Investigation on azimuthal dependence of slab-converted phases observed in receiver functions by 2.5-D numerical simulations

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Receiver function analysis is one of the important and popular methods for study of the crust and upper mantle structures using teleseismic waveform data. In this analysis it is often necessary to calculate synthetic waveforms for the structure models. For this purpose horizontally layered structure models have been assumed, because the response of such a simple structure model to teleseismic P wave (plane wave) can be calculated easily and accurately by a semi-analytical method such as the propagator matrix method.

However, for structures with strong lateral heterogeneity such as subdunction zones, it is often difficult to consider horizontally layered media for modeling the receiver functions observed above such complex structures.

Full 3-D modeling of seismic wave propagation is still computationally intensive. Recently, 2.5-D methods for calculating 3-D elastic wavefields in 2-D varying media have been developed, which are an economical approach for calculating 3-D wavefields, and require storage only slightly larger than those of the corresponding 2-D calculations. Takenaka and Kennett (1996) proposed a 2.5-D elastodynamic equation in the time domain for seismic wavefields due to obliquely incident plane waves in a 2-D varying models. The azimuthal directions of the incident plane wave can be arbitrarily chosen from zero to 360 degrees. Nevertheless, the method requires only as small computation time as the 2-D modeling. Takenaka and Okamoto (1997) used a finite-difference implementation of this 2.5-D equation to simulate teleseismic seismograms at ocean-bottom stations for assessing the effect of sea-bottom topography. Here we apply this 2.5-D finite-difference method (FDM) to modeling receiver functions for laterally heterogeneous structures. In our previous study we applied this approach to a profile across a realistic model of subduction zone structure, and simulated the effects of a subducting slab on the receiver function waveform observed at subduction zone (Ando et al. (AGU, 2003)). In this study we particularly focus on the azimuthal dependence of the slab-converted phases. We also perform another simulation using a slab model with unrealistically high velocity contrast to the mantle, and extract clear characteristics of the azimuthal dependence of the slab-converted phases, which

enable us to detect the slab structure even by a single station analysis.