

Distributions of focal mechanisms in background seismicity and earthquake clusters in Japan

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This study tries to find the probability distributions of focal mechanisms in background seismicity and earthquake clusters in Japan by analyzing F-net data. To describe the probability distribution, each focal mechanism is decomposed as the result of a rotation about a particular pole starting from a reference focal mechanism. In this study, DC4 symmetry is considered, i.e., either nodal-plane can be the fault plane and the two sides of the fault plane are distinguishable.

To separate the background and clustering seismicity, we fit the space-time ETAS model (e.g., Zhuang et al, 2011) to the earthquakes with magnitude 4.2+ from 1997 to 2017 in the F-net catalog, and use the stochastic declustering method to estimate the background probabilities that each event is a background event and the triggered probabilities that each event is triggered by other events.

For the background events, the reference focal mechanism is taken as the average focal mechanism in each area, calculated by the method in Kagan (2014). The rotation angles between a background event and the mean focal mechanisms at (x, y) is reconstructed by

$$\xi(\Delta) \propto \sum_j \phi_j I(\text{Rotation angle between } j \text{ and the mean focal mechanism is within } (\Delta - \delta, \Delta + \delta)),$$

where j runs over all background events near x, y , δ is a small number, and ϕ_j is the background probability estimated from fitting the space-time ETAS model. For the triggered events, the reference focal mechanism is naturally taken the focal mechanism of the event which triggers it. The rotation angles between the parent event and its direct offspring are reconstructed by

$$\xi(\Delta) \propto \sum_{\{i,j\}} \rho_{ij} I(\text{Rotation angle between } i \text{ and } j \text{ is within } (\Delta - \delta, \Delta + \delta)).$$

where i and j run over all the event pairs in the catalog, ρ_{ij} is the probability that event j is triggered by event i estimated based on the ETAS model.

We find that the rotation poles are almost uniformly distributed. The reconstructed results for the rotation angles are shown in Figure 1.

Figure 1 (a) mean focal mechanisms of background seismicity in Japan. (b) Reconstructed distribution of rotation angles for focal mechanisms in the background seismicity and triggered seismicity.

References:

- Zhuang J., (2011) , *Next-day earthquake forecasts for the Japan region generated by the ETAS model. Earth Planets Space*, 63, 207-216. doi:10.5047/eps.2010.12.010.
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