Source model and strong ground motion simulation for the 2016 Mid Tottori prefecture, Japan, earthquake (M_w6.2) based on the empirical Green’ s function method

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At 14:07 Japan Standard Time (JST=UT+9) on October 21, 2016, an inland crustal earthquake (M_{JMA}6.6, M_w6.2) with strike-slip occurred in the mid Tottori prefecture, Japan. Strong ground motions with a peak acceleration 1381 cm/s^2 were recorded at one of the nearest strong motion stations, TTR005, about 10 km away from the hypocenter. For understanding the physical mechanisms of strong motion generation processes during this event, we estimate the source model composed of strong motion generation areas (SMGA) to explain the observed strong motion records in broadband frequency range between 0.3 and 10 Hz.
In this study, we use the empirical Green’ s function method to simulate the broadband strong motion records at 18 sites of K-NET and KiK-net located around the source region. The observed ground motion records of M_w4.1 event (element event) occurring at 12:12 on October 21, 2016, are used as the empirical Green’ s functions. For an objective estimation of corner frequencies for the target and element events, we apply the source spectral ratio fitting method (Miyake et al., 1999). From the obtained corner frequencies, scaling parameters *N* and *C*, which required for the empirical Green’ s function method of Irikura (1986), are determined. Then, the parameters of each SMGA (e.g., the size, rupture starting point, rise time, rupture velocity, and relative location from the hypocenter) are estimated by trial and error method. Since we can clearly see the S-wave portion consists mainly of two wave packets for observed waveform at TTR005, we assume two squared SMGAs on the fault plane, and will call the SMGA that generates the first S-wave packet SMGA1 and that generating the second SMGA2.
As a result, we construct the source model with SMGA1 located including the hypocenter and SMGA2 located north from the hypocenter. The sizes of SMGA1 and 2 are 30.3 and 19.4 km^2, respectively. The stress drops of both SMGAs are estimated to be same as 16.6 MPa. Rupture propagations within SMGAs bring forward and backward rupture directivity effect in ground motion observed at TTR005 that is located near-source fault: The forward directivity effect by SMGA1 contributes to the pulse-shape wave packet for fault-normal component observed at TTR005. On the other hand, the random-shape wave packet is generated by the backward directivity effect from SMGA2. However, the amplitude of pulse-shape wave from SMGA1 is not as large as that expected from the ground motion prediction equation (GMPE), because the rupture within SMGA1 propagates bilaterally from the center of SMGA1 to both north and south directions. For other sites located around the source region, the SMGA1 mainly reproduces the observed acceleration, velocity, and displacement waveforms fairly well. Thus, the near-source strong ground motion observed at TTR005 gives us the insight into the possiblity for the presence of SMGA2. In order to improve the reproducibility of observed ground motions, the parameters of SMGAs need to be examined objectively in more detail.

Acknowledgements: We use the hypocentral information catalog of JMA, the moment tensor catalog by F-net, and the strong motion data from K-NET, KiK-net, and F-net provided by NIED.

Keywords: The 2016 Mid Tottori prefecture earthquake, Strong motion generation area, Empirical Green’ s function method

