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Integration of Terrestrial and Satellite Gravity Data for Crustal Structure Investigation

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Introduction.

The integration of terrestrial and satellite gravity data is a relevant methodological strategy to overcome the individual limitations of each dataset: while terrestrial data offer high resolution and capture local variations, satellite data provide broad coverage and global consistency, yet resolve only low-frequency components. This work proposes an integrated approach to interpolate and combine both datasets, aiming to generate continuous gravity grids suitable for crustal geophysical modeling.

Method and/or Theory

The methodology consists of interpolating, via the equivalent sources method, the differences between surface gravity observations and the values predicted at the same points by satellite models. The interpolation parameters, such as source depth and damping, are automatically selected using k-fold cross-validation. The final grid is obtained by recombining these differences with the regular satellite-derived grid at constant altitude. Normal gravity is computed based on the GRS80 ellipsoid, and gravity disturbance is used as the reference field for Bouguer and isostatic corrections, both implemented through direct modeling with prisms. Topography and geological layers are discretized on regular meshes to enable spectral and spatially consistent corrections.

Results and Conclusions

The proposed technique yields a high-resolution, harmonic, physically consistent, and statistically validated interpolated model. The interpolation of differences ensures spectral compatibility between datasets, while prism-based modeling enables the application of gravity corrections even in geologically complex areas. Its application in a case study over the Southern Mantiqueira Province demonstrated its effectiveness in integrating heterogeneous data and recovering crustal features hidden beneath sedimentary cover. The results indicate that the approach is robust and replicable, and can be applied to other regions and for various structural investigation purposes.