8th International Conference on Seismology & Earthquake Engineering
11-13 Nov. 2019, Tehran, Iran

EVALUATING OF THE EARTHQUAKE HAZARD PARAMETERS WITH BAYESIAN METHOD FOR THE DIFFERENT SEISMIC SOURCE REGIONS OF THE NORTHERN IRAN

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Keywords: Bayesian method, Earthquake hazard parameters, Maximum regional magnitude, Northern Iran

Bayesian method is straightforward procedure of estimating of hazard parameters. We present the results of Bayesian statistics technique for northern Iran to estimate the earthquake hazard parameters (maximum regional magnitude Mmax, b value of GR relationship and seismic activity rate or intensity λ) and quantiles of its probabilistic distribution on some future time interval. Therefore, we using a reliable earthquake catalogue which is homogeneous for 3.1 ≤ mb ≤ 6.2 and during the period before 1900 to August 2018 is compiled. The northern Iran has been further divided into six seismic zones. In this study, quantiles of functions of distributions of true and apparent magnitudes for future time intervals of 50, 100 and 475 years are calculated with confidence limits for probability levels of 50%, 70% and 90 % in all seismogenic source zones. The maximum magnitude is for the regions 1 and 6 with the range of greater than 7.6 and the lowest for the regions 2 and 5. Note that in this method, we used a priori uncertainty domain of values of parameters. This approach allows the uncertainty of earthquake magnitude to be accounted for seismic hazard parameters like the β-value which is the slope of the magnitude-frequency law (where, b = loge β) and the intensity (rate) λ of seismic activity and their uncertainties are also estimated. Indeed to calculate the seismic hazard, we are looking for the possibility of a major earthquake in a long time period (Lyubushin and Parvez, 2010). We used a statistical approach. The advantage of statistical approach is based on its generality. It does not need to identify values of different parameters, which we must know if we try to solve differential equations, the most of which could not be defined with sufficient accuracy. Seismic hazard analysis in different regions of Iran has been carried out in different studies, for example: Khodaverdian et al. (2016) using an up-to-date earthquake catalog for all grid points estimated seismicity parameters. Among statistical methods, Bayesian approach has a special interest that comes from its ability to take into consideration uncertainty of parameters in fitted probabilistic laws and a priory given information (Campbell, 1983). The advantages of this approach are given by the ability to consider the uncertainty of the parameters in probabilistic calculations and initial information (Lyubushin, 2010). Since there is no need for the mid-steps to estimate the maximum ground seismic acceleration and other parameters, like the maximum likelihood magnitude estimation occurring in a particular zone or source has made it simpler (Lamarre et al., 1992). Jafari (2007) using Bayesian probability approach calculated the probability of occurrence of earthquakes with more than a special magnitude in different time periods for the Alborz region. Jafari (2010) using the probabilistic analysis of the prediction of the next earthquake, was carried out maximizing the conditional probability density of earthquake occurrence in Tehran. The maximum likelihood magnitude of a certain source or region and its associated uncertainty, the Gothenburg-Richter slope, and the seismic activity rate (intensity) are the most probable earthquake hazard parameters used in the estimation of probable seismic hazard which be estimated for the study area.

After the division of northern Iran using seismic information, geological, focal mechanism and fault trend into six seismic sources, the seismic parameters were calculated using the Bayesian static method. The estimated values changing between 7.21 and 7.82 are listed in Table 1 and mapped in Figure 1 by dividing into third groups (7.21 ≤ Mmax < 7.40; 7.40 ≤ Mmax < 7.60; Mmax ≥ 7.70).

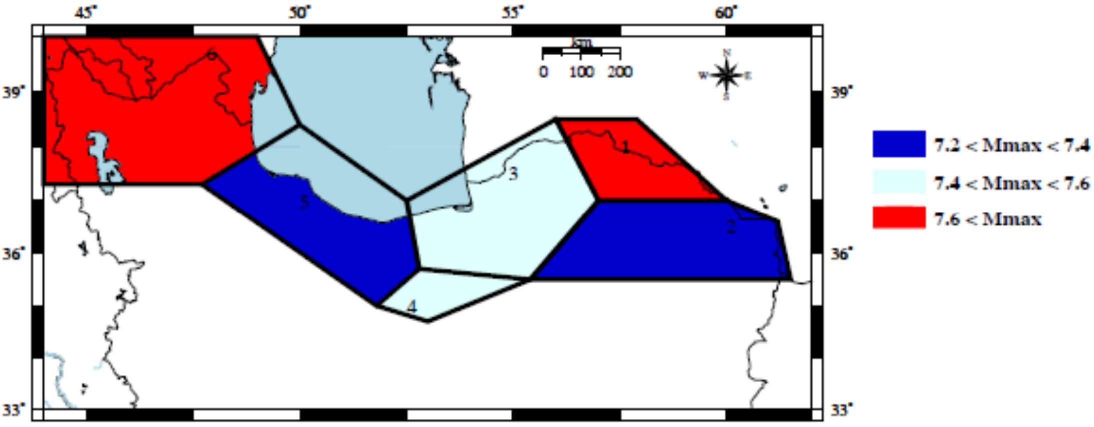

Figure 1. Computed regional maximum magnitudes, Mmax, for the different 6 regions of northern Iran.

REFERENCES

Ashtari Jafari, M. (2007). Time independent seismic hazard analysis in Alborz and surrounding area. *Natural hazards*, *42*(1), 237.

Ashtari Jafari, M. (2010). Statistical prediction of the next great earthquake around Tehran, Iran. *Journal of Geodynamics*, *49*(1), 14-18.

Campbell, K.W. (1983). Bayesian analysis of extreme earthquake occurrences. part ii. Application to the sanjacinto fault zone of southern California. *Bulletin of the Seismological Society of America*, *73*(4), 1099(1115).

Ghodrati Amiri, G., Motamed, R., and Rabet Es-Haghi, H. (2003). Seismic hazard assessment of metropolitan Tehran, Iran. *Journal of Earthquake Engineering*, *7*(03), 347-372.

Lyubushin, A.A and Parvez, I.A. (2010). Map of seismic hazard of India using Bayesian approach. *Natural hazards*, *55*(2), 543-556.

Khodaverdian, A., Zafarani, H., Rahimian, M., and Dehnamaki, V. (2016). Seismicity parameters and spatially smoothed seismicity model for Iran. *Bulletin of the Seismological Society of America*, *106*(3), 1133-1150.

Lamarre, M., Townshend, B., and Shah H.C. (1992). Application of the bootstrap method to quantify uncertainty in seismic hazard estimates. *Bulletin of the Seismological Society of America*, *82*(1), 104-119.