

## Disturbances of the lower ionosphere during strong seismic activity in 2023-2024 as observed on the Kamchatka peninsula

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Data from the very low/ low frequency (VLF/LF) receiver in Petropavlovsk-Kamchatsky have been used to study the response of the lower ionosphere to two strong ( $M \geq 6.5$ ) earthquakes. The  $M_w = 6.5$  earthquake has occurred on April, 3rd, 2023 in offshore area of the Avachinsky gulf (Pacific coast of the Kamchatka peninsula); the  $M_w = 7.5$  earthquake has occurred on January, 1st, 2024 on the Noto peninsula, Japan. Disturbances of the electromagnetic signals were observed for some days before the earthquakes and in days of earthquakes in the radio wave paths from two transmitters which crossed epicenters' areas. During the intervals under consideration the influence of other factors (magnetic storms, cyclones) which could cause similar disturbances was absent. We suppose the anomalies in the radio signals behavior in the two wave paths have been caused by preparation and realization of these strong earthquakes. An additional argument in favor of such statement is absence of the anomalies in signal variations in other radio wave paths passing far away from the epicenters of the earthquakes. The wavelet-analysis of the filtered in a range of frequencies 0.3-15 mHz of the amplitude and phase of night signal variations, has shown that the maximum of radio signals disturbances corresponded to the atmospheric internal gravity waves (IGW) with periods of 10-50 minutes.

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