Geophysical Research Abstracts
Vol. 16, EGU2014-13840-1, 2014
EGU General Assembly 2014
© Author(s) 2014. CC Attribution 3.0 License.

Neo-deterministic definition of earthquake hazard scenarios: a multiscale application to India

Antonella Peresan (1,2), Andrea Magrin (1), Imtiyaz A. Parvez (3), Bal K. Rastogi (4), Franco Vaccari (1,2), Stefano Cozzini (5), Davide Bisignano (1), Fabio Romanelli (1,2), Giuliano F. Panza (1,2,6), Mr Ashish (3), and Ramees R. Mir (3)

(1) University of Trieste, Department of Mathematics and Geosciences, Trieste, Italy, (2) The Abdus Salam International Centre for Theoretical Physics, SAND Group, Trieste, Italy, (3) CSIR Centre for Mathematical Modelling and Computer Simulation, NAL Belur Campus, Bangalore, India, (4) Institute of Seismological Research, Raisan, Gandhinagar, Gujarat, India, (5) Consiglio Nazionale delle Ricerche, CNR/IOM uos Democritos. Trieste, Italy, (6) Institute of Geophysics, China Earthquake Administration, Beijing, China

The development of effective mitigation strategies requires scientifically consistent estimates of seismic ground motion; recent analysis, however, showed that the performances of the classical probabilistic approach to seismic hazard assessment (PSHA) are very unsatisfactory in anticipating ground shaking from future large earthquakes. Moreover, due to their basic heuristic limitations, the standard PSHA estimates are by far unsuitable when dealing with the protection of critical structures (e.g. nuclear power plants) and cultural heritage, where it is necessary to consider extremely long time intervals. Nonetheless, the persistence in resorting to PSHA is often explained by the need to deal with uncertainties related with ground shaking and earthquakes recurrence.

We show that current computational resources and physical knowledge of the seismic waves generation and propagation processes, along with the improving quantity and quality of geophysical data, allow nowadays for viable numerical and analytical alternatives to the use of PSHA. The advanced approach considered in this study, namely the NDSHA (neo-deterministic seismic hazard assessment), is based on the physically sound definition of a wide set of credible scenario events and accounts for uncertainties and earthquakes recurrence in a substantially different way. The expected ground shaking due to a wide set of potential earthquakes is defined by means of full waveforms modelling, based on the possibility to efficiently compute synthetic seismograms in complex laterally heterogeneous anelastic media. In this way a set of scenarios of ground motion can be defined, either at national and local scale, the latter considering the 2D and 3D heterogeneities of the medium travelled by the seismic waves. The efficiency of the NDSHA computational codes allows for the fast generation of hazard maps at the regional scale even on a modern laptop computer. At the scenario scale, quick parametric studies can be easily performed to understand the influence of the model characteristics on the computed ground shaking scenarios. For massive parametric tests, or for the repeated generation of large scale hazard maps, the methodology can take advantage of more advanced computational platforms, ranging from GRID computing infrastructures to HPC dedicated clusters up to Cloud computing. In such a way, scientists can deal efficiently with the variety and complexity of the potential earthquake sources, and perform parametric studies to characterize the related uncertainties. NDSHA provides realistic time series of expected ground motion readily applicable for seismic engineering analysis and other mitigation actions. The methodology has been successfully applied to strategic buildings, lifelines and cultural heritage sites, and for the purpose of seismic microzoning in several urban areas worldwide.

A web application is currently being developed that facilitates the access to the NDSHA methodology and the related outputs by end-users, who are interested in reliable territorial planning and in the design and construction of buildings and infrastructures in seismic areas. At the same, the web application is also shaping up as an advanced educational tool to explore interactively how seismic waves are generated at the source, propagate inside structural models, and build up ground shaking scenarios.

We illustrate the preliminary results obtained from a multiscale application of NDSHA approach to the territory of India, zooming from large scale hazard maps of ground shaking at bedrock, to the definition of local scale earthquake scenarios for selected sites in the Gujarat state (NW India). The study aims to provide the community (e.g. authorities and engineers) with advanced information for earthquake risk mitigation, which is particularly relevant to Gujarat in view of the rapid development and urbanization of the region.