ESC2016-328, 2016
35th General Assembly of the European Seismological Commission

Did two decades of ground motion prediction equations improve seismic hazard estimates in Italy?

Simone Barani (1), Dario Albarello (2), Marco Massa (3), and Daniele Spallarossa (1)

(1) Università degli Studi di Genova, DISTAV, Genova, Italy , (2) Università degli Studi di Siena, DSFTA, Siena, Italy, (3) Istituto Nazionale di Geofisica e Vulcanologia, Milano, Italy

This study compares the performance of twelve hazard models based on dated and recent ground motion predictive equations (GMPEs) in order to evaluate the improvement provided by new equations on probabilistic seismic hazard assessments (PSHAs) in Italy. To this end, two alternative statistical procedures are applied to score the outcomes of each hazard model at 56 sites for which ground motion recordings have been available for at least 25 years. While one of the scoring procedures accounts for the correlation among the hazard estimates provided by each computational model, the other does not. Both procedures calculate the likelihood of the outcomes of each hazard model relative to available observations. This allows evaluating the performance of each model and, indirectly, the influence of the selected GMPEs in providing effective hazard estimates. Moreover, since local soil conditions are taken into account in the computations (by means of site coefficients for specific ground types), the study allows evaluating the feasibility of seismic hazard mapping in Italy accounting for site amplification. A restricted number of GMPEs is found appropriate to this scope. In particular, we have found that older GMPEs tend to lead to high-frequency ground motion hazard values that are overconservative at shorter mean return periods and underconservative at longer ones. In order to identify the sources of the different behavior between older and recent equations, the biasedness of each GMPE has been evaluated by comparing median predictions with observations available at two accelerometric sites where a relatively large number of ground motions from different earthquakes have been recorded and local soil conditions are well established. Specifically, the sites of L'Aquila (AQP) and Mirandola (MRN) were selected. The former was struck by the April 6, 2009 earthquake (M = 6.3). The latter experienced the May-June 2012 Emilia seismic sequence with main shock of magnitude M = 6.1. Our results indicate that two decades of research on GMPEs have resulted in a significant reduction of bias, with an improvement in the accuracy of predictions. Major improvements have been observed at the turn of 2008 to 2010 and may be related to an increased effectiveness of functional forms, which allow a better modeling of the physical process governing the propagation of ground motions. Since then, the GMPE bias has remained almost stable and no significant improvement in the performances of the relative hazard models has been observed. Our results also indicate that worldwide GMPEs applied to the Italian area are less effective in providing hazard results that are corroborated by observations.