SSS28-09   :303   :5   23   09:15-09:30

3   2011

Rupture Process of The 2011 Tohoku-Oki Earthquake Inferred by a Waveform Inversion Using 3D Green's Tensor Synthetics

Taro Okamoto[1*], Hiroshi Takenaka[2], Tatsuhiko Hara[3], Takeshi Nakamura[4], Takayuki Aoki[5]

[1]Dept. Earth Planet. Sci., Tokyo Institute of Technology, [2]Dept. Earth Planet. Sci., Kyushu University, [3]IISEE, Building Research Institute, [4]JAMSTEC, [5]GSIC, Tokyo Institute of Technology

The March 11, 2011 Tohoku-Oki earthquake (GCMT Mw9.1) generated strong ground motions and large tsunamis, and caused devastating damages in the northeastern Japan. Estimating the rupture process of this event is very important for understanding the geophysical condition of the generation of megathurust earthquakes and the mechanism of the excitation of the large tsunamis.

We present the rupture process analysis of the 2011 Tohoku-Oki earthquake by using a non-linear full-waveform inversion method in which the teleseismic and the strong motion seismograms are jointly used. We incorporate the effect of the near-source laterally heterogeneous structure on the synthetic Green's tensor waveforms because the solution can be erroneous one if the effect is not considered (e.g., if only a flat layered structure is used) [1]. For the teleseismic P-wave synthetics we use a 2.5-dimensional finite-difference method [2]. For the strong motion synthetics we use a full three-dimensional finite-difference method that incorporates topography, oceanic water layer, three-dimensional heterogeneity and attenuation. Our simulation is accelerated by the use of hundreds of GPUs used in parallel [3]. We use a GPU supercomputer, the TSUBAME-2.0 in Tokyo Institute of Technology.

As a preliminary analysis we computed Green's tensor synthetic waveforms for 31 teleseismic and 15 strong motion components. We used 640 GPUs of the TSUBAME supercomputer for the calculation of each strong motion synthetics. The inferred slip distribution has large slips near and around the JMA epicenter and has relatively less slips near the trench: the major rupture apparently migrate toward the north of the epicenter and the maximum slip is about 40 m. We will present results by incorporating more strong ground motion records and discuss the effect of the choice of the Green's tensor waveforms on the solutions.

[1] Okamoto and Takenaka, Earth Planets Space, 61, e17-e20, 2009.
[2] Takenaka and Okamoto, in Seismic Waves, Research and Analysis, ed. Kanao Masaki, Intech, 2012.
[3] Okamoto et al, in GPU Solutions to Multi-scale Problems in Science and Engineering, ed. D.A. Yuen et al., Springer, 2013.

:   ,   , 3
Keywords: 2011 Tohoku-Oki earthquake, rupture process, 3D finite-difference method