caused a significant increase in the amplitude of electromagnetic signals on the SR frequency. Their registration was carried out in observatory Mikhnevo in Russia, located at a distance of 15000 km from the volcano. The possibility of conducting geomagnetic measurements and the reaction of the SR to lightning activity in one point for the first time allowed us to obtain an independent from other geophysical data estimate of the velocity of propagation of geomagnetic disturbances and the time of eruption phases that caused the generation of giant atmospheric waves and pumping of the Schumann resonator. The SR response time was taken as the moment of the maximum signal amplitude at the SR1 frequency, and the time of the appearance of AGW and the corresponding geomagnetic disturbance was determined at the moment of recording the maximum amplitude of the negative bay of the total geomagnetic field vector. The acoustic wave propagation velocity is determined from the time interval between these events and the distance along the great circle route between the volcano and the observatory. The obtained velocity value was 293 m/s, which is close to the velocity estimated from measurements in the Intermagnet network. The difference in velocity on different traces is due to the different state of the ionosphere and the effect of atmospheric-ionospheric winds.