Estimation of quantiles of maximum magnitude in the future time interval on the example of the Baikal rift zone

Pisarenko V.F. (1), Ruzhich V.V. (3), Skorkina A.A. (1, 2), Levina E.A. (3)

(1) Institute of Earthquake Prediction Theory and Mathematical Geophysics of the Russian Academy of Sciences, Moscow, Russia

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

(3) Institute of the Earth Crust of the Siberian Branch of the Russian Academy of Sciences, Irkutsk, Russia

e-mail: anna@mitp.ru

The study of the structure of the seismic field and, in particular, the determination of the maximum possible regional magnitude in seismically active regions has recently received much attention [Pisarenko et al., 2010; Kijko and Singh, 2011]. Previously, for the territory of the Baikal rift zone, work was carried out to estimate Mmax [Ruzhich et al., 1998]. In this work, new methods are applied to the earthquake catalog, increased, respectively, by the interval in 1999-2021, taking into account such strong earthquakes as the Kultuk (August 27, 2008, M = 6.3) and Khubsugul (January 12, 2021, M = 6.8)). In this work, the catalog of magnitudes of the Baikal Branch of the GS RAS was used (seis-bykl.ru) for the period 1963–2021; 48.0 $\leq$ latitude $\leq$ 58.93; 96.0 $\leq$ longitude $\leq$ 122.0; 2.6 $\leq$ M $\leq$ 8.2.

Statistical estimates of the Mmax parameter are often unstable and non-robust. Such a conclusion can be drawn for situations where there are not a sufficiently large number of observations in the range of strong earthquakes to reliably estimate the tail of the magnitude distribution. Proposals were put forward to characterize seismicity in the range of strong earthquakes using a physically understandable and statistically correct random variable - the maximum earthquake magnitude that will occur in the future time interval T (in a given region). This random variable can be characterized using its distribution function or density, but it is more convenient to use the inverse function with respect to the distribution function - the quantile function Qq(T) with a variable level q. The distribution function and the quantile function for a continuous distribution uniquely define each other. Note that the Qq(T) quantile can be considered as an upper confidence limit for the future Mmax in the T interval with a confidence level q [Pisarenko et al., 2022]. The maximum likelihood estimate for the parameter Mmax for the entire BRZ zone is large, though, large values of Mmax occur relatively rarely: Mmax of more than 8.5 occur with a probability of 0.95 over large time intervals T $\approx$ 300 years or more. Therefore, from the standpoint of seismic risk assessment, the Mmax parameter is not quite adequate. The 95% upper confidence limit for the Mmax essentially depends on what time interval T we want to predict. If we are interested in T = 10 years, then the forecast does not exceed Mmax = 7.1. But if we take large values of T of the order of 300 years or more, then we can get a forecast of Mmax $\approx$ 8.0 or more. For this reason, according to the authors, for seismic risk assessment problems, the Qq(T) quantiles are much more adequate than the Mmax parameter.

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