Retrospectively forecasted seismicity in eastern Japan using spatio-temporal kernel smoothing

*Yuichi Ohkubo[1], Shinji Toda[1]

1.Graduate School of Science, Tohoku University

The best and pervasive statistical model to describe seismicity is the ETAS (Epidemic Type Aftershock Sequence) model (Ogata, 1988) which is based on modified Omori law and explain secondary aftershocks together with background seismicity. The ETAS model better explains mainshock-aftershock sequence but does not always fit earthquake swarm. Helmstetter and Werner (2014) instead proposed a simple, nonparametric model using a spatio-temporal kernel smoothing, without using the modified Omori law.

We applied the smoothing kernel model not only to the mainshock-aftershock type sequences, such as the Tohoku-oki earthquake (2011.3.11 M9.0) and the Iwate-Miyagi Inland earthquake (2008.6.14 M7.2) but also to a significant earthquake swarm in the Izu Peninsula that occured in 2000 to compare with the ETAS model. As a result, our kernel model for the mainshock-aftershock type earthquake performed almost same accuracy as the ETAS model did, except the significant underestimate immediatery after mainshock. Furthermore, the case of Tohoku-oki earthquake that a large foreshock (2011.3.9 M7.3) was observed, the number of predicted earthquakes became several hundred times higher than the background rate during the time period between the foreshock and M9 mainshock. Although the probability gain was about several hundred times higher than the one in a few days after the Iwate-Miyagi Inland earthquake, probability gain was low in a few days after the Tohoku-oki earthquake compared to that for the Iwate-Miyagi Inland earthquake. Because we applied the two-dimentional model only using earthquakes shallower than 30 km, the prediction accuracy of the interplate earthquakes is lower than that of the inland earthquakes. In the case of the earthquake swarm occurred in the Izu Peninsula, our kernel model was able to better estimate the seimicity than the ones by the ETAS model.

Keywords: smoothing, aftershock, earthquake swarm

