The role of dynamic earthquake modeling on strong motion prediction

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A key element in earthquake hazard assessment is the estimation of strong ground motion parameters. Many mega-cities around the world are located at close distance to seismogenic faults. In these cases earthquake hazard assessment must integrate the complex properties of near-field ground motions, for which it becomes essential to consider the details of the earthquake source: the rupture extent, its space-time properties, its complexity. Past efforts included kinematic source models in strong motion analysis, i.e. prescribed space-time distributions of coseismic slip. As our understanding of the earthquake physics and computational capabilities improve, there is a more recent trend towards considering dynamic source models, i.e. spontaneous rupture models with prescribed fault friction properties and initial stress conditions. The aim of this approach is to integrate the most relevant features about the physics of the earthquake source that are currently understood. We will summarize the goals and constraints in the design of a standard dynamic earthquake model. We will emphasize the role of heterogeneities of fault stress and fracture energy in reproducing realistic earthquake scenarios, consistent with available strong motion observations. The appropriate parameterization of these heterogeneities will be described. We will review recent achievements and standing issues with this approach. Furthermore, we will discuss the features of these dynamic models that can be included in pseudo-dynamic approaches, i.e. parameterizations of kinematic source models that integrate the lessons from dynamic models.