Construction of stable S receiver function and its application to observations of seismic discontinuities in the lithosphere-asthenosphere system beneath South Korea

Xuzhang Shen[1], *Younghee Kim[2], Teh-Ru Alex Song[3], Hobin Lim[2]

1. Sun-Yat Sen University, 2. Seoul National University, 3. University College London

This presentation aims to improve the robustness of seismic processing in the S receiver function (SRF), a technique now commonly used to retrieve forward scattering of S-to-P converted waves originated from the lithosphere-asthenosphere system (LAS) beneath the stations. Unlike P wave receiver function method, SRF does not suffer interferences from backward scattering waves such as the first multiples from the Moho. However, one severe drawback is that S-to-P converted waves can interfere with P coda waves and it is not necessarily trivial to make robust identification and interpretation of S-to-P converted waves from the LAS. These P coda waves can consist of multiple mantle P waves or/and S-to-P scattering waves within the crust and lithosphere between the source and the receiver, whereas the amplitude and timing of these P coda waves depend on the strength of scatters as well as epicentral distance, source depth, and earthquake source mechanisms.

To devise an objective criterion to minimize the interference from P coda waves, as a proof of concept, we first examine SRFs recorded in South Korea seismic network, sitting on a geologically stable continental platform. Through systematic analysis of full-waveform synthetic waveforms and SRFs from realistic focal mechanisms and source depths, we find the systematics that, when the mean amplitude of P coda waves is comparably stronger than the S wave recorded in the radial component, SRFs from 1-D IASP91 model display strong and dubious arrivals. Furthermore, if the mean amplitude of SRFs after the S wave is large, dubious signals of SRFs before the S arrival become strong as well. It is conceivable that these signals may be mistakenly interpreted as S-to-P converted waves beneath seismic stations.

We devise measures of ZRR, the amplitude ratio between vertical P coda waves and radial S waves, and AMP, the amplitude of SRFs after the S arrival and systematically test how ZRR and AMP threshold may be used to detect and retain robust S-to-P converted waves. We will demonstrate the effectiveness of our new data selection criteria, which not only provides a more robust and consistent observation of S-to-P converted waves in a broad frequency band between 0.1 Hz and 1 Hz, but offers a great potential to better characterize seismic discontinuities in the LAS.

Keywords: S receiver function, lithosphere-asthenosphere system

