A method of simultaneously measuring crustal azimuthal anisotropy and Moho geometry based on receiver functions

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Receiver function is a routine technique to measure crustal structures. However, it is still a challenge to obtain accurate parameters of the azimuthal anisotropy and Moho geometry (dip direction and dip angle) for the trade-off between the two features. In this study, we made two major modifications to the method of the joint analysis method[1] to measure the crustal anisotropy and Moho geometry simultaneously. Here, our purpose is to improve the joint analysis method for the case with anisotropy and a tilted Moho, rather than to resolve all problems.

One modification is to apply the waveform correction to the Pms polarization (R') and the transverse related to the polarization (T') instead of the radial (R) and transverse (T). Because the tilted Moho will deflect the ray path of the Pms, its T energy is not zero[2], it is against the assumption of zero T energy in the traditional correction method[3]. Before the splitting of the Pms, its T' energy is constant zero. Thus, if we rotate the shifted fast-slow components to the R' and T', the directions of which were estimated from the assumed Moho geometry, the maximum corrected R' energy is the optimal solution for the anisotropy with a tilted Moho. In the synthetic test, the application of the R'-T' correction successfully retrieved the model parameters, whereas the traditional method did not (Figure 1).

A previous study[1] has shown that, with the respect to the BAZ, a tilted Moho and crustal azimuthal anisotropy will result in a 1st harmonic and a 2nd shift of the Pms arrivals, respectively. Assuming the Pms ray path is much longer than its variation, which results from the tilted Moho, the azimutal variation of the Pms arrivals approximates to the combination of the 1st order harmonics from the tilted Moho and the 2nd order harmonics from the anisotropy. As a second major modification, we combined the 1st order and 2nd order harmonics to fit the Pms arrivals. Particularly, to joint the measurements of the harmonic analysis and that of the R'-T' correction, we used the assumed Moho dip angle to compute the range of the 1st order harmonics and searched for the dip angle instead of the range.

We normalized the measurements of the R'-T' correction and the harmonic analysis, respectively, and gave different weights to these two measurements to obtain the joint solution (Figure 2).

References

1 Liu, H. and Niu, F., 2012, Estimating crustal seismic anisotropy with a joint analysis of radial and transverse receiver function data. GJI, *188*(1), 144-164.
2 Langston, C. A., 1977, The effect of planar dipping structure on source and receiver responses for constant ray parameter, BSSA, 67(4), 1029-1050.
3 McNamara, D.E. Owens, T.J., Silver, P.G., and Wu, F.T. (1994), Shear wave anisotropy beneath the Tibetan Plateau, JGR, 99(B7), 13655-13665.

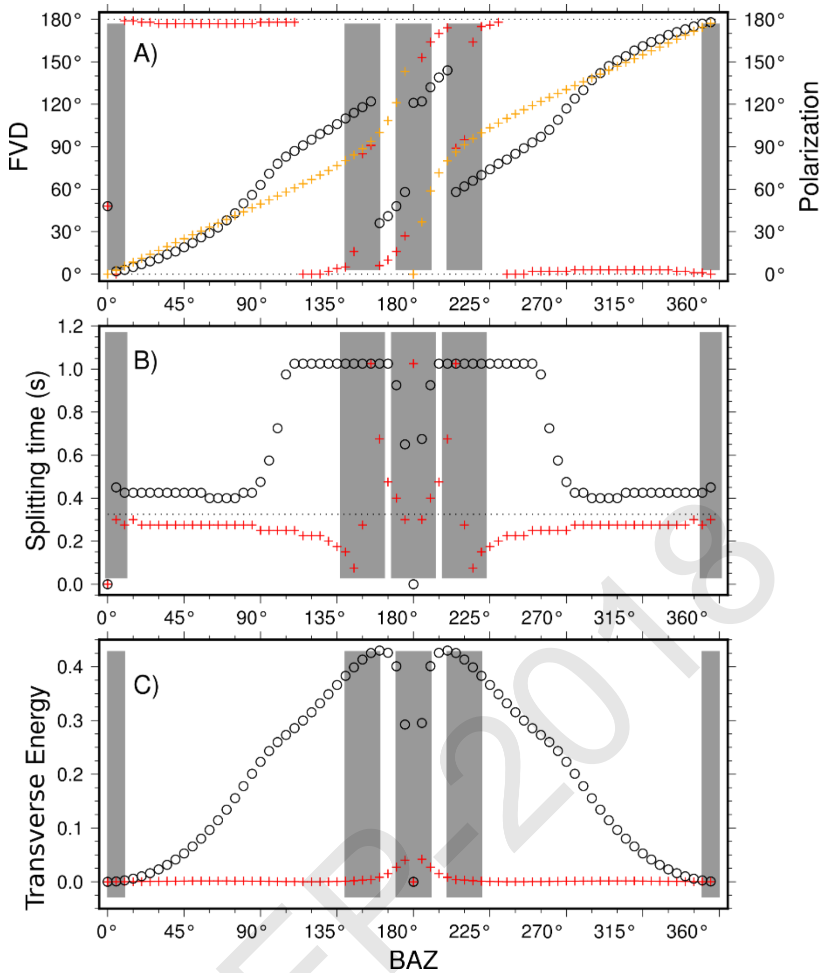

Figure 1. The R’-T’ correction (plus) and the comparison with the traditional method (circle).

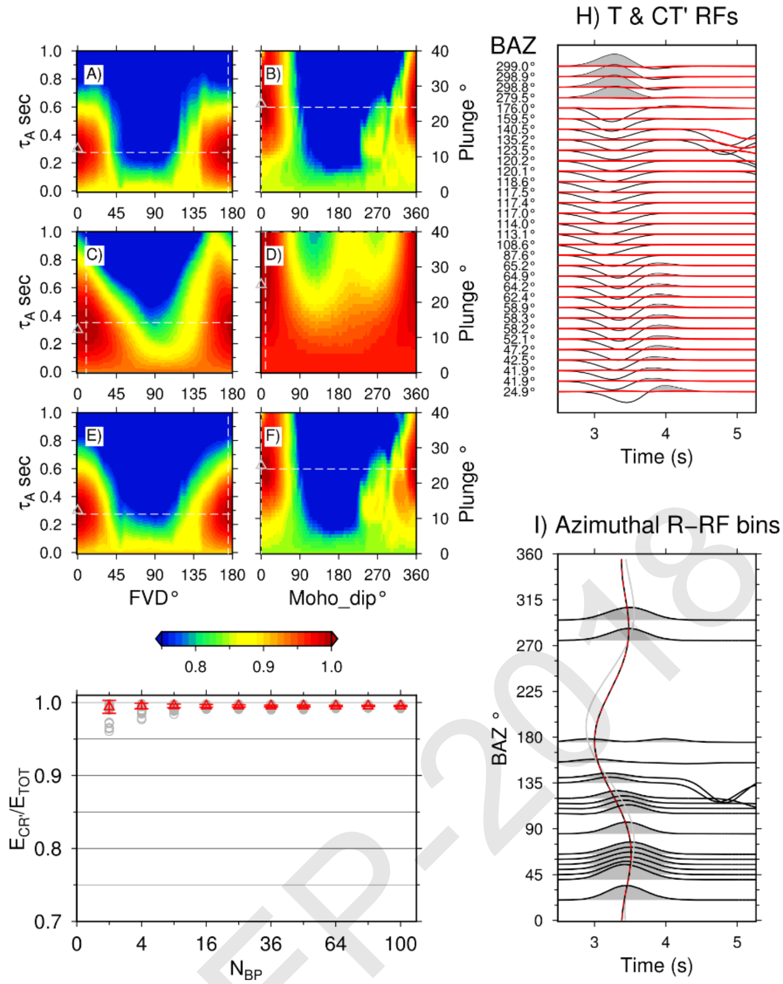

Figure 2. The synthetic test; **A** & **B** show the R'-T' correction; **C** & **D** show the harmonic analysis; E & F show the joint solution; the measurments (plus) are close to the model parameter (triangle); **G** shows the bootstrap test; H shows the T and the corrected T'; I shows the fitness of the Pms.