Geophysical Research Abstracts
Vol. 20, EGU2018-5241, 2018
EGU General Assembly 2018

A Combined optimisation of local and global gravimetric data to improve geoid modelling in Sudan

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Geoid modelling in Sudan suffers from the lack of necessary ground measurements such as country-wide GNSS-levelling and terrestrial gravity data from neighbouring countries. Most of the geodetic measurements conducted during the past 4 decades are either not officially released or not easily accessible. In this study, we use available GNSS-levelling data, terrestrial gravity data and recent global geopotential models (GGMs) from the Gravity field and steady-state Ocean Circulation Explorer (GOCE) mission. The optimization of local and global datasets has been done in three steps based on the minimization of the root mean root (RMS) of their differences. Firstly, the GGM-based undulations are compared versus the GNSS-levelling undulations. There, GOCE satellite-only models based on the direct, space-wise and time-wise methods (GOCE-DIR-R4, GOCE-DIR5, GOCE-SPW-R4 and GOCE-TIM-R5) show the best agreement at degree and order (d/o) 222. Secondly, the accuracy of the local gravity data has been estimated by means of spherical radial basis functions (SRBF) using the Poisson kernel. The optimal minimization of the RMS of the differences between the real and predicted values based on an optimal radial depth of 375 m was 3 mGal. Lastly, the parameters obtained from the previous steps are combined to estimate the least-squares parameters b_n for the modified Stokes formula. The optimum spherical cap radius $\sigma_0$around the computation point was found to be 1.74°. The parameters have been successfully estimated by combining data information from GOCE-DIR-R4 and local gravity data and σ_0 to compute the gravimetric geoid. The final gravimetric geoid solution is evaluated by GNSS-levelling data. Best-fit comparison between them is found to be 18 cm after fitting by a 7-parameter model. This result shows an improvement of about 10 cm compared to the existing models computed in 2008 and 2014.