Seismic Hazard and Earthquake Rate In Fault Systems – SHERIFS : a python tool for earthquake geologists, fault-hazard modelers and decision-makers.

Thomas Chartier (1,2), Scotti Oona (2), and Lyon-Caen Hélène (1)

(1) Laboratoire de géologie, Ecole Normale Supérieure, CNRS UMR 8538, PSL Research University, Paris, 75005, France (chartier@geologie.ens.fr), (2) Bureau d'Evaluation des Risques Sismiques pour la Sûreté des Installations, Institut de Radioprotection et de Sûreté Nucléaire, Fontenay-aux-Roses, France

Modelling the seismic potential of active faults and the associated epistemic uncertainty is a fundamental step of probabilistic seismic hazard assessment (PSHA). SHERIFS (Seismic Hazard and Earthquake Rate In Fault Systems) is an open-source python code to build hazard models allowing earthquake ruptures involving several fault sections (or Fault-to- Fault FtF ruptures). SHERIFS contains tools to calculate the annual rate of FtF ruptures and background seismicity rate as well as to set up and to weight the logic tree exploring a wide range of epistemic uncertainties.

Rates of earthquakes on faults are computed following two constraints: the magnitude frequency distribution (MFD) of earthquakes in the fault system as a whole must follow an imposed shape and the rate of earthquakes on each fault is determined by the specific slip-rate of each section depending on the possible FtF ruptures. In the SHERIFS methodology, the MFD of each individual faults is not imposed and can differ from the shape of the MFD of the entire system. For the background, the hazard modeler can define the ratio of on-fault/off- fault seismicity for different ranges of magnitude.

SHERIFS aims to help hazard modeler explore and weight epistemic uncertainties. To do so, SHERIFS contains tools to compare modelled earthquake rates to the available local data (earthquake catalog and paleoseismological data). This comparison can be used to weigh different hypothesis explored in a logic tree and discard the hypotheses that are not in agreement with the data. SHERIFS outputs are in OpenQuake compatible format that can be run directly with the Openquake Engine.

This methodology was first tested on the Western Corinth Rift, Greece (Chartier et al 2017) where is was shown that geological, seismological and paleoseismological rates of earthquakes can only be reconciled when a large spectrum of possible FtF is considered. An interesting aspect of SHERIFS was that part of the geologic slip rate of certain faults needed to be considered as non-seismic slip (interseismic creep or post-seismic relaxation) in order to fit the imposed regional Gutenberg-Richter MFD target.

SHERIFS aims to be versatile and applicable to a wide range of different fault systems and was tested in several regions in the framework of the ESC Fault2SHA working group. In this presentation we will illustrate the salient results of these applications.