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Gravity and gravity gradient inversion of the South American Moho using tesseroids

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Several Moho models for the South American continent have been published the last years, mostly based on active or passive seismics. However, there are still large provinces where no comprehensive data are available and where the depth and geometry of the Moho remains uncertain. Inversion of satellite gravity data can help to define a proper crustal model, especially in those areas where terrestrial data is lacking.

In our work, we invert not only the gravity but also any arbitrary gravity gradient component by accounting for the spherical earth. The gravity gradient might produce a more sophisticated crustal model, as it is more sensitive to crustal structures than vertical gravity.

The topographic corrected satellite gravity data are embedded into a novel inversion network. From the satellite gravity an initial Moho with a certain density contrast and reference Moho depth is computed using the classical Parker-Oldenbourg algorithm. The inversion problem $A\Delta z=\Delta y$ is solved for the Moho Δz by Gauss-Newton approach with generalized Tikhonov regularization. Δy contains the difference between the observed gravity component at satellite height and the forward computed gravity component of the initial Moho using tesseroids. With that the Moho depth is inverted for a certain density contrast and initial reference Moho depth. Afterwards, the results are weighted versus seismic constraints by mean square error analysis. The seismic constraints are derived by a novel approach of geostatistical Kriging analysis, based on USGS active seismics database. As an iterative process the density contrast and reference Moho of the initial Moho depth are changed and the inversion is repeated until the mean square error is minimized. Sensitivity tests like varying error assumptions of the fields, which are part of the regularization, control the robustness of the inversion.

The potential and validity of the final inverted Moho is evaluated by comparing with other regional and global Moho models like Assumpcao12 or CRUST1.0.