Rapid assessment of seismic hazard in the southern part of Sakhalin Island based on a set of geophysical data based on the current medium–term forecast

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Abstract The possibility of implementing a medium-term earthquake forecast using the LURR method in the southern part of Sakhalin Island in certain segments of the West Sakhalin and Central Sakhalin faults is considered in light of the medium-term strong earthquake forecast mode (M=5.5 (±0.5)) currently in effect for the central and southern parts of Sakhalin Island (within the latitude range from 47°N to 49.5°N, longitude range from 141.5°E to 143°E) (Protocol No. 2 of the Sakhalin Branch of the Russian Expert Council on Earthquake Prediction dated April 9, 2025). The assessments were carried out within the framework of a two-stage approach to seismic event forecasting, when previously identified medium-term forecast zones using the calculation method are refined using short-term geophysical methods. For the short-term assessment stage, the study used data from electrotelluric potential (vertical component) and subsurface radon volumetric activity measurement sites within the medium-term forecast coverage area. It was shown that in 2025, synchronous increases in electrotelluric potentials were observed at electrotelluric potential measurement sites in the village of Kolkhoznoye (Nevelsky District) and in Yuzhno-Sakhalinsk, which characterizes periods of high seismic activity. Furthermore, anomalies were detected based on subsurface radon volumetric activity measurements at sites in Yuzhno-Sakhalinsk and Firsovo before the earthquake activation in late June 2025 (a double earthquake near Aniva and Bykov). Updated LURR data (July 2025) showed that the only anomalies over the past five years were recorded in mid-2023. Although this study does not identify short-term precursors, it does provide additional data on the persistence of unstable conditions and confirms the relevance of the proposed medium-term forecast based on direct geophysical measurements.

Keywords Earthquake, forecast, focal mechanism, electrotelluric potential, subsurface radon.

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