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# Modelling of the lithosphere's density and thickness for reduction of the GOCE gravity gradients: case study of Central Europe

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Within this study we discuss the determination of gravity gradients (VXX, VXY, VXZ, VYY, VYZ and VZZ) from the orbital ceiling to the depth of the Mohorovičić boundary for Central Europe (area between 10-30° East and 45-70° North). Values of the Eötvös tensor were derived from the "Heterogeneous gravity data combination for Earth interior and geophysical exploration research" project (GOCE+). We implemented gridded data with a resolution of 0.2° to 0.2°. The grid was calculated from GOCE and GRACE data supplemented with the GOCO03s gravity field model. The gravity gradients to Moho boundary depths were modelled forward in reference to 255 km height. In order to determine the gradients to Moho boundary depths, the GOCE gradients need to be reduced for effects of different depth slices of the model. We calculated the gradient sensitivity using a 3D lithospheric model divided into: topography/bathymetry, sediments and location of the Moho boundary. To define tesseroids as mathematical model we need to define two parameters of the lithosphere: density and depth for each layer separately. In our research the altitudes for topography/bathymetry were derived from the ETOPO1 model, sediments depths from the EuCRUST-07 model, and Moho boundary from Grad and Tiira (2009) seismic map. To determine the density of the layers limited by topography/bathymetry we used the relationship between Bouguer and free-air anomalies and density contrasts for sediments and Moho level. For high latitudes we get the largest changes for the gradients towards the poles, with particular values of 579.94 mE (mili-Eotvos) and 789.16 mE for VXX and VZZ gradients, respectively. Within the study the Root-Mean-Square (RMS) of the determined gradients was also calculated, indicating that the VXY gradient is characterized by the smallest error equal to 171 mE, which is three times less than the remaining ones. We also noticed the strongest relation between terrain fluctuations and the magnitudes of the VZZ gradient. We obtained extreme values for the location of the deep and shallow areas of the crust (Alps, North-Eastern Poland and areas of seas) equal to -3 E and +1 E, respectively. Most of the gradients showed strong correlation with anomalies of crustal density of -2.5 E for VZZ and +1.5 E for VYY in the extreme cases. We also simulated different contrast of density and noticed, that change of 10-20 kg/m3 for each layer causes a variations in gradient values of 50% on average, but only 6% in case of the VYZ gradient.