On the Detection of Sharp Upper Mantle Discontinuities with Ps Receiver Functions (CRISP-RF)

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Global maps of upper mantle discontinuities are typically produced using the popular technique of receiver functions (RF) – source-deconvolved seismograms that target seismic structures directly underneath a seismic array. These maps have provided crucial constraints on the global lithosphere-asthenosphere system. Although the compressional-to-shear receiver function (Ps-RF) technique has been widely successful for crustal imaging, it has seen limited use in continental-scale lithospheric imaging due to signal distortion caused by overprinting of crustal reverberations: wave echoes trapped in the crustal column. For this reason, the shear-to-compressional receiver function (Sp-RF) is usually preferred; even though it produces blurry images with lower resolution (low frequency and sparser data sampling). In this study, we obtain sharp images of mantle discontinuities by applying a sparse non-linear Radon filter to the Ps-RFs. This technique transforms ***data-domain*** Ps-RF images into ***radon-domain*** images, decomposing the signal into underlying wavefield contributions – direct conversions, multiple reflections, and noise. A selective filter is then applied to the ***radon-domain*** images to create echo-free source-deconvolved seismograms. We demonstrate, using synthetic and data examples obtained from three seismic stations, that sharper and cleaner images of the mid-lithosphere discontinuities can be obtained without compromising on image resolution.