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Preliminary cross-checking of occurrence rates from NDSHA maps and observed intensities

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The NDSHA (Neo-Deterministic Seismic Hazard Assessment) is a scenario-based method for seismic hazard analysis, where realistic and duly validated synthetic time series, accounting for source, propagation, and site effects, are used to construct ground motion scenarios. NDSHA, in its standard form, defines the hazard as the envelope ground shaking at the site, namely the maximum estimate computed from a large set of possible scenario earthquakes. Thus, the standard NDSHA maps provide rather robust and conservative hazard estimates, which do not require any assumption about the probabilistic model of earthquakes occurrence. Some specific applications, however, may benefit from temporal information about the computed ground shaking, including a gross estimate of its average occurrence time.

The standard NDSHA procedure has been recently expanded and provides the option to take into account the information about earthquake occurrence rates, whenever this information is required and for the areas where statistically sound rate estimates are available. The used frequency-magnitude relations for earthquakes in the Italian region are obtained according to the multi-scale seismicity model, which accounts for the extent of the investigated territory. In the first step of the procedure an occurrence rate estimate is associated to each of the modeled sources. The synthetic seismograms are then computed at the different sites of interest, following the standard NDSHA procedure. The rate of occurrence of the seismic source is also associated to the related seismograms; therefore the occurrence rate of the maximum ground motion obtained by standard NDSHA can be estimated. The introduction of occurrence rates in NDSHA also allows for the generation of ground shaking maps associated with a specified occurrence time, which permit a straightforward comparison between the NDSHA and the PSHA maps in terms of rates.

Here we report about a preliminary cross-checking between observations and model ground motion rates. Since the instrumental data cover just a short time window, the estimated rates of ground motion cannot be compared with the rates of recorded ground motion. Therefore the only possible verification is against the rates of observed macroseismic intensities. For this purpose, we convert the estimated ground motion parameters in intensity values, using existing relationships, and then we consider the associated occurrence rates.

Based on the performed cross-comparison, we can formulate the following preliminary conclusions. The conservative choices, which are at the base of the expanded NDSHA procedure, lead to rather conservative estimation of occurrence rates. The occurrence rates of intensities estimated from PGV are generally lower than those estimated from DGA and, therefore, they are closer to the observed ones. Even if mismatches between DGA and PGV estimate are not surprising, the systematic nature of this differences could derive from a limit of the used conversion relationships. We also notice that the occurrence rates of earthquake used in the model could be overestimated, particularly in Northern Italy. Moreover the completeness level of intensity observations may be different in Northern and Southern Italy, possibly explaining the better agreement between modelled and observed rates in peninsular Italy.