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Assessing magnitude probability distribution through physics-based rupture scenarios

Sébastien Hok (1), Virginie Durand (2), Pascal Bernard (2), and Oona Scotti (1)
(1) IRSN, Fontenay-Aux-Roses, France, (2) IPGP, Paris, France

When faced with complex network of faults in a seismic hazard assessment study, the first question raised is to what extent the fault network is connected and what is the probability that an earthquake ruptures simultaneously a series of neighboring segments. Physics-based dynamic rupture models can provide useful insight as to which rupture scenario is most probable, provided that an exhaustive exploration of the variability of the input parameters necessary for the dynamic rupture modeling is accounted for. Given the random nature of some parameters (e.g. hypocenter location) and the limitation of our knowledge, we used a logic-tree approach in order to build the different scenarios and to be able to associate them with a probability.
The methodology is applied to the three main faults located along the southern coast of the West Corinth rift. Our logic tree takes into account different hypothesis for: fault geometry, location of hypocenter, seismic cycle position, and fracture energy on the fault plane. The variability of these parameters is discussed, and the different values tested are weighted accordingly. 64 scenarios resulting from 64 parameter combinations were included. Sensitivity studies were done to illustrate which parameters control the variability of the results. Given the weight of the input parameters, we evaluated the probability to obtain a full network break to be 15 %, while single segment rupture represents 50 % of the scenarios.
These rupture scenario probability distribution along the three faults of the West Corinth rift fault network can then be used as input to a seismic hazard calculation.