We present the first results of a long-term project that aims at the construction of a comprehensive seismic model of the European upper mantle, that describes 3D variations of S and P velocities, dissipation and density.

Our method is based on a full waveform tomography that combines spectral-element simulations of seismic wave propagation with adjoint techniques. The advantages of this approach are (1) the high accuracy of the synthetic seismograms computed for strongly heterogeneous Earth models, (2) the avoidance of crustal corrections, (3) the exploitation of complete waveforms, including both body and surface waves within a broad frequency range, and (4) the simultaneous inversion for crustal and mantle structure, as well as for source parameters.

As data we use three-component recordings from permanent stations, complemented by data from local temporary arrays such as HOTSPOT (Iceland) and IberArray (Spain). This leads to a multi-scale model that exhibits great detail in the most densely covered regions.

The initial results for the longest periods (80-200 s) already reveal smaller-scale features such as the geometries of the Hellenic trench and the Pannonian basin. One of the most prominent structures found in the images is the Iceland plume that exhibits unexpectedly low S velocities (-7 %) down to depths of at least 300 km. Whether the images of 3D density variations in our model are sufficiently well resolved is a matter of ongoing research.