Space-time model for wide regional and global seismicity

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http://www.ism.ac.jp/~ogata/Ssg/ssg.html

We consider the location-dependent space-time ETAS (epidemic-type aftershock sequence) model which takes account of different regional physical characteristics of the earth crusts. Its parameters such as p-value for aftershock decay vary from place to place. The parameter variations of the estimated space-time model are visualized and used to investigate features of the regional seismic activity.

Specifically, each parameter is a 2-dimensional piecewise linear function whose value at a location is linearly interpolated by the three values at the location of the nearest three earthquakes (Delaunay triangle vertices) on the tessellated plane by epicenters. Such modeling by using Delaunay tessellation is suited for the observation on clustered points. The estimates of the parameter functions are simultaneously adjusted by the penalized log-likelihood that defines a trade-off between the goodness of fit to the data and uniformity constraint of the function (i.e., each facet of the piecewise linear function being as flat as possible). The constraint can be objectively adjusted from the data by means of an empirical Bayesian method using the Akaike"s Bayesian information criterion (ABIC).

In this talk, I am particularly concerned with the spatial estimates of the first two parameters of the space-time model: namely, mu-values of the background seismicity for the long-term prediction of the large earthquakes; and aftershock productivity K-values for the immediate aftershock probability forecast. The reasons and their utility of the model are demonstrated by applying it to Japan and global seismicity. For both objectives, we further need the spatial estimates of Gutenberg-Richter b-values that are also modeled using similar function on Delaunay tessellated space and optimized by the ABIC procedure.