Does an ETAS model dream of foreshocks?: Through the application of an earthquake forecasting method based on swarm-like activity

*Fuyuki HIROSE[1], Koji TAMARIBUCHI[1], Kenji MAEDA[2]

1. Meteorological Research Institute, 2. Japan Meteorological Agency

It has been a long debate about whether foreshock activity is a stochastic phenomenon that can be represented by the epidemic type aftershock sequence (ETAS) model or a physical phenomenon such as a nucleation process involving precursory slips. We investigated the reproducibility of foreshocks of real data by the space-time ETAS model. Our investigation resulted in that real data yielded higher scores than ETAS catalogs by applying Maeda’s method that is a method of detecting seismic swarm activity that sometimes appears before a mainshock and issuing an alert for a period of time. Also, temporal acceleration of foreshocks of real data was larger than that of ETAS catalogs. That is, it is hard for the ETAS model to reproduce foreshock characteristics well, indicating the earthquake forecast model based on Maeda’s method is more efficient rather than the ETAS model. We also found that foreshocks along the Japan trench were distributed on edges of low-velocity anomalies among areas of background swarms related to slow slip events (SSEs). Those foreshocks may be caused by heterogeneous stress distribution associated with the existence of a plate bending axis and a subducted seamount. In particular, foreshocks off Iwate and Miyagi prefectures were excited by periodic SSEs. In inland tectonic zone and island arc, swarm activity associated with magmatic activity tended to result in a target earthquake. Accordingly, Maeda’s method is a forecast model which extracts foreshocks from swarm activity efficiently even in various tectonic settings having the different physical background of foreshocks.