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Implications of fault behaviour and rupture complexity for seismic hazard models

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Seismic hazard assessment based on ground motion simulations using kinematic finite fault models is being applied in various regions of the world such as California, Japan, Sumatra, as well as Europe. The advantage of such methodologies is that they are based on earthquake scenarios which make use of the available knowledge on fault behaviour and rupture complexity. In this study we adopt a hybrid broad-band ground motion simulation technique, where we combine the deterministic simulation of the low frequencies (0.1-1.0 Hz) with a semi-stochastic simulation of the high frequencies (1.0-10.0 Hz) using empirical Green's functions. Examples from two case studies will be used to illustrate the various aspects of the method. Results will be presented for simulations performed for an expected future earthquake in the Marmara Sea, NW Turkey, and for the Dec 26, 2004 Sumatra earthquake. The success of these simulations depends upon the reliability of the knowledge about the active faults and their rupture characteristics in the studied region. In this sense, several input scenario models with various critical fault parameters can be applied in order to illustrate the effects of the critical input parameters in ground motion simulations. Our results from the Marmara Sea show that the most influential parameters are the location and size of the asperities, rupture initiation point, rupture velocity, rise time and stress-drop. Other important aspects of the fault behaviour are the geometry of the fault segmentation and linkage between the segments in individual earthquake ruptures. One limitation of the deterministic methodologies is that the hazard assessment is usually conducted due to a single scenario earthquake. Several scenarios need to be applied to take into account the uncertainties associated with the parameter variability. This is usually ad-

equate, as long as the earthquake hazard is controlled by a single fault close to the site of interest. In many regions, however, the seismic hazard is combined from the threat of several active faults for which several scenario earthquakes can be defined with different probabilities of occurrence. Future plans towards the implementation of deterministic earthquake scenarios in probabilistic seismic hazard calculations will be discussed.