Updated probabilistic seismic hazard values for Egypt

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Abstract:

Seismic hazard in terms of mean peak ground acceleration (PGA) and spectral acceleration (SA) values has been computed for Egypt using both historical and instrumental earthquake data. In order to carry out this appraisal, a typical zoning method using the CRISIS software was employed. For this purpose, an updated earthquake catalog, spanning the time period from 2200 B.C. to 2013, has been compiled for Egypt and its surrounding regions, and prepared to be used in a new probabilistic seismic hazard assessment. The earthquakes sizes were unified in terms of the moment magnitude scale and the catalog was declustered. A new seismic source model, for the seismic activity in and around Egypt, consisting of a total of 88 seismic zones (for shallow- and intermediate-depth seismicity) was considered in this new assessment. The seismic parameters have been specifically computed for 35 seismic sources covering the Egyptian territory and the Eastern Mediterranean region. A logic-tree design was setup in order to consider the epistemic uncertainty in the Gutenberg-Richter b-value, maximum expected magnitude (Mmax) and the selected ground-motion prediction equations (GMPEs). Computations: Seismic hazard computations, for rock-site conditions, with 10% and 5% probability of exceedance in 50 years have been carried out. In addition, uniform hazard spectra for twelve, among the most important and populated cities in Egypt, are computed and compared with the most recent Egyptian building code values. Then, the seismic hazard deaggregation results for the most important cities has been performed in terms of distance and magnitude, to help understanding the relative contributions of the different seismic sources. Seismic hazard deaggregation, in particular, was computed for spectral acceleration at periods of 0.0, 0.2, 1.0 and 2.0 s for rock-site conditions, for 10% probability of exceedance in 50 years. It is interesting to highlight that the maximum hazard values are observed at the Gulf of Aqaba region, specifically around the epicentral location of the biggest Egyptian recorded earthquake of 22 November 1995 (MW 7.2) Aqaba earthquake. The obtained seismic hazard values for Nuweiba city (located in this region), for PGA and SA (0.1-s) are 0.29 g and 0.74 g, respectively, for a return period of 475 years. Moreover, the deaggregation results indicate that distance to the seismic sources which mostly contributes to the seismic hazard is mainly controlled by the nearby sources. However, distant events contribute more to the hazard for larger spectral periods (for 1.0 and 2.0 s). A significant result of this type of works 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:

Seismic hazard, Earthquakes, Seismotectonics, Egypt

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