Probabilistic approach to estimate the background seismic activity - application to the 2003-2004 Ubaye earthquake swarm, France.

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Ubaye Valley is located in the French Alps, close to the French-Italian border. It is composed of a sedimentary nappe overlying a crystalline bedrock. Few kilometres south to the Ubaye Valley, this crystalline basement crops to form the Argentera Massif.

From January 2003 to December 2004, an earthquake swarm occurred in the Ubaye Valley. More than 16,000 events were detected during this swarm period, with magnitudes ranging between -1.3 and 2.7. The swarm propagates along a vertical plane between 3 and 8 km depth and over a distance of ∼7 km. This swarm sequence includes both background earthquakes that are directly related to an external forcing (e.g. fluids), and aftershocks triggered by the background earthquakes. In order to explain the sequence, a non-stationary external forcing is required. We here aim at resolving this time-varying external forcing in an objective systematic way.

We analysed earthquakes recorded at the permanent station JAUF of the French Sismalp Network, that is located just above the swarm. This catalogue is composed of 16,147 event detection times and estimated magnitudes. We developed a statistical procedure leading to the estimation of the non-stationary background-forcing rate. It consists in using a change-point method to optimize the time variations of this forcing. This method requires to adjust the probability density function of the inter-event times distributions. This function stands for a gamma law and constant parameters, and the adjustment uses a log-likelihood function.

Tests are performed to evaluate the capacity of this method to correctly characterize a non-stationary forcing. This method can be supplied to other earthquakes sequences, in very different tectonic regimes, that are known to undergo strongly time-varying stress perturbations: post-seismic slip, slow earthquakes, among others.