

Stress Release and Rebuilding Processes of Mega-thrust Earthquake and Periodic Slowslip Detected by Focal Mechanism Patterns

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We proposed new approach to derive temporal changes of stress states before and after megathrust earthquake by using moment tensor catalog and Space-Time Epidemic-Type Aftershock Sequence (ETAS) model. Although focal mechanism pattern in seismic source region have information of stress state, the pattern is easily disturbed by aftershock sequences. In this study, we obtained rate-time function of normal, reverse and strike-slip fault earthquakes in background seismicity with background probability of each earthquake estimated by the Space-Time ETAS model.

We applied the proposed method to the NIED F-net catalog and the JMA catalog in and around the aftershock region of the 2011 Tohoku earthquake. First, we classified the focal mechanisms from the NIED F-net catalog into four faulting types: normal, reverse, strike-slip, and odd types based on Frohlich (1992). Second, we applied the etas8p program (Zhuang, 2006) to the JMA catalog to estimate the space-time ETAS parameters of before and after the 2011 Tohoku earthquake. Finally, we obtained the occurrence rate of normal, reverse and strike-slip fault earthquakes in background seismicity with background probability of each earthquake.

Estimated occurrence rate time function of reverse faulting is 60 to 80 % before the 2011 Tohoku earthquake, while it decreased discontinuously to 40 % after 2011 Tohoku earthquake and then recovered gently. Estimated rate-time function of normal faulting is 5 to 15 % before the 2011 Tohoku earthquake, while it decreased discontinuously increased to 30 % after 2011 Tohoku earthquake and then gradually decreased. The occurrence rate time functions of reverse and normal faulting are well consistent with stress release and reload process related to the 2011 Tohoku earthquake. We also found periodic temporal rate change in the occurrence rates of reverse and normal earthquakes before the 2011 Tohoku earthquake. The reverse and normal faulting occurrence rates have positive and negative correlation respectively with the periodic slow-slip estimated by repeating earthquake (Uchida et al., 2016).

Keywords: Temporal changes of focal mechanism patterns, ETAS model, Tohoku-oki earthquake

