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Radial anisotropy in Europe from surface waves ambient noise tomography and transdimensional hierarchical inversion

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We present a 3D probabilistic model of shear wave velocity and radial anisotropy of the European crust and uppermost mantle mainly focusing on the Alps and the Apennines.

The model is built using continuous seismic noise recorded between 2010 and 2018 at 1521 broadband stations, including the AlpArray network (Hetényi et al., 2018).

We use a large dataset of more than 730 000 couples of stations representing as many virtual source-receiver pairs. For each path, we calculate the cross-correlation of continuous vertical- and transverse-components of the noise records in order to get the Green's function. From the Green's function, we then obtain the group velocity dispersion curves of Love and Rayleigh waves in the period range 5 to 149 s.

Our 3D model is built in two steps. First, the dispersion data are used in a linearized least square inversion providing 2D maps of group velocity in Europe at each period. These maps are obtained using the same coverage for Love and Rayleigh waves. Dispersion curves for both Love and Rayleigh waves are then extracted from the maps, at each geographical point. In a second step, these curves are jointly inverted to depth for shear velocity and radial anisotropy. The inversion in done within a Bayesian Monte-Carlo framework integrating some a priori information coming either from PREM (Dziewonski and Anderson 1961) or the recent 3D shear wave model of Lu et al. 2018 performed for the same region.

Therefore, this joint inversion of Rayleigh and Love data allows us to derive a new 3D model of shear velocity and radial anisotropy of the European crust and uppermost mantle. The isotropic part of our model is consistent with the shear velocity model of Lu et al. 2018. The 3D radial anisotropy model of the region adds new constraints on the deformation of the lithosphere in Europe. Here we present and discuss this new radial anisotropy model, with particular emphasis on the Apennines.

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