Source inversion using empirical Green's functions for the 2016 Tottori earthquake (Mj 6.6)

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During the 2016 Tottori earthquake on October 21, the peak ground accelerations at K-NET Kurayoshi (TTR005) reached 1381 gal. Since the station is located just above faulting area, spatial and temporal source rupture process would strongly affect the strong motions at TTR005. The response spectrum calculated from the strong motion record of TTR005 shows relatively large amplitude in the frequency range higher than 1 Hz, therefore the analysis of source process should take into account such higher frequency ground motions. In this study the inversion method using empirical Green's functions is adopted for the source modeling of the Tottori earthquake in order to evaluate broadband ground motions.

From the aftershock distribution and CMT solution of the main shock estimated by F-net, we assumed the left-lateral fault plane model with the strike in the NS direction and the nearly vertical dip angle. Observed records from the aftershocks of Mj 4.0 occurring just beneath TTR005 were used for the empirical Green's functions. Velocity motions of two horizontal components for KiK-net subsurface stations and near-source K-NET stations are used for the source inversion in the frequency range from 0.2 to 2 Hz. Once the moment density distribution on the fault plane is estimated, the effective stress is searched with moment density simultaneously by using the histogram of estimated model parameters as prior probability distribution for the inversion procedure.

The obtained source model indicates large slips mainly in the shallow area around the hypocenter and secondary large slips just beneath TTR005 station, which is located about 5 km north of the epicenter. Estimated rise time on the fault plane is as short as 1.6 seconds at maximum. From the slip distribution of the main shock, it suggests that strong motions at TTR005 area radiated from these two SMGAs sequentially. In case of inversion analysis without records of TTR005, the secondary large slip does not vanish in the estimated source model.

The simultaneous inversion of effective stress and moment density revealed that the shallow large slip area beneath TTR005 shows relatively small effective stress, while the asperity near the hypocenter implies also large effective stress. It is considered to be consistent with the empirical relation that shallow SMGA tends to show small stress drop compared to deep SMGA.

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