PRIN-6: Efecto de sitio y microzonificación sísmica

Probabilistic seismic hazard assessment for Northern Chile and Southern Peru

Ranjit Das[1,2], Gabriel Armando González[1,2], Pablo Salazar[1,2], Juan González[1,2].
(1) Centro de Investigación para la Gestión Integrada del Riesgo de Desastres (CIGIDEN), CONICYT/FONDAP/15110017, Santiago, Chile
(2) Departamento de Ciencias Geológicas, Facultad de Ingeniería y Ciencias Geológicas, Universidad Católica del Norte

Probabilistic Seismic Hazard Assessment (PSHA) gives a framework in which uncertainties at various steps of seismic hazard assessment can be identified, quantified and combined in a rational manner to provide a complete picture of the seismic hazard related to earthquake catalog incompleteness, source modelling, estimation methods, earthquake recurrence models and attenuation relationships. PSHA methodology has been applied to northern Chile and southern Peru region as a case study, between latitude 17°–30°S and longitude 67°–74°W for which the geological and tectonic setup was studied and an improved earthquake catalog has been prepared using General Orthogonal Regression (GOR) as suggested in recent literature. Based on events data collected for the period 1976–2016, GOR relations have been derived for conversion of mb, ML and M_s to M_w. GOR relations have been obtained using study area datasets for magnitude ranges $4.3 \leq m_{b,ISC} \leq 6.1$ and $4.6 \leq m_{b,NEIC} \leq 6.1$. Similar relations have also been obtained between M_s and M_w in ranges $4.1 \leq M_{s,ISC} \leq 6.1$; $4.2 \leq M_{s,NEIC} \leq 6.1$. We considered global data for a relationship between M_s and M_w in range $6.2 \leq Ms \leq 8.4$. The prepared catalog using the developed regression relations has been further used for seismic hazard estimations. The study area is subdivided into three seismogenic zones, based on tectonic and geological features, focal mechanism solutions and spatial distribution of earthquake events. The magnitudes of completeness, which has direct bearing on estimation of G-R parameters a and b values have been derived for the seismogenic zones using Stepp's method. The seismic hazard parameters namely activity rate λ, seismicity parameter β and maximum magnitude M_{max} have been derived for seismic hazard assessment. The ground motion prediction equations (GMPE) developed by various authors have been used to estimate the strong ground motion. PSHA analysis has been carried out using the classical Cornell–McGuire approach. Seismic hazard has been computed by performing computations at a grid interval of 0.1°x0.1° covering the entire region. PSHA maps have been produced for Peak Ground Acceleration (PGA) and spectral acceleration at 0.2 and 1 s for 10% probabilities of exceedance in 50 years corresponding to return periods of 475 years, at bed rock and in surface level. PGA values are obtained in the range of 0.003g to 0.954g and 0.004 g to 1.81g for bedrock and surface level, respectively, with 10% exceedence probability in 50 years.