Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

SSS25-P02 Room:Convention Hall Time:May 25 18:15-19:30

Reproducing the short-period seismic surface waves from subduction zone earthquakes based on large-scale simulation

OKAMOTO, Taro[1*] ; TAKENAKA, Hiroshi[2] ; HARA, Tatsuhiko[3] ; NAKAMURA, Takeshi[4] ; AOKI, Takayuki[1]

[1]Tokyo Institute of Technology, [2]Okayama University, [3]Building Research Institute, [4]JAMSTEC

The seismic-wave propagation from shallow subduction zone earthquakes is strongly affected by the heterogeneous structure: there are the thick layers with low-seismic wave velocities, such as the oceanic water and the sedimentary layers, and these layers are separated with three-dimensionally irregular interfaces. These heterogeneities affect both the excitation and propagation of the seismic waves. Therefore they must be considered in generating the synthetic waveforms for the waveform analysis of the earthquake sources and structural heterogeneities, otherwise the analysis could result in erroneous solutions [1,2]. In this paper we study the effect of the structure of the Japan trench on the strong-motion seismic waveforms, especially the surface waves, from a shallow subduction zone earthquake in connection with the analysis of the 2011 Tohoku-Oki earthquake (Mw9.1). We selected an small event (2003/11/1, Mw5.8) because this event occurred in the source area of the 2011 Tohoku-Oki earthquake, and has a similar mechanism (inter-plate thrusting) as that of the 2011 Tohoku-Oki earthquake. The strong-motion records (K-NET, KiK-net) were integrated to obtain velocity components. We assumed a three-dimensional structure model for the Japan trench by compiling models for topography [3], sediments [4], crust, and subducting plates [5,6]. We applied a GPU-accelerated finite-difference program developed by ourselves [7,8]. We used the TSUBAME-2.5 supercomputer in Tokyo Institute of Technology for the finite-difference computation. By using the 3D structure model, the strong-motion seismograms were well reproduced for a period band of 12-40 s. For periods shorter than around 10 s, however, the misfit of surface waves was large: the amplitudes of the synthetic surface waves were smaller than that of the observations. That is, the excitations of the short period surface waves from shallow earthquakes were not sufficient in the assumed 3D structure model. As an experiment we reduced the S-wave velocities of the oceanic sediments by 30 % and re-computed the synthetics. However, the fit between the observed and synthetic waveforms were not improved. We will discuss these results and present findings based on further experiments (e.g., results by modifying the thickness of the sediments).

References

[1] Okamoto, T. and Takenaka, H., *Advances in Geosciences*, **13** (Solid Earth), p.215-p.229, World Scientific Pubishing, 2009.
[2] Okamoto, T. and Takenaka, H., *Earth Planets Space*, **61**, e17-e20, 2009.
[3] Kisimoto, K., *Geological Survey of Japan, Open-file Report*, No. 353, 2000.
[4] Fujiwara, H. et al., *Technical Note of the National Research Institute for Earth Science and Disaster Prevention*, No.337, 2009.
[5] Baba, T. et al., *Abstr. Japan Geoscience Union Meet.*, S111-006, Makuhari, Japan, 2006.
[6] Nakamura, T. et al., *Abstr. Seism. Soc. Japan*, P1-06, Hiroshima, Japan, 2006.
[7] Okamoto, T. et al., *Earth Planets Space*, **62**, 939-942, 2010.
[8] Okamoto, T. et al., *GPU Solutions to Multi-scale Problems in Science and Engineering*, 375-389, Springer-Verlag, 2013.

Keywords: subduction zone earthquake, waveform modeling, short period wave, GPU computing