Preliminary 3D S-wave velocity model of the European upper mantle from inversion of Surface and S waveforms.

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Europe's fascinating tectonic framework encompasses subduction zones and zones of continental collision, ancient suture zones of various ages, and active hotspots. Global models currently don't resolve this complexity. However, the presence of a dense network in Europe allows to resolve both large scale structures (cratons), but also smaller structures (with a lateral extent of about 150 km).

We present a new 3D S-wave velocity model for the upper mantle beneath Europe. It is calculated by means of an automated waveform inversion of surface- and S-wave forms assuming approximate sensitivity kernels of surface-wave modes. Waveforms of S and Surface waves are inverted for 1D paths average S-wave models that constrain the 3D model.

We used waveform data recorded during the last decades by the Geoscope, IRIS and GEOFON permanent stations running in Europe. Many others permanent networks, such as GRSN, ReNaS or other data centers, such as ORFEUS were also used. Furthermore, some temporal networks provide useful data, such as the TOR project, Eifel Plume Project, or the SVEKALAPKO experiment.

The calculated model will be used in the future as a background model for an even more detailed local tomographic model for the southern Aegean using the EGELODOS (Exploring the GEodynamics of subducted Lithosphere using an Amphibian Deployment Of Seismographs) dataset. We have used all events that occurred in Europe between 1990 and 2004. This represents almost 5,000 events, for more than 400 stations. Our model is constrained by over 50,000 seismograms recorded at hundreds of stations; structural information was extracted from both the fundamental and higher modes. Most of the 1D path are short paths, with source-station distance smaller than 3,000 km, whereas most of the earthquakes occurs around the Pacific belt, have distances of about 10,000 km. Generally, long paths are used to resolve the structures at greater depth (because they sample the upper mantle including the Transition Zone), but with adding the small paths, we can also increase the resolution of the uppermost part of the mantle. The short paths permit to use both small frequencies (3-5mHz) and higher frequencies (40-60mHz).

Our model is calculated with a horizontal grid spacing of about 150 km, and a vertical griding of about 30 km, that is enough to resolve quite small anomalies. We use a linear interpolation between the nodes of our grid. The main structures of the model are consistent with the predictions found in the literature, but the resolution is strongly increased. The model displays high-resolution images of major features beneath the continent, including subducting slabs, particularly in the Mediterranean Region, structural contrasts across major suture zones, and deep seismic expressions of hotspots. Seismic expressions of major structures including Afar, the Dead Sea Rift, the Tonquist Zone, old subducted slabs, the Iceland hotspot, the North Atlantic Ridge others are seen clearly and located accurately. Map views and vertical cross sections are presented.