Accounting for spatial inhomogeneity of the parameters of seismic regime for calculating reliable seismic hazard estimates

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This study compares two approaches to the description of diffuse (distributed over an area) seismicity when calculating seismic hazard maps using probabilistic methods. The traditional approach, in which the occurrence of earthquakes is considered to be equally probable at any point of the areal seismic source zone, is compared to the approach based on smoothing the observed seismicity. The Cornell-McGuire probabilistic seismic hazard analysis (PSHA) method is used for calculations. The comparison is made on the example of the vicinity of the Lake Baikal. The catalog of earthquakes of the Baikal branch of the FRC UGS RAS for the entire period of instrumental observations was used in the work. First, the spatio-temporal variations of the magnitude of complete reporting of earthquakes were analyzed using the catalog, and spatial distributions of the parameters of seismicity were constructed - the cumulative frequency of earthquake occurrence (λ), the slope of the earthquake recurrence graph (b-value), and the maximum magnitude of earthquakes (Mmax) for periods of uniform registration. Then the distributions of these parameters are constructed for the entire period of instrumental observations. Thus, estimates of the values of the parameters characterizing the seismic regime of the territory as a whole were obtained. The seismicity parameters of local seismogenic faults were taken from the database of the GSZ-2015 maps. To assess seismic impacts the method of stochastic modeling of accelerograms of local earthquakes was applied, a set of accelerograms was generated in a wide range of magnitudes and distances, and a ground motion prediction equation (GMPE) was constructed that describes the dependence of peak ground acceleration (PGA) on magnitude and distance. Seismic hazard maps were constructed for return periods of 475, 975, and 4975 years. The resulting maps demonstrate a pronounced effect of the two approaches to the description of diffuse seismicity.