



Time-Dependent Risk Estimation and Cost-Benefit Analysis for Mitigation Actions

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Earthquakes strongly cluster in space and time. Consequently, the most dangerous time is right after a moderate earthquake has happened, because there is a 'high' (i.e., 2-5 percent) probability that this event will be followed by a subsequent aftershock which happens to be as large or larger than the initiating event. The seismic hazard during this time-period exceeds the background probability significantly and by several orders of magnitude. Scientists have developed increasingly accurate forecast models that model this time-dependent hazard, and such models are currently being validated in prospective testing. However, this probabilistic information in the hazard space is difficult to digest for decision makers, the media and general public.

Here, we introduce a possible bridge between seismology and decision makers (authorities, civil defense) by proposing a more objective way to estimate time-dependent risk assessment. Short Term Earthquake Risk assessment (STEER) combines aftershock hazard and loss assessments. We use site-specific information on site effects and building class distribution and combine this with existing loss models to compute site specific time-dependent risk curves (probability of exceedance for fatalities, injuries, damages etc). We show the effect of uncertainties in the different components using Monte Carlo Simulations of the input parameters. This time-dependent risk curves can act as a decision support.

We extend the STEER approach by introducing a Cost-Benefit approach for certain mitigation actions after a medium-sized earthquake. Such Cost-Benefit approaches have been recently developed for volcanic risk assessment to rationalize precautionary evacuations in densely inhabited areas threatened by volcanoes. Here we extend the concept to time-dependent probabilistic seismic risk assessment. For the Cost-Benefit analysis of mitigation actions we calculate the ratio between the cost for the mitigation actions and the cost of the potential losses. If this ratio is larger than the probability of exceedance of a certain loss, the decision may be worth to be taken. With STEER, users can evaluate the cost effectiveness of a wide range of mitigation actions in one common framework.