

Ionospheric response on June 21-22, 2019 Raikoke volcano eruption, Kuril Islands as seen from GNSS-observations

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Recently, the significant efforts are done by a number of researchers to study ionospheric response on volcano eruptions (see, for example, Cahyadi et al., J. Volcanology Geothermal Res, 2020; Cahyadi et al., EPS, 2021; Heki and Fujimoto, EPS, 2022). However, an each new evidence about covolcanic ionospheric effects might be important due to limited amount of such observations.

In this work we analyzed the ionospheric response to June 21-22, 2019 Raikoke volcano eruption (VEI class 4) by using surrounding Russian and Japanese GNSS-networks.

Raikoke is a small island-stratovolcano belonging to the Kuril Islands Arc stretched between the Kamchatka Peninsula and Hokkaido Island. It is located 20 km to the north from another active stratovolcano - Sarychev Peak which ionospheric response to the explosive 2009 eruption was studied by Shestakov et al., Remote Sensing, 2021. The volcano is infrequently active (only three historical eruptions are known) and remotely located. The 2019 eruption was characterized by the four strong explosions resulted in eruptive columns of 10-12 km height. The eruption chronology was reconstructed primarily based on satellite data including observations from the infrasonic measurements provided by the International Monitoring System infrasound network. No seismic records of the eruption were obtained by the nearest seismic arrays due to remote location of Raikoke Island.

Prominent covolcanic TEC disturbances (CVIDs) with amplitudes and periods ranged between 0.01-0.03 TECU and 2-4 min were discovered for the last strongest eruptive event occurred at 05:30 UT, June 22. The most of the ionospheric perturbations were detected ~ 9 min after the explosion. They lasted from 4 to 20 minutes and were observed within 10-250 km from the volcano. The estimates of apparent CVIDs velocities vary within 900-1500 m/s. The most of CVIDs were observed in the south quadrants with respect to the Raikoke volcano. The obtained characteristics of the observed TEC variations allow us to attribute them to acoustic mode. We estimated the position of CVIDs ionospheric source using the first maxima arrival time. The ratio between the explosion strength and background ionization level was also investigated. This work was supported by RFBR grant 20-05-00509a and grants of JSPS KAKENHI numbers 19H01984, 20KK0073, 25257204.

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