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Crustal Vp, Vs, and thickness estimations via vertical and radial receiver functions

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Receiver function analysis is one of the effective tools to investigate crustal seismological structure. Here, we present a grid search technique using three seismic phases, Ps, PpPs, and PpPp, observed at teleseismic P coda portion in radial and vertical components, in order to simultaneously determine crustal properties, such as vertically-averaged P and S wave velocities (Vp and Vs), and Moho depth. Using a nonlinear waveform analysis, called simulated annealing, source wavelet of teleseismic P wave can be estimated by using records in vertical component observed at an array of seismometers. Deconvolving individual vertical component by the resulting source wavelet, PpPp phases recorded in vertical component can be extracted. Ps and PpPs phases can be extracted by calculating conventional radial receiver function. The frequency bands are 0.2-1.0 Hz for Ps converted phase, and 0.1-0.5 Hz for PpPs and PpPp reflected phases. The time-to-depth conversion of receiver function is performed by using 1D JMA velocity model. As a result, in addition to seismic images produced by using Ps and PpPs phases, seismic images with PpPp phase also successfully display the continental Moho, the oceanic Moho and the top slab surface of the Philippine Sea slab. This allows us to obtain reliable crustal properties by a grid search over three parameters, Vp, Vs, and thickness. Moreover, we demonstrate that seismic images could be improved by applying the estimated crustal properties, representing crustal lateral variations, to the conversion of time-to-depth domain receiver function.

Keywords: receiver function, Moho, seismic wave speed, Vp/Vs