SSS24-04   Room:315   Time:May 1 16:30-16:45

Location of early aftershocks of the 2011 Tohoku-oki Earthquake using seismogram envelopes as templates

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The location of early aftershocks is very important to estimate the initial size of mainshock fault, because the aftershock zone generally extends with time. However, the location of early aftershocks is often difficult due to the long-lasting coda wave of mainshock and successive occurrence of aftershocks. To overcome this situation, we developed a location method using seismogram envelopes as templates. During the process of location, we firstly calculate the cross-correlation coefficients between a continuous (target) and template envelopes, and obtain time series of station-averaged cross-correlations for all templates. We then search for templates (initial location) in the descending order of cross-correlations in a time window excluding the dead times around the previously detected events. The third process is the relative event location that accounts for the lag times between actual and template envelopes. We applied the method to the early aftershock sequence of the 2011 Off the Pacific Coast of Tohoku Earthquake (Mw = 9.0). In a time window of 30-minutes just after the mainshock, we could locate 22 events in 8 Hz band by using 96 templates recorded at 33 Hi-net stations. The number of located events by the JMA is 13. Though we should carefully examine the location of detected events, we conclude that the proposed detection method works adequately even just after the mainshock of large earthquake.

Keywords: early aftershocks, template, envelope, Off the Pacific Coast of Tohoku Earthquake