

The Role of Physics-based Ground Motion Simulations for Seismic Hazard Assessment

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The seismic hazard has as main objective the anticipation of ground motion at a given site; and the risk evaluates the potential damage or losses to society caused by the ground motion anticipated in the hazard analysis. Therefore, reliable ground-motion prediction of future earthquakes is a key input to reduce uncertainties in seismic hazard, and consequently in risk assessment as well. The hazard analysis has two main components: 1) the earthquake forecasting, that is, the probability of all possible events, usually characterized by a magnitude M in a given region and in a given time span. 2) The measure of the ground shaking (intensity) at a given distance from the earthquake source (fault) caused by the previously forecasted earthquake. Traditionally the ground shaking is estimated from empirical Ground Motion Prediction Equations (GMPEs). But the available dataset used to build GMPEs is limited since it does not cover the whole magnitude range and observed data near the source are sparse. Therefore, potential effects of source complexity, such as those from hanging-wall, footwall, buried faults, surface-rupturing, kink faults, step-over faults, directivities, focal mechanism, permanent displacement, and other source-dominated ground motion phenomena are not observationally well constrained. On the other hand, recent development of numerical simulations of earthquakes based on physics of the causative source rupture and wave propagation have contributed to substantial advances to predict the variability of near source ground motion dominated by the source and/or wave propagation effects. Therefore GMPEs must rely on synthetic earthquake ground motion data for meaningful extrapolation in areas where there are not sufficient observations. Here we discuss the use of these physics-based numerical models for ground motion prediction that will have a fundamental role in site-specific hazards assessment in the future, particularly for critical infrastructures such as Nuclear Power Plants .