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Radial anisotropy models and their uncertainties beneath Sri Lanka derived from joint inversion of surface wave dispersion and receiver functions using a Bayesian approach

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Radial seismic anisotropy (RA) designates the difference between the speeds of vertically and horizontally polarized shear waves. RA in the crust can provide information on past tectonic events. Since the amplitude and impact of anisotropic are smaller than the variation of velocity, it is more difficult to distinguish whether radially anisotropic anomalies are driven by the structure or uncertainty. Hence, a lack of considering uncertainty and trade-off here may underestimate radial anisotropy and lead to divergent geodynamical interpretations. The hierarchical transdimensional Bayesian approach is able to provide uncertainty estimates taking fully into account the nonlinearity of the forward problem. Under the Bayesian framework, the mean and the variance of the ensemble containing a large set of models are interpreted as the reference solution and a measure of the model error respectively.

In our study, we applied a two-step RA inversion of surface wave dispersion and receiver function based on a hierarchical transdimensional Bayesian Monte Carlo search with coupled uncertainty propagation to a temporary broadband array covering all of Sri Lanka. First, we constructed Rayleigh and Love wave phase velocity and errors maps at periods ranging from 0s to 20s. To remove outliers, data uncertainty distribution was expressed as a mixture of a Gaussian and uniform distribution. Next, we inverted local dispersion curves and receiver functions jointly to obtain 1D shear velocity and RA models. The method effectively quantifies the uncertainty of the final crustal shear wave velocity and RA model and shows robust results. The negative RA (Vsv > Vsh) anomalous with low uncertainty found in the mid-lower crust of Central Sri Lanka may show evidence that the charnockite inclusion is associated with the shear zones confined to the cores of some doubly-plunging synforms. In the east Highland Complex, the positive radial anisotropy (Vsh > Vsv) anomalous with low uncertainty may reveal the evidence for sub-horizontal shear zones along the thrust boundary.