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Joint inversion of receiver functions and surface wave dispersion with the Neighbourhood Algorithm

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Receiver functions and surface waves have both been used extensively for the investigation of crustal and upper mantle structure. A growing number of studies also tries to exploit the complimentary information from both data sources: Both, receiver functions and surface waves, are primarily sensitive to S-velocities. However, receiver functions show a rather non-linear response to the underlying structure, and only contain information on relative and not on absolute velocities, while being very sensitive to the existence and sharpness of discontinuities. Meanwhile, surface waves mainly constrain absolute average velocities in certain depth ranges.

In this study, the non-linear Neighourhood Algorithm is used to jointly invert receiver function waveforms and Rayleigh and Love fundamental mode dispersion curves. The algorithm uses an irregular grid to preferentially sample promising regions of parameter space and results in an ensemble of models that fit the constraints imposed by the data. Investigations of trade-off between different model parameters and of inconsistencies between the two data types are also possible.

We apply the inversion scheme to data from the central forearc and volcanic arc of the Hellenic subduction zone, where a complex tectonic history has left its imprints on the crustal and upper mantle structure. Installation of several digital broad-band networks in this region has provided the opportunity to study these variations, for example in Moho depth, crustal velocity and depth level of the subducting African plate, in detail. When inverting for 1D-velocity models, care has to be taken due to the pronounced 2D-effects of strong Moho topography observed in receiver functions for some parts of the region. However, data can be fairly well explained by 1D-models in locations with flat discontinuities, for example beneath the center of the volcanic arc. Here, receiver functions add detail to the crustal structure and confirm the information on slab depth

and a low-velocity asthenosphere above the slab in the Aegean mantle provided by the dispersion curves. Besides, additional information on vp/vs ratios is obtained.