

Small repeating earthquakes after the 2011 off the Pacific coast of Tohoku earthquake (2)

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The 2011 off the Pacific coast of Tohoku earthquake (Mw9.0) was the largest earthquake in recorded history in Japan. For the stress changes by this earthquake, many aftershocks and induced earthquakes have occurred in and around the source regions. In this study, I show the space-time characteristics of the inter-plate aseismic slip from sequences of small repeating earthquakes in Japan after the 2011 Tohoku earthquake.

I have already detected many small repeating earthquakes occurred at the upper boundary of the subducting plates in Japan before the 2011 Tohoku earthquake. The inter-plate slip-rates estimated from these sequences were consistent to the space-time changes of the inter-plate coupling. I also identified aseismic slips following large inter-plate earthquakes occurred in 2003 to 2008 and quasi-static slips associated with foreshocks off Miyagi that started from 2011.

After the 2011 Tohoku earthquake, seismic activities of small repeating earthquakes become active around the source regions. They are particularly active in the northwestern deeper part of the 2011 main-shock and its large aftershocks. The cumulative slip is more than 4 m in the most frequent area and is consistent to the value estimated from GPS data analysis. Detected sequences also show post-seismic slips at the trench-side of the northern and southern part of the source region in the subducting Pacific plate and in the subducting Philippine Sea plate beneath the metropolitan district, which suggest induced inter-plate slips. In two years after the earthquake, the slip-rates are three to five times of the relative plate motion in the north and western part. On the other hand, they are almost decreasing to the rate before the 2011 main-shock in the southern part. I cannot detect small repeating earthquakes within coseismic slip areas of the 2011 main-shock and large aftershocks after the 2011 main-shock. Distributions of small repeating earthquakes probably outline their large slip areas. Therefore, I suggest that both coseismic slip areas and after-slip areas of large earthquakes can estimate from the space-time changes of small repeating earthquakes.

Some of small repeating earthquakes are burst-type sequences which occur only after the 2011 Tohoku earthquake. Observed seismograms may be distorted by the multiplicity of the seismic waves to come from various places, the seismic velocity changes at the propagation path or site, or changes of physical properties at the plate interface. Other repeating sequences, which classify in continuous type conventionally and are not detected after the 2011 main-shock, seem to be included in earthquake clusters influenced for the recurrence cycle of the larger earthquake. We should pay attention to future activities to investigate whether physical property at the plate interface has changed by the effect of inter-plate large slip and stress changes.

Keywords: The 2011 off the Pacific coast of Tohoku earthquake, small repeating earthquake