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on

Challenges in Seismic Hazard Assessment: Indian Perspective

by

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ABSTRACT

Seismic hazard analysis (SHA) is a scientific method to forecast future ground shaking caused by earthquakes for a specific location or multiple locations. Growing societal awareness, emergency preparedness needs, and governmental policies have significantly increased its importance in the last few decades. A reliable SHA requires the state-of-the-art specification of its three key elements, (1) seismic source modelling (2) ground motion modelling and the (3) uncertainty modelling. This multidisciplinary science integrates numerous fields of study such as geology, tectonics, seismology, geodesy, statistics, and engineering seismology. Models are developed that encapsulate the earthquake process from earthquake interaction, rupture initiation, and crustal attenuation through to local site effects. However, most SHA studies continue to rely on a plain seismic source description, simplistic statistical analyses of historical and incomplete earthquake catalogues, and ergodic ground motion models subject to varying types and degrees of uncertainties.

Seismic hazard models generally consist of a probabilistic framework that quantifies uncertainty across a complex system. However, SHA is very often divided into deterministic analysis and probabilistic analysis, the primary difference being the treatment of the uncertainty on the occurrences of the next earthquakes. Although there is no scientific prescription for the forecast length, most common probabilistic seismic hazard analyses consider forecasting windows of 30 to 50 years, which are typically an engineering demand for building code purposes.

A need for more accurate and spatially precise hazard forecasting must be balanced with increased quantification of uncertainty and new challenges such as moving from time-independent hazard to forecasts that are time dependent and specific to the time period of interest. Meeting these challenges require the development of science-driven models, which integrate all information available, the adoption of proper mathematical frameworks to quantify the different types of uncertainties in the hazard model, and the development of a proper testing phase of the model to quantify its consistency and skill. Some of the examples of the national seismic hazard exercises are presented with special emphasis on Indian seismic hazard exercises carried out from time to time by various individuals, groups and organisations. The present work reviews multinational along with the current status of National Seismic Hazard Modeling for India, examining the latest advancements and innovative methodologies aimed at confronting forthcoming challenges. It is recommended to have at least two main goals in Indian context which include: (1) comprehending, quantifying, and reducing uncertainties throughout all phases of the modeling process and (2) enhancing the targeting of end-user requirements in the development and output of the models. Finally, a summary of key issues is presented that is fundamental for the future direction of seismic hazard analysis. In Indian context, proper strategic planning is required before building the several inherent modeling's in PSHA through more formal and structured expert elicitation processes that focus on capturing the full range of uncertainty and avoiding the pursuit of consensus.