Earthquake Waiting Time Distribution: Modeling and Scaling Law

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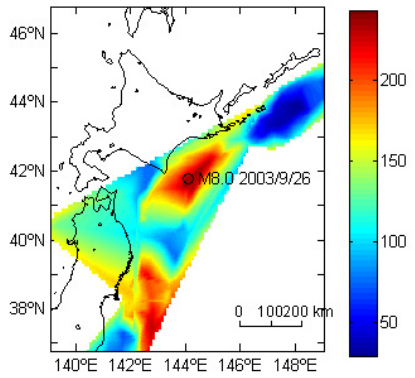
We examine the universality of the scaling law proposed for earthquake interevent time distribution EITD, and the Gamma adjustment of its local component, using the JMA catalog, especially for long time span and heterogeneous earthquakes rate. We propose a new sampling method for earthquake process: Earthquake Random Sampling (ERS) to account for space-time clustering of earthquakes at different distances from a given source. We select two concentric neighborhoods for each selected seismic event. The first one is a kind of extended seismic source that controls the spatially dependent seismicity features whereas the second one is a measure of the spatial resolution in EITD mapping. Obtained samples are used to estimate the EITD locally and in the whole region by mixing samples from different locations. The distributions estimated successively using declustered and whole catalogs reveal that dependent events acts both at short and long range according to their relative proportion in the whole catalog. This mechanism acting on the distribution tails, is investigated to understand the shape of the EITD and to evaluate its impact on the universality of the scaling law. Significant fluctuations in the scaling law exponents of the EITD are observed for different threshold magnitudes in contrast with a unique universal behavior. Under the hypothesis of a doubly power law regime, estimated power law exponents for the scaling law range between -0.77 and -0.76 for relatively short interevent times and between -2.32 and -2.29 in case of large interevent times. Comparing with the results from former studies a slower decay and a steeper one are observed respectively for short and large interevent times.

Mapping of EITD for each model at different resolutions is used to investigate spatio-temporal patterns in seismicity before large shocks. In the case of the M 8.1 2003 Tokachi-Oki earthquake, we show raise of mean waiting time distribution of about 30% and drop of the mean epicentre velocity of about 30% arround the ruptured asperity during the five years preceeding the main shock.



Mean waiting time distribution for M>4.5 events, in days around the asperity of the shock about 6 months before.