

Beyond Receiver Functions: Direct Estimation of Green' s Functions Using Reversible-Jump MCMC Method

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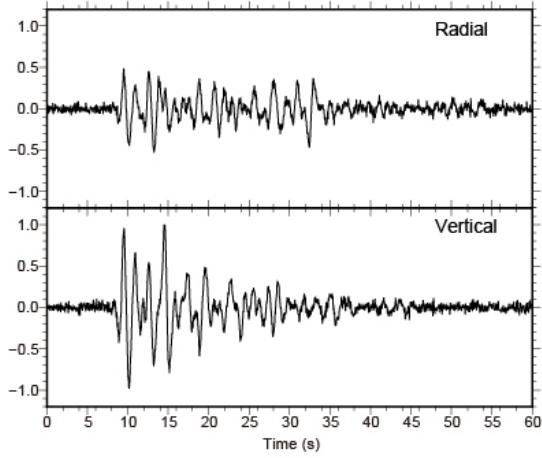
Receiver functions (RFs), calculated by the deconvolution of horizontal-component records with vertical-component records of teleseismic events, have illuminated Earth' s interior. A fundamental assumption in estimating RFs is that incident wavelets to receiver-side structure are well approximated by vertical-component records. With this assumption satisfied, RFs can be a good approximation of the horizontal-component Green' s functions.

RF analysis performed in this way has three issues: (1) incapacity for retrieval of vertical-component Green' s functions, (2) possible violation of the fundamental assumption due to strong reverberatory phases, and (3) numerical instability during the deconvolution of noisy data. Solving the issue (1) would allow retrieval of new constraints on P-wave velocity; solving the issue (2) would lead to recovery of more accurate Green' s functions with, e.g., data from seafloor observatories, where reverberations within the seawater and sediment layers dominate vertical-component records; and solving the issue (3) would afford reliable estimation of Green' s functions without stacking large numbers of data.

In this study, we present a novel technique that directly estimates multi-component Green' s functions. The method assumes that Green' s functions are expressed as the series of delta functions and optimizes their number, locations, and amplitudes using a reversible-jump MCMC algorithm. We also employ a Parallel Tempering technique to enhance the efficiency of the algorithm. This new method has potential to resolve the three issues listed above and has additional advantages, (i) its amenability to single station data, and (ii) its capability to supply uncertainty estimates. We demonstrate the potential of this new method with synthetic tests and application to real data.

Keywords: Seismic waveform analysis, Receiver function, Blind deconvolution, Reversible-jump MCMC, Parallel tempering

Input: synthetic seismograms with gaussian noise



Output: Green's functions

