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Gravity data application to crustal thickness determination of Latvia

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The crustal structure of the Baltic states is relatively poorly understood among other European continental areas. Parameters such as crustal thickness are constrained over small area only due to the limited amount of field seismic measurements. Only one seismic profile that spans from Sovetsk in Kaliningrad oblast (Russia) to Kohtla-Järve city in north-eastern Estonia crosses the territory of Latvia. This severely limits the knowledge about tectonic evolution and development of the vicinity, as well as restricts various geodynamic modelling and resource exploration studies.

The crustal thickness (here considered equal to the depth of the Moho) is commonly measured in various seismic studies. Most commonly seismic profiling and seismic refraction methods are used. However, Moho is also a pronounced density gradient, and gravity data can be used to understand the features and depth of Moho. Due to few seismic stations in the region and relatively small spatial extent of seismic profiling studies, gravity data offers a more regular coverage and increased resolution for crustal thickness determination.

In this research, we used gravity data to determine the crustal thickness in the territory of Latvia. To achieve our goal, we combined all available ground Bouguer anomaly data (Zandersons et al., 2018) with EIGEN-6S4 satellite gravity model up to 300th degree (Förste et al., 2015). Datasets were interpolated with regression-kriging method increasing the spatial resolution to ± 2 km.

To separate the gravity sources of Moho interface from sources occurring at shallower depth levels, a cut-off low pass filter was used. All spatial frequencies with wavelength higher than 220 km were removed. The depth to Moho interface was calculated using Parker-Oldenburg iterative inversion algorithm (Oldenburg, 1974) using the constraints provided by seismic exploration in the Baltic sea region (Bogdanova et al., 2006).

The resulting crustal thickness model provides new insight into the crustal structure of the Baltic states. The resulting model is comparable to previous few seismic study results in Latvia. Modelled data can be used as a necessary constraint in geodynamical modelling and further resource exploration. Data can be combined with other studies improving our understanding of the East European Craton.

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