Auto-selection (script) of receiver function data in the frequency domain

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Abstract

Receiver Function (RF) is a seismological method that determine the main discontinuities of the medium under seismological stations with prominence for the Moho discontinuity.

RF trace is a result of deconvolution that can be applied in time or in frequency domain. By using the ZRT rotation and applying deconvolution in the frequency domain the RF trace is characterize by P energy arriving near, followed by Ps arrivals (relative to a discontinuities) and the related multiples arrivals. The time difference between P and Ps is associated with the depth of the discontinuity. For the Moho, usually Ps is located around 5s, which reflects an average crustal thickness of 40km.

This work proposes a quantitative quality control for the RF results obtained in frequency domain based on the RF signal to noise ratio (SNR) and additionally P to Ps ratio (P/Ps). The energies are calculated from time-window -5s to -1s for the noise, from 0s to 0.4s for the P and statistically defined to Moho Ps.

To identify the Ps time of Moho for each station of database, a time-window around 5s is defined and a sweep takes place to locate the maximum amplitude inside this window and correlate this with a Ps time. A group of Ps time samples is generated for each station, and through successive calculation of the mean and standard deviation the group of samples is refined until shows a convergence (low standard deviation), which corresponds to the mean time of Ps.

With Ps time, the energy of the noise and the signal (P and Moho Ps) windows are calculated. Therefore, the SNR and P/Ps ratios are obtained, resulting a dimensionless values representative of the trace. The P/Ps ratio is used with the objective of a stronger selection with this conditional.

Considering that Ps characteristics (amplitude and frequency) observed on RF trace is a consequence of the impedance contrast through the discontinuities, a Moho with a first order discontinuity is represented by an impulsive Ps, meanwhile in a second order discontinuity the Ps is shown flattened.

Thus, for a seismographic array with the same equipment and working in the same time period, it is possible to use the SNR as a cutoff value to differentiate geological domains, p.ex. zones of smooth Moho from the ones with complexity structure and even sedimentary domains.