Source inversion using empirical Green's functions for the 2016 Kumamoto main shock (M 7.3) and two large foreshocks (M 6.5, M 6.4)

*Yoshiaki Shiba[1]

1.Central Research Institute of Electric Power Industry

On April 14, 2016, inland earthquake of M 6.5 occurred at Kumamoto prefecture and seismic intensity scale 7 were recorded near the epicenter (Mashiki town). After that another event of M 6.4 and the main shock of M 7.3 have successively occurred on 15 and 16 April. During the main shock Mashiki town and Nishihara village suffered intensity 7 again. Here we call the first M 6.5 event and second M 6.4 event as foreshock 1 and 2 respectively, and the rupture process of these three events are estimated by using simulated annealing with empirical Green's function.
Foreshocks 1 and 2 are considered to rupture along the northern part of Hinagu fault according to the estimated fault mechanisms by F-net and aftershock distribution. On the other hand the main shock ruptured Futagawa fault. All events show the right-lateral strike-slip faulting with almost vertical dip. Based on these information we assume each fault plane model. For empirical Green's functions aftershock records from the M 4.8 and M 4.9 events are adopted, both of which occurred near the Hinagu fault since suitable data from the aftershocks at Futagawa fault were not available. Strong-motion records of K-NET and KiK-net stations located within about 50 km from the epicenters of the events are utilized for the inversion analysis. Observed acceleration records are band-pass-filtered in the frequency range from 0.1 or 0.2 Hz to 2 Hz, and numerically integrated to derive velocity motions. Then two horizontal S-wave portions are inverted to obtain the source models.
Consequently the estimated source model of the foreshock 2 shows a main slip on the southern part of the fault plane, which implies the spatially complemental relation with the slip distribution of the foreshock 1. Foreshock 1 also shows rather large slip just beneath the Mashiki-town area, where the seismic intensity 7 was reported. For the main shock we see the relatively large slip on the shallow part along the Futagawa fault where surface deformation was observed. The largest slip area beneath the west part of the outer rim of Mt. Aso is consistent with the aftershock gap area.

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