

## COMPARISON OF SEISMIC HAZARD CURVES BASED ON OBSERVED AND SIMULATED EVENTS: CASE STUDY OF THE CITY OF TEHRAN, IRAN

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The Probabilistic Seismic Hazard Analysis (PSHA) has been performed in this paper for the city of Tehran, Iran. Two catalogues were used which are (1) the observed events which are collected from previous studies (Shahvar and Zare, 2013; Berberian, 1994), and (2) a simulated set of events based on Han and Choi approach (Han and Choi, 2008). All the observed and simulated events are from 200 km radius area of the city of Tehran. The pre and post quakes are eliminated based on the Gardner and Knopoff approach (Gardner and Knopoff, 1974). Finally, 273 observed data are available for further investigations. The whole area is divided to 11 sub regions and seismic characteristics are calculated for each region (Wells and Coppersmiths, 1994; Kijko and Sellevoll, 1992). The seismic characteristics are compared with the available founding in the literature (Tavakoli and Ghafory-Ashtiany, 1999). The conventional PSHA has been performed based on Equation (1) and the results are compared with (Gholipour et al., 2008).

$$\lambda(IM > x) = \sum_{i=1}^{n_{sources}} \lambda(M_i > m_{min}) \int_{m_{min}}^{m_{max}} \int_0^{r_{max}} P(IM > x | m, r) f_m(M) f_r(R) dm dr \quad (1)$$

where IM is the intensity measure,  $\lambda(IM > x)$  is the rate of  $IM > x$ , M is moment magnitude,  $m_{min}$  is the lower bound for moment magnitude,  $\lambda(M_i > m_{min})$  is rate of occurrence of earthquakes greater than  $m_{min}$  from the source,  $P(IM > x | m, r)$  comes from ground motion prediction equations,  $f(M)$  and  $f(R)$  are probability density functions for magnitude and distance.

A set of events is also generated by employing the Han and Choi approach (Han and Choi, 2008) for different return periods i.e.  $10^4$ ,  $10^5$  and  $10^6$  years. This approach employs a random generation procedure based on the occurrence rate. The other seismic characteristics are kept identical to the observed catalogue. Hence, the generated catalogue has a kind of inherent uncertainty which makes it different from the observed data. The PSHA is, then, performed again for the simulated cases and the result is compared with the conventional hazard curve as shown in Figure 1. As seen in Figure 1, both of the hazard curves are close together except in the middle part which corresponds to the normal return period values. The hazard curve based on the observed data is always higher than the hazard curve based on the simulated events which indicate that the hazard curve based on the observed data is always in the safe side.

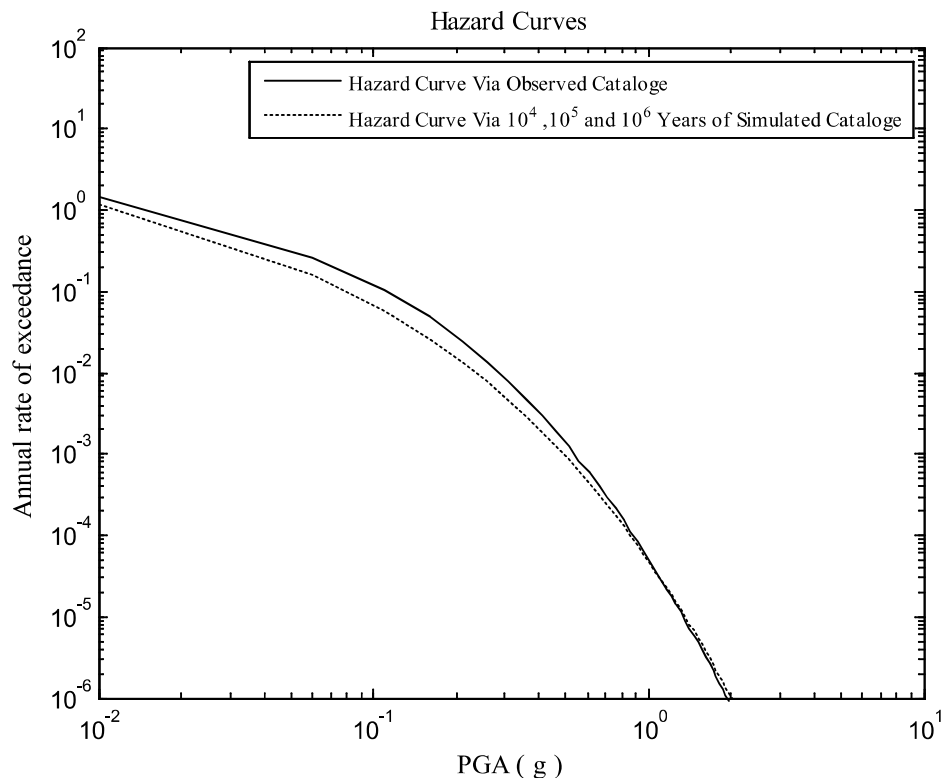


Figure 1. The hazard curves for the city of Tehran based on the observed and simulated event

## REFERENCES

- Berberian M (1994) Natural hazards and the first earthquake catalogue of Iran, Vol. 1: Historical Hazards in Iran Prior to 1900, International Institute of Earthquake Engineering and Seismology, Tehran
- Gardner JK and Knopoff L (1974) Is the sequence of earthquakes in southern California, with aftershocks removed, Poissonian. *Bull. Seismol. Soc. Am.*, 64(5): 1363-1367
- Gholipour Y, Bozorgnia Y, Rahnema M, Berberian M and Shojataheri J (2008) Probabilistic seismic hazard analysis, phase I—greater Tehran regions, Final report, Faculty of Engineering, University of Tehran, Tehran
- Han SW and Cho YS (2008) Seismic hazard analysis in low and moderate seismic region-Korean peninsula, *Structural Safety*, 30(6): 543-558
- Kijko A and Sellevoll MA (1992) Estimation of earthquake hazard parameters from incomplete data files, Part II, Incorporation of magnitude heterogeneity, *Bulletin of the Seismological Society of America*, 82(1): 120-134
- Shahvar MP, Zare M and Castellaro S (2013) A unified seismic catalog for the Iranian plateau (1900–2011) *Seismological Research Letters*, 84(2): 233-249
- Tavakoli B and Ghafory-Ashtiany M (1999) Seismic hazard assessment of Iran, *Annals of Geophysics*, 42(6)
- Wells DL and Coppersmith KJ (1994) New empirical relationships among magnitude, rupture length, rupture width, rupture area, and surface displacement, *Bulletin of the Seismological Society of America*, 84(4): 974-1002

