Determination of earthquake magnitudes using duration of high-frequency seismic signal and maximum displacement amplitudes: application to the February 6, M7.8 and M7.5 Turkey earthquakes

We applied the magnitude determination method of Hara (2007) to the February 6, M7.8 Turkey earthquake (the origin time: 01:17:35 UTC; the location 37.174°N 37.032°E depth 17.9 km after USGS) and the February 6, M7.5 Turkey earthquake (the origin time: 10:24:49 UTC; the location 38.024°N 37.203°E depth 10.0 km after USGS). In this method, an earthquake magnitude is calculated using high-frequency seismic signal duration, the maximum displacement during high-frequency seismic signal from the arrival time of a P-wave, and the epicentral distance. The duration of high-frequency seismic signal is estimated through band-pass filtering of first arriving P-waves.

Figure 1 shows an example of measurements of high-frequency seismic signal duration for the M7.8 event. The median of the measured durations is 151.6 sec. The estimated magnitude is 7.87, which is consistent with M_{ww} 7.8 from USGS W-Phase Moment Tensor solution and M_w 7.8 from the Global CMT solution.

Figure 2 shows an example of measurements of high-frequency seismic signal duration for the M7.5 event. The median of the measured durations is 25.5 sec. The estimated magnitude is 7.44, which is consistent with M_{ww} 7.5 from USGS W-Phase Moment Tensor solution, and a little smaller than M_w 7.7 from the Global CMT solution.
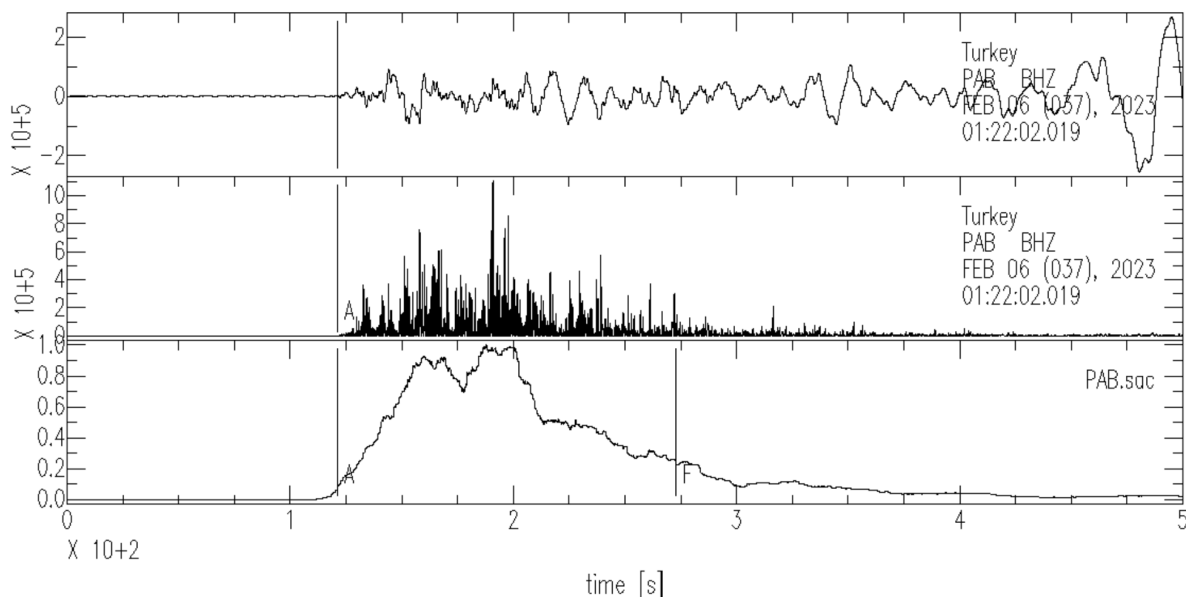

Fig. 1. An example of measurements of high frequency seismic signal duration for the February 6, M7.8 Turkey earthquake. The upper, middle and lower traces are an observed seismogram, the squares of the band-pass (2-4 Hz) filtered seismogram, and its smoothed time series (normalized by the maximum value), respectively. "A" and "F" in the lower trace denote the arrival of P-wave and estimated end of high frequency seismic signal, respectively.
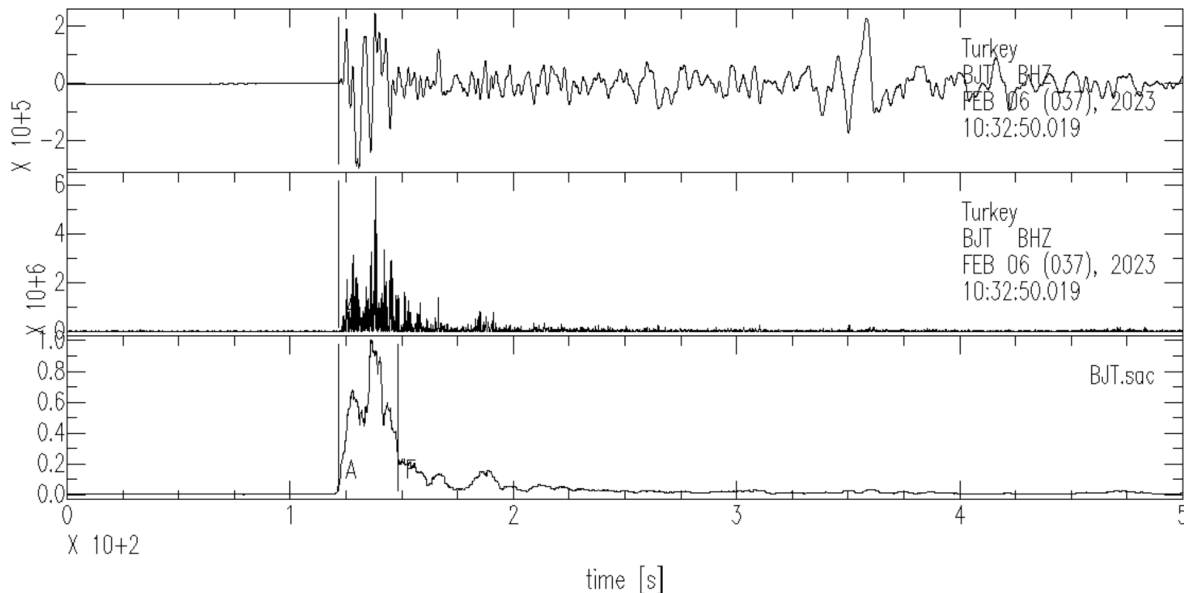
Fig. 2. An example of measurements of high frequency seismic signal duration the February 6, M7.5 Turkey earthquake. The upper, middle and lower traces are an observed seismogram, the squares of the band-pass (2-4 Hz) filtered seismogram, and its smoothed time series (normalized by the maximum value), respectively. "A" and "F" in the lower trace denote the arrival of P-wave and estimated end of high frequency seismic signal, respectively.

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