Successive recognition of earthquake-prone areas

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This work continues the series of papers, devoted to earthquake-prone areas recognition by the algorithmic system FCAZ (Formalized Clustering And Zoning), developed by the authors [1]. The original FCAZ system is based on clustering of the earthquake catalog for the considered region, and allows to locate the places of earthquake epicenters' possible occurrence. Thus, FCAZ implements a fundamentally new approach to solving the classical EPA problem (Earthquake-Prone Areas recognition) [2]. Previously, the authors, using FCAZ, performed earthquake-prone areas recognition in the mountain belt of the Andes in South America ($M \geq 7.75$), in California ($M \geq 6.5$), in the Caucasus ($M \geq 5$), as well as in the Crimean peninsula and northwestern Caucasus ($M \geq 4.5$). In these works, recognition of zones of increased seismicity was carried out for one (specified), fixed for the region, M0 magnitude threshold.

In this work the authors for the first time conducted a consistent earthquake-prone areas recognition for several magnitude thresholds in the same seismic region. This can be done by narrowing iteratively the set of recognition objects of the system FCAZ. Earthquake-prone areas for a given magnitude threshold are recognized within the zones, already recognized as dangerous for a smaller magnitude threshold. The reproducibility of the study is ensured by the fact that during all the stages the recognition algorithm remains unchanged.

Thus, for the first time the classical EPA problem is replaced with a systemically more complex task of sequential earthquake-prone areas recognition within a single region for several threshold magnitudes.

The fundamental novelty of the obtained result is based on the idea of multiple FCAZ-application to sequentially narrowed down (by clustering) set of epicenters of relatively week earthquakes in the region. As a result, a new inductive algorithm has been introduced. It provides sequential recognition within the region, where significant, strong and strongest earthquakes may occur. The new algorithm was called SFCAZ (Successive Formalized Clustering And Zoning).

The FCAZ-approach to EPA problem, developed by the authors, has an important capability of earthquake-prone areas successive recognition for finite sequentially increasing magnitude thresholds within a single region.

REFERENCES
1. Gvishiani A.D., Dzeboev B.A., Agayan S.M. FCAZm intelligent recognition system for locating areas prone to strong earthquakes in the Andean and Caucasian mountain belts // Izvestiya. Physics of the Solid Earth. 2016. Vol. 52. Is. 4. P. 461–491. DOI: 10.1134/S1069351316040017.
2. Gvishiani A.D., Dubois J.O. Artificial intelligence and dynamic systems for geophysical applications. Springer Berlin Heidelberg. 2002. 347 p. DOI: 10.1007/978-3-662-04933-4.