Quasi-Spherical FDM for Modeling of Seismic Wave Propagation in a 2D Slice of a Global Earth Model with Lateral Heterogeneity

Genti Toyokuni[1]; Hiroshi Takenaka[1]; Yanbin Wang[2]

[1] Dept. Earth & Planet. Sci., Kyushu Univ.; [2] Dept. Geophys., Peking Univ.

Modeling of seismic wavefield in a whole earth model is crucial for understanding the earth's dynamics and evolution. Since full 3D calculations are too intensive for real application, 2D or axisymmetric calculation has been used for modeling of elastic wave propagation in the whole earth (for example, 2D calculation: Wang et al.,2001; axisymmetric calculation: Igel and Weber,1995,1996). However, 2D calculation cannot correctly model 3D geometrical spreading effects. Axisymmetric calculation, on the other hand, cannot treat unsymmetrical structure with respect to the source axis although it reduces computation time and storage to nearly as short as that of 2D calculation.

Here we propose an ultra efficient approach for modeling 3D elastic wavefield. We solve the elastodynamic equations for the spherical coordinates in a ``quasi-spherical domain'' instead of the conventional spherical domain. This approach can correctly model 3D geometrical spreading effects and make possible a direct comparison of real and synthetic waveform data. Furthermore, it requires similar computation time and storage as for 2D calculations. We apply this approach for modeling of seismic wave propagation for a point source with an axisymmetric force system in a 2D slice of the whole earth including the source and receivers. We have developed a numerical code using a velocity-stress finite-difference method (FDM). In this presentation we show some numerical examples to demonstrate the validity and efficiency of this technique.