Automatic hypocenter determination for the 2018 Hualien earthquake sequences

*Masumi Yamada[1], Dayi Chen[2], Koji Tamaribuchi[3]

1. Disaster Prevention Research Institute, Kyoto University, 2. Central Weather Bureau, Taiwan, 3. Meteorological Research Institute

We applied an automatic hypocenter determination algorithm to one-day continuous Hualien earthquake dataset, and evaluated its performance by comparing to the manual catalog. The Central Weather Bureau (CWB) in Taiwan is in charge of making earthquake catalog. They manually cut the event waveforms from the continuous seismic data, and locate an earthquake. Due to the increase of seismicity after the 2018 Hualien earthquake, CWB tried to incorporate a fully automatic hypocenter determination algorithm.

We used continuous waveforms of the Hualien earthquake on February 6, 2018 at 192 stations, and applied Phase combination Forward search method (PF method) based on the Bayesian estimation (Tamaribuchi 2018, EPS). The event detection is fully automated: P-wave arrival time is detected by Tpd method (Hyldyard et al., 2008) with parameter tuning for small earthquakes. When 3 stations out of 10 predefined nearby stations are triggered within theoretical P-wave arrival times among stations, it is defined as an event detection. The PF method determine the hypocenter location by choosing the optimal combination of phases from the candidate arrival times. The most optimal location is determined based on the likelihood function with phase arrival times and amplitudes of 5 s P-waves.

We evaluated the performance of the automatic catalog by comparing with the manual catalog made by CWB. Before the mainshock, the automatic method detected about 72% of the catalog event. It also detected about 100 earthquakes not included in the manual catalog. After the mainshock, the detection performance decreased due to the later phase of the mainshock and active aftershocks. The automatic method detected about half of the manual catalog. Although the performance decreased after the large earthquake, it is still useful to recognize the distribution of aftershocks in real-time without any manual processing. The automatic method also helps the manual hypocenter determination by providing the initial location estimate.

Keywords: Hualien earthquake, Automatic hypocenter determination, Earthquake, PF method