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New data on radial anisotropy in the European region from surface waves

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There are varying opinions on the causes of radial anisotropy. It may result from convective flows of material in the upper mantle or deformation of the material due to tectonic processes over hundreds of millions of years. The lithosphere preserves geological processes that occurred over millions of years. The anisotropy of the oceanic upper mantle is likely described by the first mechanism, where VSH is consistently higher than VSV. The second factor pertains to the continental mantle, where different VSH to VSV velocity ratios are possible.

The anisotropy of seismic wave velocities in continental regions, as opposed to oceans, is still a topic of debate. Estimates in different regions show different signs between the velocities (Kustowski et al., 2008; Boschi et al., 2009; Chang et al., 2010; Schivardi and Morelli, 2011).

This study examines the radial anisotropy of the subcrustal mantle in Europe. The study is based on dispersion curves of Rayleigh and Love waves with periods ranging from 10 to 100 seconds. These curves are derived from earthquake records along paths intersecting the European continent.

A new software module based on wavelet transforms has been developed to obtain dispersion curves from earthquake records. This module allows for the conversion of primary data in mseed format to frequency-time diagrams without preprocessing.

To solve the 2D tomography problem, we employed a method based on the assumption that the resulting solution is smooth, as proposed by Yanovskaya and Ditmar in 1990. The solution was constructed directly on the spherical surface, as the region occupied by the paths is quite large.

Within the acceptable resolution range, we inverted the local dispersion curves of Love and Rayleigh waves to obtain local SH- and SV-velocity sections. We constructed and analyzed 2842 local velocity sections to investigate the distribution of the anisotropy coefficient.

The obtained data indicate that the study area can be divided into three main regions: the region of high velocities in the upper mantle, located to the west of the TTZ, the area of the East European Platform, and the region of low velocities, adjacent to the Atlantic Ocean coast and influenced by the Atlantic spreading zone. Additionally, most of the West European Platform exhibits intermediate velocities.

The belt of Alpine folding is marked by a low-velocity anomaly that is well traced to a depth of 100 km under the Anatolian and Balkan Peninsulas, as well as the Carpathian region.

Anomalous anisotropy zones are also well traced to depths of 200 km and are associated with the North Sea region, the Black Sea, and the Anatolian Peninsula region.

The obtained data best agrees with the LRSP30EU model of Boschi et al. [2009].

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