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A Regional Gravity Model for Egypt Integrating Satellite and Ground Data

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A reliable density structure modelling is essential for a good lithospheric study that is, in turn, a milestone to understand the complex geodynamics of the study region. Achieving such a reliable model is limited by the availability of a high-quality regional gravity field developed merging together heterogeneous gravity data acquired by various observational techniques whose spectral content, coverage, and spatial resolution are not the same.

For such development, the remove-compute-restore (RCR) procedure is presented, which is improved by the evaluation of the stochastic properties of the various gravitational data embedded within the variance components. In the employed processing scheme, all the signals that can be modelled or deterministically computed are considered known and then removed in order to reduce the order of magnitude of the input gravity signal, which precede the application of the least-squares collocation. Moreover, GOCE-based global geopotential models (GGMs) are synthesized in order to model the low-to-medium frequencies, while the residual terrain model (RTM) are exploited to model the high frequencies of the gravity field.

On the one hand, the RTM has not shown any added-value to the reduced signal, where the standard deviation has noticeably increased. For our combined data set, the satellite-derived model SPW-R5 developed using the space-wise strategy, which revealed the best performance among several investigated GGMs, is integrated up to degree/order 200 with the recently-made available terrestrial gravity anomaly measurements acquired for a total number of 56250 stations.

The developed combined regional gravity model is tested, in terms of performance, in comparison to the state-of-art high-resolution XGM2016 model, in which more terrestrial gravity data were exploited, to those used for EGM2008, in the development. Ultimately, the combined gravity model is used to construct a 3D forward density modelling for Egypt.