O8-6 NON-UNIQUENESS OF RECEIVER FUNCTION ANALYSIS

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Tele-seismic P waveforms recorded at a three component seismic station are effectively utilized for the investigation of local lithospheric structure in the vicinity of station. These waveforms include the effect of source mechanism, propagation through mantle, structure beneath the station, and instrument response. So called receiver function is obtained from the isolation of the response of the crust and upper mantle structure from the source, instrument, and mantle path effects (Langston, 1979). In this procedure horizontal components are first vector rotated to theoretical radial and tangential components, and then the vertical component is deconvolved from the horizontals.

Time or frequency domain least-square inversion techniques are applied to vertically heterogeneous and laterally homogeneous one dimensional models. The technique includes a smoothness constraint to minimize the model roughness. The modification introduced by Ammon (1991) preserves the absolute amplitudes on receiver function and helps increase the sensitivity to the near-surface velocity distribution. Receiver function analysis has the non-uniqueness problem that arises because the primary sensitivity of the technique is to velocity constrast at each interface and relative travel time through the layer, but not absolute velocity. Tele-seismic P wave has only a limited range of horizontal slowness and this causes the inability to resolve the absolute velocity.

We utilize the frequency domain linearized least-square inversion technique and show that inversion result is strongly dependent on initial model to start the iteration. It is evident that convergence is particularly dependent on truthness of assumed average velocity of the initial model. If this average is taken lower than the actual underground velocity structure, direct P wave arrival is represented by smaller amplitudes, while P to S conversions and multiples as well show perfect match to the observed. On the contrary, if it is taken higher than the actual velocity average, then the P arrival increases in amplitude compared to the observed. Both cases combined give the result that initial model must be as close as the true earth structure in average. We tested as many as 19 different initial models to show this dependence. About 1/3 of initials converged to the observed signals exactly and the remaining ones converged to some other local minimum.In order to alleviate the non-uniqueness we added surface wave dispersion information of regional earthquakes to the inversion of receiver function. This additional information completely reduced the non-uniqueness problem. Surface wave inversion alone has no non-uniqueness, if initial phase effect from source time function and fracture mechanism of earthquake is assumed known. However, at regional distances initial phase effect is the primary cause of deviations of observed dispersion curves, and this effect is usually hard to remove. Receiver function free of source effect combined with regional surface wave dispersion gives better result than either of these inverted alone. It is usually better to down-weight the effect of dispersion to the result of receiver function inversion, since the structure beneath the station and at regional vicinity may be to some extend different from each other, such as a change in Moho depth.

References

Ammon, C. J., 1991. The isolation of receiver effects from teleseismic P waveforms, Bull. seism. Soc. Am., **81**, 2504-2510.

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