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From retrospective to real-time system – LURR earthquake prediction on Sakhalin (2019–2022)

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Abstract. The results of an experiment on the implementation of operational analysis of Sakhalin seismicity by the LURR method of medium-term earthquake prediction are presented. Monitoring began in 2022 on the basis of the LURR parameter calculations based on 2019–2021 seismic data. The island territory is divided into 36 calculated areas, which evenly cover it in increments of 0.5 degree in latitude and longitude. Prediction zones for this period are constructed, including those calculated areas in which anomalies of the LURR parameter have been detected. During 2022, information about new anomalies and prediction zones was added quarterly. The main objective of the experiment is to test the work with data in quasi-real time mode and to check the quality of solving the procedural issues related to prediction from the approval stage to the completion one. In the period of 2019–2022, 25 anomalies of the prediction parameter were detected. In the retrospective database (from 2019 to 2021), two prediction zones were identified in 2020 (consisting of 9 and 4 calculation areas, respectively). Two more prediction zones were formed in 2022 (3 and 6 calculation areas). Predictions with the definition of time, place and strength were approved for three prediction zones at the meetings of the Sakhalin Branch of the Russian Expert Council on Emergency Situations (SB REC). During 2022, two out of three predictions were recognized as realized. In the fourth zone, the prediction was realized, but an earthquake with the required parameters has occurred after the definition of the zone within a quarter, i.e. both the prediction zone and its implementation were simultaneously recorded, already after the fact (data processing is carried out once a quarter). In this case, the forecast is not recognized as either a missed goal or realized in real time (retrospectively, this is a successful forecast), but it is procedurally defined as a technical omission. As of the beginning of 2023, there is one active prediction zone in the north of the island. The experiment continues.

Keywords:

seismicity, seismic events, LURR method, earthquakes catalog, anomaly, monitoring

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References

1. Yin X.C., Zhang L.P., Zhang H.H., Yin C., Wang Y., Zhang Y., Peng K., Wang H., Song Z., Yu H., Zhuang J. **2006.** LURR's twenty years and its perspective. *Pure Applied Geophysics*, 163: 2317–2341. https://doi.org/10.1007/s00024-006-0135-x
2. Zakupin A.S., Levin Yu.N., Boginskaya N.V., Zherdeva O.A. **2018.** Development of medium-term prediction methods: A case study of the August 14, 2016 Onor (M=5.8) earthquake on Sakhalin. *Russian Geology and Geophysics*, 59(11): 1526–1532. https://doi.org/10.1016/j.rgg.2018.10.012
3. Zakupin A.S., Bogomolov L.M., Boginskaya N.V. **2020.** Using the load/unload response ratio and self-developing processes methods of analyzing seismic sequences to predict earthquakes in Sakhalin. Izv., *Atmospheric and Oceanic Physics*, 56(7): 693–705. https://doi.org/10.1134/S0001433820070105
4. Zakupin A.S., Boginskaia N.V. **2021.** Mid-term earthquake prediction using the LURR method on Sakhalin Island: A summary of retrospective studies for 1997–2019 and new approaches. *Geosistemy perehodnykh zon = Geosystems of Transition Zones*, 5(1): 27–45. https://doi.org/10.30730/gtrz.2021.5.1.027-045 (In Russ.).
5. Kossobokov V.G. **2011.** Are mega earthquakes predictable? *Izv., Atmospheric and Oceanic Physics*, 47(8): 951–961. https://doi.org/10.1134/S0001433811080032
6. Kossobokov V.G. **2013.** Earthquake prediction: 20 years of global experiment. *Natural Hazards*, 69(2): 1155–1177. https://doi.org/10.1007/s11069-012-0198-1
7. Voeykova O.A., Nesmeyanov S.A., Serebryakova L.I. **2007.** [*Neotectonics and active faults of Sakhalin*]. Moscow: Nauka, 186 p. (In Russ.).

8. Zharov A.E. **2004.** [*Geological structure and Cretaceous-Paleogene geodynamics of Southeastern Sakhalin*]. Yuzhno-Sakhalinsk: Sakhalin. obl. kn. izd-vo, 192 p. (In Russ.).
9. Musson R.M.W., Grünthal G., Stucchi M. **2009.** The comparison of macroseismic intensity scales. *Journal of Seismology*, 14(2): 413–428. https://doi.org/10.1007/s10950-009-9172-0
10. Oskorbin L.S., Bobkov O.A. **1997.** [Seismogenic zones of Sakhalin and the adjacent areas. Geodynamics of the suture zone of the Pacific Ocean and Eurasia]. In: [*Problems of seismic hazard of the Far Eastern region*]. Yuzhno-Sakhalinsk: IMGiG DVO RAN, vol. 6: 154–178. (In Russ.).
11. Bulgakov R.F., Ivashchenko A.I., Kim Ch.U., Sergeev K.F., Strel'cov M.I., Kozhurin A.I., Besstrashnov V.M., Strom A.L., Sudzuki J., Cucumi H., Vatanabe M., Ueki T., Shimimoto T., Okumura K., Goto H., Kariya J. **2002.** Active faults in Northeastern Sakhalin. *Geotektonika*, 36(3): 227–246.
12. Kozhurin A.I., Kim Chun Un. **2010.** [Active faults of Sakhalin Island, assessment of the magnitude and recurrence of the maximum possible earthquakes]. In: *Problemy seysmichnosti i sovremennoy geodinamiki Dal'nego Vostoka i Vostochnoy Sibiri*: dokl. nauch. simp., 1–4 iyunya 2010 g., Khabarovsk [*Problems of seismicity and recent geodynamics of the Far East and Eastern Siberia*: reports of scientific symposium, June 1–4, 2010, Khabarovsk]. Khabarovsk: ITiG im. Yu.A. Kosygina DVO RAN, p. 138–141. (In Russ.). URL: http://neotec.ginras.ru/comset/_kozhurin-a-i-i-dr-2010-aktivnye-razlomy-o-sahalin-ocenka-magnitudy-i-povtoryaemosti-maksimalno-vozmozhnyh-zemletryaseniy.pdf
13. Wells D.L., Coppersmith K.J. **1994.** New empirical relationships among magnitude, rupture length, rupture width, rupture area, and surface displacement. *Bull. of the Seismological Society of America*, 84: 974–1002.