Source model of the 1997 Kagoshima-ken Hokuseibu earthquake for the intermediate period range

Ken Miyakoshi[1], Anatoly Petukhin[2], Tomotaka Iwata[3], Haruko Sekiguchi[4]

[1] G.R.I., [2] GRI, [3] DPRI, Kyoto Univ., [4] Active Fault Research Center, GSJ/AIST

1.Introduction

We estimated the slip model of recent three M6 class earthquakes in Japan with waveform inversion using records of K-NET.We recognized that asperity parameters obtained from these three earthquakes agree with the empirical relation deduced by Somerville et al. (1999). The target of the inverted slip models compiled by Somerville et al.(1999) were velocity or displacement waveform for the periods range over 1 s. To estimate source model, appropriate for the prediction of strong ground motion for the intermediate period range around 1 s, we should use more sophisticated, modified structure model for calculation of the Greens functions. Here, waveform inversion is performed for the slip model of the 1997 Kagoshima-ken Hokuseibu (March 26) for the intermediate period range using modified structure model based on after shock data.

2.Modification of structure model

For shallowest part of about 20 m or 100 m, we used velocity model specific for each satiation by K-NET or KiK-NET, while for deeper part more than 500 m, we assumed the same velocity model for all stations. We modified velocity model for depth part of about 20 m – 500 m. At first step, we applied the radial to vertical spectral ratio (R/V spectral ratio) method and estimated 5 initial models for each station. At this step, average R/V spectral ratio of the S-wave part of the aftershock data in the period range 0.67 s - 1.42 s were inverted nonlinearly (by the Genetic Algorithm) for structure parameters. At second step, the best model among initial models was selected by comparing the synthetic and observed velocity waveforms of the S-wave part. In some cases, to get better waveform fitting, additional correction of the model was made by the trial-and error method.

3. Waveform inversion

Using the modified structure model, we inverted the velocity waveform in the period range 0.67 s - 10.0 s to obtain a source model using the multi-time linear waveform inversion (Hartzell and Heaton, 1983). To carry out the detailed analyses of the rupture process, we assumed rupture area (13km x 11km) according to the slip model obtained by Miyakoshi et al.(2000).Rupture area is subdivided into 1.0 km x 1.0 km. Slip history on each subfault is modeled using two smoothed ramp time function with 0.5 s rise time, each 0.25 s apart.We constrained the variation of the rake angle to 0+-45 degree and set the first time window propagation velocity at 2.5 km/s. The final slip distribution is obtained by waveform inversion. Base on inverted slip model, we estimated seismic moment Mo = 1.05 e+25 dyne*cm. We extract asperity area following the criterion by Somerville et al. (1999). The size of combined asperity area is 34 km^2 and average asperity slip is 45 cm. The size and location of asperity area are corresponded with those extracted from slip model with waveform inversion for the periods range over 2 s. Values of these asperity parameters correlate well with the empirical scaling relation between the asperity parameters and the magnitude obtained by Somerville et al. (1999).

This study was performed through Special Coordination Funds, titled 'Study on the master model for strong ground motion prediction toward earthquake disaster mitigation', of the Ministry of Education, Culture, Sports, Science and Technology of the Japanese Government.

Acknowlegment

We deeply appreciate National Institute of Earth Science and Disaster Prevention for providing the K-NET and KiK-NET data.