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MIS036-P41 Room:Convention Hall Time:May 26 14:15-16:15

Source Model for Generating Strong Ground Motions during the 11 March 2011 off Tohoku, Japan Earthquake

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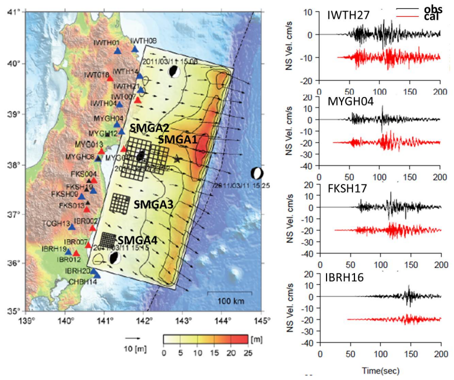
1. Introduction : This event occurred on the boundary between the Pacific and the continental plates. The focal mechanism showed a reverse fault with a compression axis in a WNW-ESE direction. The source fault roughly 400 km long and 200 km wide with strike of 193deg and dip 10deg from aftershock distribution within 24 hours and CMT solution by Japan Meteorological Agency (JMA). Strong ground motions at more than 1000 stations of K-NET and KiK-net belonging to NIED and other organizations were widely observed all over Japan including near-source areas along the Pacific coast of Tohoku. Inland areas from Miyagi to Tochigi were struck by very large ground motions as high acceleration of more than 1000 gals were recorded at 20 stations (NIED, 2011).

2. Strong ground motions simulation : We try to estimate a source model for generating strong ground motions from this earthquake from a comparison of the observed records of the mainshock and synthesized motions based on the characterized source model using the empirical Green's function method. The characterized source model consists of several strong-motion-generation-areas (SMGA) with large slip velocity or high stress drop, in entire rupture area of the earthquake. First, we specify the locations of the SMGAs by the back-propagation method by Kurahashi and Irikura (2010). The acceleration records at stations around a line from north to south show several isolated wave-packets arriving from different origins on the source fault. Such origins are considered to be the strong motion generation areas (SGMA). We identified four wave-packets in the observed seismograms, which were arriving from four SMGAs on the source fault. The onsets of the wave-packets are found to propagate with a certain velocity. We can estimate roughly the locations of the SMGAs based on the onset times of the wave-packets at many stations.

The synthetic seismograms from each SMGA are calculated, by specifying the area and starting point of the SMGA using the empirical Green's function method (Irikura, 1986). To calculate ground motions from each SMGA, the area of the SMGA is divided into equal-sized square subfaults, the area of which is set to be the same as the aftershock area. We assumed that the strong ground motions are generated only from the SMGAs and not from the background area because we are concerned primarily with the acceleration and velocity motions, which are predominantly controlled by short-period motions from the SMGAs. The ground motions from the source area of the mainshock are calculated summing those from the SMGAs considering the rupture velocity from the hypocenter to the starting points of the SMGAs.

The best-fit characterized source model consisting of four SMGAs (SMGA 1, SMGA 2, SMGA 3, and SMGA 4) is obtained as shown in the left of Figure 1. The area and starting point of each SMGA is shown by rectangle shape and star mark, respectively. The observed and synthetic ground motions at IWTH27, MYGH04, FKSH19 and IBRH16 from the best-fit source model are shown in the right of Figure 1. The agreement between the observed and synthetic ones is satisfactory at all of stations.

3. Dissection : The slip distributions from the waveform inversion using the long-period (8 s to 50 s) motions of the strong motion data are shown together with SMGAs in the left of Figure 1. There extend main slip distribution east of the hypocenter toward the Japan Trench zone, consistent with the slip distributions from the tsunami data. However, short-period ground motion simulation in this method shows large amplitude in forward rupture direction because of directivity effect, but less amplitude in backward rupture direction. This is the reason why the SMGAs have only source areas west to the starting point of each SMGA. Therefore, the areas of the SMGAs in this analysis should be examined more carefully if the strong motion data were available in the offshore east to the source fault.



IWTH01
IWTH08
2011/03/11 15:08
IWT018
IWTH14
IWTH21
IWT007
IWTH04
MYGH04
SMGA2
SMGA1
MYGH12
MYG013
MYGH08
FKS004
FKSH19
FKSH09
FKS013
SMGA3
TCGH13
IBR002
SMGA4
IBR007
IBRH19
IBR012
IBRH20
CHBH14
2011/03/11 15:25
100 km
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0 5 10 15 20 25
IWTH27
obs
cal
MYGH04
FKSH17
IBRH16
NS Vel. cm/s
Time(sec)