Modelling and forecasting three-dimensional-hypocentre seismicity in the Kanto region

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SUMMARY

This study analyses the seismicity in the Kanto region by fitting the 2-D-epicentre and 3-D-hypocentre ETAS models to the JMA catalogue for events above magnitude *M*4.0. In the 3-D ETAS model, the focal depth is assumed to follow the beta distribution. Compared with results from the 2-D-epicentre ETAS model, the 3-D ETAS model greatly improves the data fitting. In addition, the stochastic reconstruction method is used when validating the results of the 3-D ETAS model, with results indicating that the shallow events are more productive and their aftershocks decay slightly faster in the time and epicentre dimensions.We also study the changes of seismicity patterns before and after the 2011 Tohoku earthquake. The direct aftershocks of events from the post-Tohoku period are more diffusive in time and epicenter but more concentrated in depth. The seismicity rate increases significantly following the Tohoku earthquake, especially along the interface of the subducting Pacific plate. The curve of cumulative background probabilities for events above *M*4.0 implies that the background rate decays back to the pre-Tohoku level in about 5 yr after the Tohoku earthquake. However, the occurrence rates of smaller events (from *M*2.0 to *M*4.0) indicate that the adjustments of local stress field continue at finer scales. Finally, we verify that the 3-D model can reproduce the focal depths better than the 2-D model and improve the forecasting performance.

【Motivation】

This study has two aims. First, as a generalized case study, we apply the 3-D ETAS model to the Kanto region, using the result from the 2-D ETAS model for comparison and carry out a high resolution analysis of the Kanto seismicity to study the influence of the Tohoku earthquake on this region. More specifically, we want to investigate how the background rate changes after the Tohoku earthquake, which may affect the long-term probability of large earthquakes in the Kanto region. Second, we test the feasibility of the 3-D ETAS model through simulations to examine the extent to which the model can reproduce the Kanto seismicity and to make preparations for the 3-D earthquake forecasts of the CSEP Japan project.

【Reference】

Guo, Y., Zhuang, J. & Zhou, S., 2015b. A hypocentral version of the space–time ETAS model, Geophys. J. Int., 203(1), 366–372.