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Comparing NDSHA and PSHA seismic hazard maps and real seismicity for the Italian territory

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Rigorous and objective testing of seismic hazard assessments against the real seismic activity are a necessary precondition for any responsible seismic risk assessment. Recent analysis showed that the performances of the traditional probabilistic approaches to seismic hazard assessment (PSHA) in predicting ground shaking are very unsatisfactory, particularly for large earthquakes.
A viable alternative to PSHA is represented by the definition of credible scenario events by the neo-deterministic approach (NDSHA), a methodology based on the realistic modelling of seismic wave propagation, which permits the generalization of empirical observations by means of physically sound theoretical considerations. The NDSHA complements shaking data from prior earthquakes with physical modeling of ground motion from a wide set of possible earthquakes, and can be submitted to a formalized validation process and parametric tests that allows for the quantification of the uncertainties involved.
Besides the standard NDSHA maps, providing estimates of maximum seismic ground motion, the flexibility of NDSHA permits to account for earthquake recurrence and eventually allows for the generation of ground shaking maps at specified return periods (i.e. probability of exceedance). This allows for a straightforward comparison between the NDSHA and the PSHA maps, which provide the hazard estimates in terms of probability of exceedance of a given threshold of ground motion at a specific site.
Because seismic hazard maps seek to predict the shaking that would actually occur, the reference hazard maps for the Italian seismic code, obtained by PSHA, and the alternative ground shaking maps based on NDSHA, are cross-compared and tested against the real seismicity for the territory of Italy. The comparative analysis evidences the excessive dependency of PSHA expected ground shaking on earthquakes recurrence (i.e. on the probability threshold selected for the maps), which is affected by large uncertainties and often turns out incorrect. The comparison between predicted intensities and those reported for past erthquakes shows that models generally provide a rather conservative estimates, except for PGA with 10% probability of being exceeded in 50 years, which underestimates the largest earthquakes. In terms of efficiency in predicting ground shaking, measured accounting for the rate of underestimated events, the NDSHA maps appear to outscore the PSHA ones.