Crustal properties from joint inversion of scattered teleseismic body waveforms

Mehdi Tork Qashqai[1], Erdinc Saygin[1]
[1]Deep Earth Imaging, Future Science Platform, CSIRO, Perth, WA, 6151, Australia[1]
mehdi.torkqashqai@csiro.au
ORCID: https://orcid.org/0000-0002-1155-0505

P-to-S receiver functions are a class of converted P to S-waves at seismic discontinuities of the subsurface. They are primarily sensitive to the shear-wave velocity (S-wave) at seismic discontinuities as the reflected, and transmitted P-waves are cancelled by the deconvolution process during the calculation of the P-to-S receiver functions. Autocorrelations of radial and vertical components of teleseismic P-wave coda, on the other hand, include both S- and P-wave reflection responses as well as phases associated with P-to-S-wave conversions below a seismic receiver. Therefore, joint inversion of autocorrelations of vertical and radial components alone or with receiver functions offers a framework which has a great potential to provide more robust estimates of the medium properties at crustal-scale, thus reducing uncertainties surrounding the crustal seismic properties (Vp, Vs and Vp/Vs). There have been many studies about the inversion of receiver functions, but the joint inversion of both radial and vertical components autocorrelations (or with receiver functions) is rare. In this study, we develop a probabilistic joint inversion approach to better constrain both the receiver-side Vp and Vs structures simultaneously, and consequently Vp/Vs crustal structure, which is commonly used to make inferences about the composition of the rocks. We first show the feasibility of using this approach by comparing to single-inversions through a series of synthetic inversion tests. The synthetic tests show that probabilistic joint inversion of autocorrelations of both radial and vertical components provides a robust estimate of the crustal properties and the inclusion of the receiver function into this framework does not provide a better constraint. We then apply the approach on real field passive seismic data, recorded on a series of broadband seismic sensors deployed across a north-south profile in central Australia.