Comparison of crustal thickness models obtained by satellite gravity and gravity gradient inversion – A case example for South America

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The Moho discontinuity is a crucial boundary that can be investigated by several geophysical techniques. Gravity inversion of the Moho depth is a well-established tool, especially in those regions, where terrestrial data on crustal thickness is lacking. One of those regions is the Amazonian Craton, where large areas are poorly covered with seismic stations.

In our work, we compare crustal thickness models of South America derived by satellite gravity inversion. These models are mostly obtained by inverting the vertical gravity component using the classical Parker-Oldenburg algorithm. We developed an alternative approach, where we invert gravity gradients *g_zz*, measured by the GOCE satellite, instead of vertical gravity, by solving the inverse problem $A\Delta z = \Delta g\_zz$ with the Gauss-Newton algorithm. As an initial Moho depth, we use a novel approach of geostatistical kriging of seismic stations from a global database of USGS. The forward calculation of the initial Moho depth is performed with tesseroids software, which allows to compute every gravity component at any arbitrary height for a given anomalous density layer. The hyperparameters that control the inversion are reference Moho depth, density contrast and a smoothing operator that is added to the design-matrix of the inversion. The final Moho depth model is chosen by validating the gravity inverted Moho with information of seismic Moho depth.

We present the differences of the gravity inverted Moho depth models, which relate to the different technical approaches of solving the inverse problem. Furthermore, we point out, how the inversion of gravity gradients enhances the prediction of crustal thickness in remote areas. Since we are using global data, our inversion procedure can be applied at any user-defined study area and allows to invert any arbitrary gravity component.