Spatial distribution of fault slip during the 1978 Miyagi-oki earthquake -Joint inversion of JMA and SMAC strong motion records-

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Spatio-temporal distribution of fault slip during the 1978 Miyagi-ken-oki earthquake is investigated from strong motion records. In this region, large events with Japan Meteorological Agency (JMA) magnitude 7.5 were periodically occurred with an interval of 40 years, and the next event is anticipated in the near future. We collected and digitized the strong motion records obtained by JMA 50-52 type seismographs at 7 stations surrounding the focal region of the 1978 event. The amplitudes of JMA 50-52 type seismographs at 3 stations close to the epicenter are saturated after the onset of S-waves. First of all, we carry out the waveform inversion by using the displacement records at 7 JMA stations. The width and length of the fault plane is assumed to be 40 km and 80 km, respectively, with dipping angle of 20 degree. The fault plane is divided into 5 for strike direction, 10 for dip direction, and 50 sub-faults are considered. Rupture velocity is assumed to be 3.2 km/s after several trials. Large slip area is appeared at western side of the fault plane, and seismic moment Mo with 2.2E27 dyne-cm is obtained. Moment magnitude Mw converted from Mo is 7.5. We also performed the waveform inversion by using the unsaturated displacement records at 4 JMA stations alone. These stations are located relatively far from the fault plane. The inverted slip distribution shows almost the same as the results by using the 7 stations including the saturated displacement records. This fact indicates that the near-fault saturated displacement records do not contribute to the inverted slip distribution. In other words, the obtained fault model may account for far field records, but it is uncertain that the fault model can explain the near fault ground motions that are important from earthquake engineering point of view.

To solve this problem, we collected the unsaturated acceleration records at 3 stations in near fault region obtained by SMAC type seismograph. SMAC is an abbreviation of Strong Motion Acceleration Committee. Although the trigger time of acceleration records is unknown, we deduce the S-wave on-set time from nearby JMA station records by considering the difference of travel time between the two stations. Joint inversion by combining 4 JMA and 3 SMAC station records is performed. As for the SMAC site, velocity waveforms numerically integrated from acceleration records are used in the inversion. Comparing the inverted slip distribution with that of JMA station records alone, the slip at western side of the fault plane shows larger amplitude. In addition, relatively larger slip can be found at northeastern side of the fault plane and in the vicinity of the rupture initiation point. Mo estimated from the fault slip is 3.5E27dyne-cm, and Mw is 7.6.

This fault model can explain not only the two pulses observed on velocity waveforms in near fault region, but also the displacement waveforms in far field regions.