A Bayesian approach to uncover temporal variations in seismicity

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In this study we statistically analyze some earthquake sequences of Central Italy to identify possible temporal variations in the probability distributions of seismic parameters, such as magnitude and spatial location of the epicentres. The data suitable for this analysis are taken from the Italian Seismological Instrumental and Parametric Database (ISIDe), compiled by INGV since 1985. In addition to the probability distributions commonly used to fit these data types (e.g. tapered Pareto, generalized gamma), the q-exponential distribution is also considered: it is the solution of a maximum entropy problem in the frame of nonextensive statistical mechanics, useful for describing complex, non-linear dynamic systems in many applications of environmental and social sciences, including seismology. Bayesian inference is performed by processing data on sliding time windows, such that each window has a fixed number of events and shifts at each new event. An indicator of the activation state of the system is identified in the variations of the estimated parameters of the models in the time windows [1]. Another criterion is based on the best fitting distribution in each time window, which is selected by comparing the evaluated values of the posterior marginal likelihood [2]. We found that the best fitting distribution varies over time jointly with seismic phase variations.

References

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