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Numerical simulation of receiver functions for a 3D trench-trench junction model

Hiroshi Takenaka[1*], Taro Okamoto[2], Takumi Murakoshi[3], Takeshi Nakamura[4]

[1]Kyushu University, [2]Tokyo Institute of Technology, [3]National Defense Academy of Japan, [4]JAMSTEC

We recently proposed a novel approach for calculating response of three-dimensionally (3D) heterogeneous structure model to an oblique incidence of seismic plane wave with the finite-difference method in the time-domain (FDTD)(Takenaka et al., 2009, AGU Fall meeting). Computation of seismic response to a plane-wave incidence has many applications of practical interest such as synthesis of teleseismic body waves for source inversion or receiver function analysis, and evaluation of basin effects or local site effects of strong ground motion. However, in most cases of those applications horizontally layered media have been locally employed except recent works based on 2.5D FDTD of Takenaka and Okamoto (1997) which can calculate the 3D response of a 2D heterogeneous model. It has been difficult to calculate the response of a 3D heterogeneous model mainly because of a technical issue. In modeling of seismic wavefields with domain methods such as the FDTD, special manipulation called non-reflecting boundary or absorbing boundary condition is necessary for suppressing the spurious reflections from the boundaries of the computational domain. In 3D modeling some methods are effective for source excitation problems, while for oblique plane-wave incidence problems, as far as we know, almost no method is effective at the side boundaries. Strong artificial reflections from the plane wave at the side boundaries contaminate the computed wavefields. In 2D modeling we could use large computational domain so that the artificial waves arrive at the study area after the all target phases completely pass there. However, in 3D modeling adopting such simple approach is difficult because of its huge requirements of computer memory and CPU time. Here we present a breakthrough to overcome this technical issue. It is a field splitting approach to the discretization of the Floquet transformed elastodynamic equations.In this presentation we apply our algorithm for solving the 3D elastodynamic equations for a plane-wave incidence to simulate seismograms and the receiver functions at sea floor of a trench-trench junction model.

Keywords: receiver function, trench, teleseimic wave, finite-difference method, simulation