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Stochastic generator of earthquakes in French territories

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Both French mainland and Lesser Antilles are characterized by sparse earthquake catalogues respectively due to the low-to-moderate seismic activity and the low recording historical depth. However, it is known that major earthquakes could strike French mainland (e.g. Ligure in 1887 or Basel in 1356) and even more French Lesser Antilles (e.g. Guadeloupe 1943 or Martinique 1839). Assessing seismic hazard in these territories is necessary to support building codes and prevention actions to population. One approach to estimate seismic hazard despite lack of data is to generate a set of plausible seismic scenarios over a large time span. A generator of earthquakes is thus presented in this paper. Its first step is to generate only main shocks. The second step consists of trigger aftershocks related to main shocks.

To draw the time occurrence of main shocks, original draw of frequencies and year-by-year summation of it is proceeded. The frequencies are drawn, for each magnitude step, in probability density functions computed through the inter event time method (Hainzl et al. 2006). By propagating magnitude uncertainties contained in the initial catalogue through a Monte Carlo Markov Chain, each magnitude step has not only one main shock frequency but a distribution of it. Once a main shock is temporally drawn, its 2D location is drawn thanks to the cumulative seismic moment recorded on each 5x5 km cell in the French territories. A seismotectonic zoning is used to limit both the spatial distribution and magnitude of large earthquakes. Finally, the other parameters (strike, dip, rake and depth) are drawn in ranges of values depending on the seismotectonic zone where the main shock is located.

For purpose of trigger aftershocks from the main shocks, an approximation of the Bath law (Richter 1958; Båth 1965) is proceeded during the computation of the frequency – magnitude distributions. Thus, for each magnitude step, an α -value distribution is obtained in which, for each main shock an α -value is drawn. In this way, the maximal magnitude of triggered aftershocks is known.