Estimation of source rupture process during the 2018 Shimane-ken seibu earthquake using strong motion data

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1. Introduction

The 2018 Shimane-ken seibu earthquake (Mw5.6) occurred in the western part of Shimane-prefecture, Japan, on April 9, 2018. The maximum seismic intensity with 5 upper was observed at Ohta city. PGA of 564 gal is observed at the SMN006 station. We estimated the source process of this earthquake by the waveform inversion using the strong motion data.

2. Estimation of rupture area from the waveform inversion

We analyzed the slip distribution during this earthquake using the multi-time window linear waveform inversion method (Sekiguchi et al., 2000). The data sets used for the inversion analysis were velocity waveforms of S-waves parts at 13 stations (KiK-net, K-NET). The Green's functions were calculated using the one-dimensional velocity structure models by the discrete wavenumber method (Bouchon, 1981) with the reflection and transmission matrix method (Kennett and Kerry, 1979) at the stations. A fault plane was assumed referring to the aftershock distribution and the moment tensor solution determined by F-net data.

First, in order to estimate the rupture area, we analyzed the waveform inversion in target frequency 0.1-0.5Hz. The fault plane is divided into 36 subfaults of 2.0km×2.0km. The temporal moment release history from each subfault is modeled by a series of 3 smoothed-ramp-functions with a rise time of 1.0 second each separated by 0.5 second. The estimated rupture area was trimmed by criteria of Somerville et al. (1999). The trimming result removes one column of the north edge of rupture area. Seismic moment, area, rupture velocity and average slip are estimated 4.67 $\times 10^{17}$Nm,126km^2, 2.7km/s and 0.11m, respectively. The rupture area was approximately three times larger than the scaling relationship of rupture area vs seismic moment from Irikura and Miyake (2001).

3. Extraction of asperity from the waveform inversion results

Next, in order to extract of asperity from slip distribution, we analyzed the waveform inversion in the frequency range of 0.1-1.0Hz. The rupture area is divided into 56 subfaults of 1.5km×1.5km. The temporal moment release history from each subfault is modeled by a series of 6 smoothed-ramp-functions with a rise time of 0.6 second each separated by 0.3 second. A large slip area is constructed in the proximity of the hypocenter.
The asperity and high rate area (HRA) were extracted from the slip distribution by the criterion of Somerville et al. (1999) and Yoshida et al. (2005), respectively. Seismic moment and area are estimated 2.23×1017Nm and 27km2, respectively. The area and location of the asperity and the HRA are estimated to be almost the same. On the other hands, the asperity was overestimated in comparison with the scaling relationship of asperity are vs seismic moment from Irikura and Miyake (2001).

4. Conclusion

We estimated source process of the 2018 Shimane-ken seibu earthquake (Mw 5.6) form the waveform inversion using the strong motion data. The asperity and the HRA of this earthquake are collocated with nearly the same area. On the other hands, the rupture area and the asperity were overestimated corresponding to scaling law from Irikura and Miyake (2001). The rupture area data of earthquake of Mw6 class vary widely in the scaling law from Irikura and Miyake (2001). Therefore, it is necessary to consider about earthquake of Mw6 class.

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