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Strong motions from the 2007 Niigata-ken Chuetsu-oki earthquake based on characterized source model with super-asperity

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Strong motion records of the 2007 Niigata-ken Chuetsu-oki earthquake were obtained at several observation stations in the Kashiwazaki-Kariwa (KK) NPP site. Three distinctive pulse waves are observed in common among these main-shock records, thus they were considered to be radiated from three asperities on the fault plane. On the other hand the observed velocity amplitude of third pulse shows large variation among stations distributing within several hundred meters. Since the base mat of the reactor building where the seismometer is installed is located on bedrock, such variation of observed ground motions cannot be attributed to local site response estimated from shallow subsurface structure. Shiba et al. (2011) calculated the third pulse by using the finite difference method with 3-D deep subsurface velocity model; however the difference of pulse amplitude could not be sufficiently derived by assuming characterized source model. In this study we examine the detailed wave propagation from the asperity generating third pulse (i.e. third asperity) to KK-NPP site by dividing the asperity area into small sub-areas, and find that the variation of third pulse's amplitude becomes apparent when the seismic waves are radiated from only the southwestern part of the asperity. Source inversion analysis simultaneously searching the slip and the peak slip rate also shows locally high slip rate at the southwestern corner of the third asperity. Thus we assume the characterized source model having the super-asperity with relatively high stress drop on the southwestern corner of the third asperity, and carry out the broadband strong-motion simulation at the KK-NPP site. As a result the observed third pulse waveforms for the EW component are successfully reproduced including the quantitative variation. However for the NS component the fit between the observed and the synthetic pulses are insufficient. In the characterized source model the spatial variation of the rake angle on the fault plane is not taken into consideration, and it might cause the different goodness of fit between two horizontal components.

Keywords: the 2007 Niigata-ken Chuetsu-oki earthquake, characterized source model, strong-motion simulation, super-asperity, source inversion