Geophysical Research Abstracts,
Vol. 10, EGU2008-A-06285, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-06285
EGU General Assembly 2008

Recurrence times of large earthquakes: what can be inferred from small and intermediate events?

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We present a renewal model for the recurrence of large earthquakes in a fault zone consisting of a major fault and surrounding smaller faults with Gutenberg-Richter type seismicity represented by stress jumps drawn from a truncated power-law distribution. This model describes a fault undergoing positive and negative stress jumps and a constant drift (plate motion), with a large number N of stress steps between two major earthquakes. In the limit $N \to \infty$ the first-passage time distribution is a Brownian passage-time (BPT) distribution. Using the central limit theorem, the mean value and the standard deviation of the distribution can be calculated exactly. This allows to derive individual recurrence time distributions for specific fault zones without tuning free parameters: the mean recurrence time can be estimated from geological or paleoseismic data, and the standard deviation is determined from the frequency-size distribution of an earthquake catalog. The potential of the model with respect to seismic hazard calculations is that it can be applied, even if the catalog includes no large earthquake. The approach is demonstrated by using observational data and long numerical simulations, where the "true" distribution is known. We argue that the BPT distribution is a reasonable choice for seismic hazard assessment, because it governs not only Brownian motion with drift, but also models with power-law statistics for the recurrence of large earthquakes in an asymptotic limit.