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Tsunami simulation for the 2011 Tohoku earthquake using long-period source model

Anatoly Petukhin[1*], Kunikazu Yoshida[1], Ken Miyakoshi[1], Kojiro Irikura[2]

[1]Geo-Research Institute, [2]Aichi Institute of Technology

On March 11, 2001, M9.0 earthquake has occurred east off the Pacific coast of Tohoku, as a result of thrust faulting on the interface of plate boundary between the Pacific and North American plates. This earthquake generated tsunami of 20-30m high and strong ground motions up to 1000gal and more. This is one of the best geophysically-recorded great earthquakes and due to this numerous source models were generated using teleseismic, GPS, strong ground motion and tsunami data. The question we addressing here is the possibility of evenly good simulation of observed ground motions and tsunami using the same source model.

Here we used rupture process of the 2011 Tohoku earthquake inverted by the multi-time window linear waveform inversion method using the long-period (20s and more) strong-ground motion data (Yoshida et al., 2011, EPS submitted). A single planar fault model of 480 km in strike and 160 km in dip is assumed. The rupture velocity inferred to be slower than 2.2 km/s at early stage of the rupture process. The inverted slip distribution shows a large asperity with a maximum slip of 29 m which is located on the shallower part of the fault plane, slightly north of epicenter. This is consistent with the tsunami source model of Fujii and Satake(2011). But in contrast to the Fujii and Satake(2011) source model the slip distribution is small on the fault plane south of epicenter.

We simulated tsunami using Bousinessq type model of Watt et al. (2003), and source model of Yoshida et al. (2011) and compared it with observation data and with results of simulation using other source models. Without any asperity on the fault plane south of epicenter, we have simulation results that fit observation tsunami data on the coast of the Iwate and Miyage prefectures. On the coast of Fukushima prefecture, south of epicenter, simulated amplitudes are smaller than observed ones. Source models having asperity in southern part of source (including model of Fujii and Satake,2011) produce tsunami that could better fit observations. In order to get model that describes both long-period strong ground motions and tsunami amplitudes similarly good, by try and error method we modify model of Yoshida et al.(2011).

Keywords: 2011 Tohoku earthquake, tsunami simulation, long-period ground motion, earthquake source model