Algorithm with a single learning class for earthquake-prone areas recognition

Dzeboev B. (1, 3), Gvishiani A. (1, 2), Korolkova A. (1)

(1) Geophysical Center of the Russian Academy of Sciences, Moscow, Russia

(2) Schmidt Institute of Physics of the Earth of the Russian Academy of Sciences, Moscow, Russia

(3) Geophysical Institute – the Affiliate of Vladikavkaz Scientific Centre of the Russian Academy of Sciences, Vladikavkaz, Russia

e-mail: b.dzeboev@gcras.ru

The EPA (Earthquake-Prone Areas recognition) uses dichotomy algorithms with learning, such as "Kora-3", "Subclasses", "Hemming" and others, to recognize strong earthquake-prone areas ($M \geq M0$). At the first stage the algorithm forms the learning sets of high- and low-seismic classes. These sets are further used for algorithm learning.

Two sets of high and low seismic class for learning of dichotomy algorithm are formed within the whole set of objects. Essentially, the task is a limit recognition problem, and the low-seismic learning class includes potential errors. These errors are the objects which will transit into the high-seismic class when the problem is solved.

The Barrier algorithm developed by the authors implies learning only from the high-seismic class. The task of the Barrier algorithm is to study the characteristics of the learning set based on the single given high-seismic class, avoiding learning from the low-seismic one. Using this knowledge, the algorithm detects the objects "similar" to the learning objects. These "similar" objects are defined by the Barrier algorithm as high-seismic. In the parlance of pattern recognition, the Barrier algorithm solves the problem of formation a subset within the finite manifold of objects, that will extend a single high-seismic learning class.

Because the Barrier learns from a single high-seismic class, it cannot be classified as a dichotomy algorithm. However, it can be effectively used as a part of the EPA approach instead of the abovementioned dichotomy algorithms. Therefore the created Barrier algorithm can be viewed as a new step in recognition of strongest, strong and significant earthquake-prone areas.

The Barrier algorithm proved to be effective in recognition of earthquake-prone areas with one learning class in the Caucasus ($M \geq 6.0$) and in the Altai-Sayan-Pribaikalia ($M \geq 6.0$). The algorithm is supposed to be tested in other mountain countries where the classical EPA approach has already been used.

The results of recognition by the Barrier algorithm in the Altai-Sayan-Pribaikalia were used for estimation of influence of the Altai-Sayan orogenic area on the stability of earth crust and on the seismic hazard in the contact zone between the Western Siberian Platform and Siberian Plate. This contributes the study of the problem of geoecologically safe high-level radioactive wastes disposal at the Nizhnekansk massif.

This study was supported by the grant of the Russian Science Foundation № 18-17-00241 «Study of the rock massifs stability by system analysis of geodynamic processes for geoecologically safe underground of radioactive waste isolation».