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Source Modeling of Sanriku-oki 2011(Mw7.6) Outer Rise Earthquakes Using the Empirical Green's Function Method

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1. Introduction

Just after the Tohoku Pacific ocean earthquake, at 15:26JST outer-rise earthquake (Mw 7.6) occurred in Sanriku?oki area. Outer-rise earthquakes frequently occurred in this area after this. The largest outer-rise earthquake is the 1933 Sanriku-oki earthquake in this area. It was difficult to recognize the character of strong ground motion of outer-rise earthquakes before this earthquake. However after this earthquake, we can study with rich strong ground motion data. It is important to grasp the seismic source characteristics of this earthquake not only for understanding the 1933 Sanriku-oki earthquake but also for next large outer-rise earthquake. In this study, we make the source model of this earthquake using the Empirical Greens Function (EGF) method and compare the parameters with empirical formulas.

2. Data

We use an outer-rise earthquake (05 May 2011 23:58JST Mw6.1) as element earthquake of EGF. Reason of this selection is this earthquake occurred near from target and it has similar source mechanism. Strong motion data which we use is delivered from KiK-net and Institute of Seismology and Volcanology, Faculty of Science, Hokkaido University.

3. Source modeling of EGF

We assume a rectangle strong ground motion generation area with a constant slip and stress drop to simulate wide-band strong-motion with simple fault model. In this case, seismic waves are generated only from strong motion generation area (SMGA) not from background area. The fault plane is determined based on focal mechanism of the target event and aftershocks distribution (Obana et al., 2012). The number to divide the SMGA into subfaults (=N) and the ratio of the stress drop of the target event to the element one (=C) are estimated with Yokoi and Irikura (1991). Under these setting we carry out grid-search analysis to get the size of SMGA, epicenter, rise time and rupture velocity. The epicenter is determined in south part of fault plane. This fact is related to directivity effects owing to the northward propagation of rupture understanding from observed wave forms. The model explains the envelope of acceleration, velocity and displacement records.

4. Combined SMGA and Stress Drop

We compare the SMGA parameters between this outer-rise earthquake and the shallow intraplate earthquakes in the Pacific Plate. The relationship between the combined SMGA and the total seismic moment is similar to the intraslab earthquakes (Sasatani et al., 2006). The stress drops for this earthquake are also similar to those for the intraslab earthquakes. Therefore the SMGA parameters of the outer-rise earthquake are similar to those of the intraslab earthquakes despite the shallow focal depths of the former events.

Acknowledgement

We use strong motion data from NIED (National Research Institute for Earth Science and Disaster Prevention) and Institute of Seismology and Volcanology of Hokkaido University. And we use the focal mechanism from GCMT.

Keywords: Outer-rise Earthquake, Source Characteristics, Empirical Green's function method