



The global statistical distribution of time intervals between consecutive earthquakes

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Earthquakes cluster in time in a tighter way than in a Poisson process, in which events would be independent from each other and from when each one occurred. This tight clustering should be considered for forecasting the probability of occurrence of earthquakes in a time period.

Nevertheless, the standard analysis of temporal earthquake occurrence usually proceeds by “declustering” the earthquake time series, trying to identify aftershocks or other triggered events and then pruning them from the sample, leaving only the supposedly independent events. This procedure attempts to artificially make the process Poissonian-like (so that the probability of the next earthquake is forced to be constant in time).

Since there is not a unique way of identifying triggered earthquakes, this removal is subjective to some degree (it involves lack of knowledge about the process, that is, epistemic uncertainty). Such a method also reduces the sample itself, reducing the power of any statistical inference made with it (in other words, with fewer events it is more difficult to distinguish which model best fits the data).

An example of this issue is the debate on whether the recent surge of great earthquakes (magnitude 8 or larger) since 2004 is random or not. If they were Poissonian, the distribution of time intervals between them should be exponential. The answer may depend on whether triggered events are artificially removed from the sample or not.

In this research, we explore in a comprehensive way the statistical distribution of time intervals between consecutive earthquakes worldwide. We use a complete earthquake catalogue, and do not attempt to separate triggered from independent events.

We consider different magnitude thresholds, and for each of them test which statistical distribution (such as Weibull, gamma or exponential) best fits the data. This enables us to quantitatively assess whether there is a universal distribution or, on the contrary, if it depends on the magnitude range considered. Also, we test whether Poissonian occurrence can be rejected for the whole series of the largest earthquakes.

Finally, we show how this distribution, calibrated for each magnitude range, can be used for calculating probabilities of earthquake occurrence in a time period of interest, in a more realistic

way than typically achieved.