

Strong Motion Simulation of the West off Fukuoka Prefecture Earthquake of 2005 by a Single Asperity Model

Naoko Umeda[1]; Hiroshi Kawase[2]; Shinichi Matsushima[3]

[1] Human-Environment Studies, Kyushu Univ.; [2] Faculty of Human-Env. Studies, Kyushu Univ.; [3] SIT, Shimizu Corp.

The source inversion of the West off Fukuoka Prefecture earthquake is carried out by several research teams, and they obtained the results similar to each other in a global sense. However, they are not all in good agreement in their details. It is an important subject to find a source model that can explain up to a short period based on a source inversion studies. So, in this research, the dislocation model obtained by Suzuki and Iwata (2006) is taken as an initial model, then calculation of a theoretical waveform is performed with a three-dimensional finite difference method based on the basin structure by Nakamichi and Kawase (2002), and comparison with observed waveforms is performed in order to propose a new dislocation model.

The finite difference method of Graves (1996) is adopted with the grid point interval of 0.08km and the time interval of 0.004s (5000 steps for search, 6250 steps for the final model). The analysis region is a rectangular block with a depth of 20km, a width of 36km, and a length of 76km, which is rotated 45 degrees in an anti-clockwise direction. The points for comparison with observed record are 10 observed points of K-NET in the region and local seismograph data (operated by Fukuoka Pref.). The three-dimensional basin structure in the region was generated as an extension of the model proposed by Nakamichi and Kawase (2002).

Because of the direction of observed points relative to the hypocenter in the initial model the strong motions will be controlled by the backward directivity. However, the pulse-like waveforms are clearly observed, which suggests the strong influence of forward directivity. Then, in order to investigate the influence of the position relative the rupture initiation point, comparison and examination of waves were done using the scenario 2 and 3 where a rupture initiation position differs from the initial model, the scenario 1. The scenario 2 placed the initiation point right in the middle of the asperity so that influencing of directivity might be neutral, and the scenario 3 on the northwest side so that the influence of forward directivity might come out at stations in Fukuoka. However, the depth of the initiation point starting is not changed. Consequently, the first pulse is not clear in the scenario 1 and the scenario 2, but in the scenario 3 we can get a clear directivity pulse. Thus a scenario 3 seems suitable for the rupture initiation position.

Although the first pulse is reproduced by the scenario 3, the whole wave duration seems to be too long. As the main cause of this we consider that the assumed asperity may be too large. Then, the scenario 4 is propose in which we cut the upper and lower sides by 1/4, without changing the position of the rupture starting point of a scenario 3. As a result the scenario 4 creates relatively short duration and reproduced the later part very well.

Although the first pulse and the duration time were successfully reproduce by the scenario 4, the return waveform and the later part do not match. This is probably due to the slip velocity. The slip velocity function of scenarios 1 to 4 is that the velocity falls gradually after the first peak (3,115 cm/s), so that the return waveforms cannot be reproduced. Then, we compare the model of a scenario 4 with two other slip velocity functions. We obtained the final slip velocity function in which we set the velocity level of the tail part to be one half of the first peak velocity.

Finally, the seismic moment was assumed to be one half of the initial model in consideration of the size of asperity, and then theoretical FDM calculation was performed. At the final stage strong motion evaluation was performed by considering the amplification of the surface soil at observation points (Nejime, 2006). As a result good reproduction was completed except for the seismogram site in Jonan-ku.