Geophysical Research Abstracts, Vol. 7, 07597, 2005
SRef-ID: 1607-7962/gra/EGU05-A-07597

Estimation of probabilistic seismic hazard using synthetic seismic catalogs: a tool for testing the impact of declustering

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In this study, we compute probabilistic seismic hazard assessment (PSHA) using synthetic seismic catalogs in conjunction with the spatio-temporal ETAS model (Epidemic Type Aftershock Sequence). This model consists of a Poissonian background activity and triggered Omori type aftershocks sequences which parameters are inverted from real data. Each seismic catalog generated is one possible realization of the seismicity for the studied region. The corresponding spectral accelerations at the site of interest are calculated using a ground-motion attenuation model and taking into account the aleatory variability of ground-motions. By simulating numerous synthetic catalogs of a fixed time length (e.g. 50 y), the acceleration corresponding to a certain probability of non-exceedance over this time length can be computed. This probabilistic method does not require any declustering of the catalog to fulfill the Poisson hypothesis. Another advantage is its transparency as seismic scenarios contributing to the hazard estimation are clearly identified (in terms of magnitude, distance source-site and dispersion of ground-motion). A procedure is proposed to quantify the impact on hazard estimates of the declustering of the catalog and of the usual assumption that earthquakes occurrences are poissonian. Tests and quantification of impacts performed in the Pyrenees (France) show that the aftershocks participation in probabilistic hazard estimates is lower than 6%.