Seismic hazard deaggregation for selected Egyptian cities


Abstract:

Probabilistic seismic hazard analysis in terms of peak ground acceleration (PGA) and spectral acceleration (SA) values was assessed for the Egyptian territory. Eighty-eight potential seismic sources (for shallow- and intermediate-depth seismicity) in and around Egypt were identified and characterized based on an updated and unified earthquake catalogue spanning the time period from 2200 B.C. until 2013. Earthquake recurrence rates were computed, from both instrumental and historical data, for the defined seismic sources. Six well-known ground motion attenuation models were selected to predict the ground motion for the different tectonic environments in and around Egypt. Finally, a logic tree approach was followed, after a sensitivity analysis, to consider the epistemic uncertainty in different inputs (b-value, maximum expected magnitude and ground motion attenuation model). In the present study, we show the seismic hazard deaggregation results, in terms of distance and magnitude, for the most important cities in Egypt to help understanding the relative contributions of the different seismic sources. Seismic hazard deaggregation for PGA, 0.2, 1.0 and 2.0 s SA, for 10% probability of exceedance in 50 years (return period of 475 years), was computed in detail. The deaggregation graphs were drawn considering bins of 0.5 for magnitude and 25 km for distance. The mean and modal values of magnitude and distance, to identify the distribution of control earthquakes that contribute to exceedance of the considered SA level were also computed. In general, the results at most of the cities, indicate that the distance to the seismic sources which mostly contributes to the seismic hazard is mainly controlled by the nearby seismic sources (especially for PGA). However, the more distant events contribute more to the hazard for larger spectral periods (for 1.0 and 2.0 s SA). For instance, the control earthquake for Cairo has a moment magnitude (MW) values in the range 5.0-5.5 and a focal distance between 0 and 25 km for PGA, 0.2, and 1.0 s SA, whereas for 2.0 s the distance remains the same but the magnitude become 6.0-6.5. However, for Port Said (located along the Mediterranean Sea coast), values of 7.0-7.5 MW and 375-400 km for the control earthquake has been obtained for all spectral periods. A significant result of this type of work is that seismic hazard deaggregation provides useful data on the distance and magnitude of the contributing seismic sources to the hazard in a certain place, which can be applied to generate scenario earthquakes and select acceleration records for seismic design.

Keywords:

Probabilistic seismic hazard, peak ground acceleration, spectral acceleration, deaggregation, Egypt.

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