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A new gravity model of the crust and upper mantle of Europe based on joint inversion of the gravity and seismic data

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Density structure of the crust and upper mantle represents a key, which helps to understand origin of tectonic processes and evolution of the lithosphere. We use gravity, seismic and other available data to construct a new density model of the crust and upper mantle of Europe. One of the most principal issues of the deep gravity modelling is the problem to eliminate the crustal effect from the observed gravity field. Despite extremely good coverage by seismic profiles, a consistent 3D crustal model of the entire Europe doesn't exist at the moment. At the initial stage of this study we construct a new unified model of the European crust, which is based on local maps showing main crustal layers and available seismic determinations. The improved residual mantle gravity anomalies and residual topography are estimated based on these data. We invert these fields jointly with seismic tomography data to image density distribution within the crust and upper mantle. The inversion technique accounts for the fact that the residual gravity and residual topography are controlled by the same factors but in a different way, e.g. depending on depth. This provides a possibility for remarkably better vertical resolution of the resulting density models. In the final stage we separate the effect of mantle temperature variations, which is estimated from seismic tomography models constrained by geothermal modelling. Some features of the composition density distribution, which are invisible in the seismic tomography data, are for the first time detected in the upper mantle. One important example is a strong positive density anomaly under significant part of the Alpine fold belt, which is likely related to remnants of the lithosphere plate.