So-002 Room: C101 Time: June 4 13:45-14:00

Modeling of spatio-temporal seismic activity and its residual analysis

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Tectonic seismic activity is assumed as a superposition of earthquake clusters triggered by relatively large earthquakes. Based on several established empirical laws in the traditional studies of aftershock statistics, we construct a space-time point-process model which needs seven parameters to characterize seismicity in a geophysical region. This is extended to the case where each of the parameters is function of location to get the spatial image of the parameter changes which show regional characteristics of seismicity. Our final goal is to detect a space-time volume in which unusual seismicity changes such as 'relative quiescence' take place in order to to examine whether these are useful as a precursor to predict the time and location of forthcoming large earthquakes.

We assume that tectonic seismic activity is given by a superposition of earthquake clusters triggered by relatively large earthquakes. Based on several established empirical laws in the traditional studies of aftershock statistics, we construct a space-time point-process model in terms of the conditional intensity function which needs seven parameters to characterize seismicity in a geophysical region.

However, as the data size increases, each characteristic parameter takes significantly different values from place to place. Thus we further need to consider a hierarchical extension of the model such that each parameter is a function of location. Specifically, it is represented by two dimensional piecewise linear function consisting of facets defined on Delaunay tessellated triangles whose vertices are locations of earthquakes in the data. Then the penalized log likelihood is considered for the trade-off between the good fit to the data and the uniformity of each function (i.e., the facets of the piecewise linear function are as flat as possible). A Bayesian method is applied for the optimal tuning of the trade-off to the long-term earthquake occurrence data in and around Japan. Thus we have spatial images of the parameter changes (the maximum a posteriori estimate) which show regional characteristics of seismicity.

Our final goal is to detect a space-time volume in which a certain unusual seismicity change is revealed. For this purpose we consider space-time piecewise linear function defined on Delaunay tessellated tetrahedra whose vertices are locations and times of earthquakes in the data. Then this function and the previously estimated space-time conditional intensity function multiply to make a new conditional intensity function, which is applied to the same earthquake data to estimate the piecewise linear function. The estimation is carried out by means of the Bayesian method for the similar trade-off. Thus the estimated function shows a three dimensional image indicating space-time volumes of standard, high or low seismicity relative to the evaluated activity by the previously obtained space-time point-process model, according to that the function takes equal to, larger or smaller than 1, respectively. Our serious interest is particularly placed on the last case called 'relative quiescence' to see whether this could be useful as a precursor to predict the time and location of forthcoming large earthquakes.