Source Process and Near-Source Ground Motions of the 2005 West Off Fukuoka Prefecture Earthquake

Kimiyuki Asano[1]; Wataru Suzuki[1]; Tomotaka Iwata[1]

[1] DPRI, Univ. Kyoto

1. Introduction

The 2005 West Off Fukuoka Prefecture Earthquake occurred on March 20, 2005. This earthquake brought severe disaster to Genkai Island in the Sea of Genkai. To understand the strong motion generation process of this earthquake, it is necessary to model the source based on observed records. We estimated a source rupture process of the 2005 West Off Fukuoka Prefecture Earthquake by the kinematic waveform inversion using strong motion records, and conducted a strong ground motion simulation.

2. Source Modeling

The methodology of the kinematic waveform inversion employed here followed Sekiguchi et al. (2000). Green's functions were calculated by the discrete wavenumber method (Bouchon, 1981) with the reflection and transmission matrix (Kennett and Kerry, 1979). One dimensional structure model ware assumed referring to Kawase et al. (2003) and logging data by K-NET and KiK-net for superficial layers. We used the S-wave portion of velocity waveforms that were bandpass-filterd between 0.05-1.0Hz, and we used 16 strong motion stations belonging to K-NET and KiK-net around the source region. A fault plane is assumed based on the moment tensor solution (Strike 122 deg, Dip 87 deg) by F-net and the aftershock distribution. The length and width of the assumed fault plane are 26km and 18km, respectively. The fault plane is divided into sub-faults of 2km x 2km. The rupture starting point is fixed at the hypocenter determined by the Institute of Seismology and Volcanology (ISV), Graduate School of Science, Kyushu University. The slip time-history at each subfault is expressed by six time-windows. One time window composes a smoothed ramp function having the rise-time of 1.0s, and time-window interval is 0.5s. We also include the spatio-temporal smoothing and rake-angle constraint following Sekiguchi et al. (2000). The appropriate smoothing strength is selected based on ABIC.
The obtained source model is rather complicated compared to that of the 2004 Mid Niigata Earthquake (e.g., Asano and Iwata, 2005). The slip near the rupture starting point was relatively small, and the large slip was observed at the southern and shallow part of the fault plane. Total seismic moment is $1.25\times10^{**19}$Nm (Mw6.7), and maximum slip is 2.8m. The first time-window front propagates at a velocity of 2.2km/s, which is almost equal to 65% of the shear-wave velocity assumed in the source region. The synthetic waveforms fit the observed ones fairly well although the pulsive wave at FKO006 are not well reproduced.

3. Strong Motion Simulation

We carried out a strong motion simulation by the finite difference method (Pitarka, 1999). We assumed a one-dimensional underground structure model with the lowest S-wave velocity of 2.0km/s. Large ground motion area was observed above the fault plane. At Genkai Island and Shikanoshima Island which are close to the south-east portion of fault plane, relatively larger ground motions were estimated, that can be interpreted to the source rupture directivity effect of the asperity of south-east portion of the fault plane.

Acknowledgements: We are appreciating to the K-NET and KiK-net operated by the National Research Institute for Earth Science and Disaster Prevention (NIED) for releasing the strong motion records, to the F-net by the NIED for providing moment tensor solutions, and to the ISV for providing the hypocentral information.